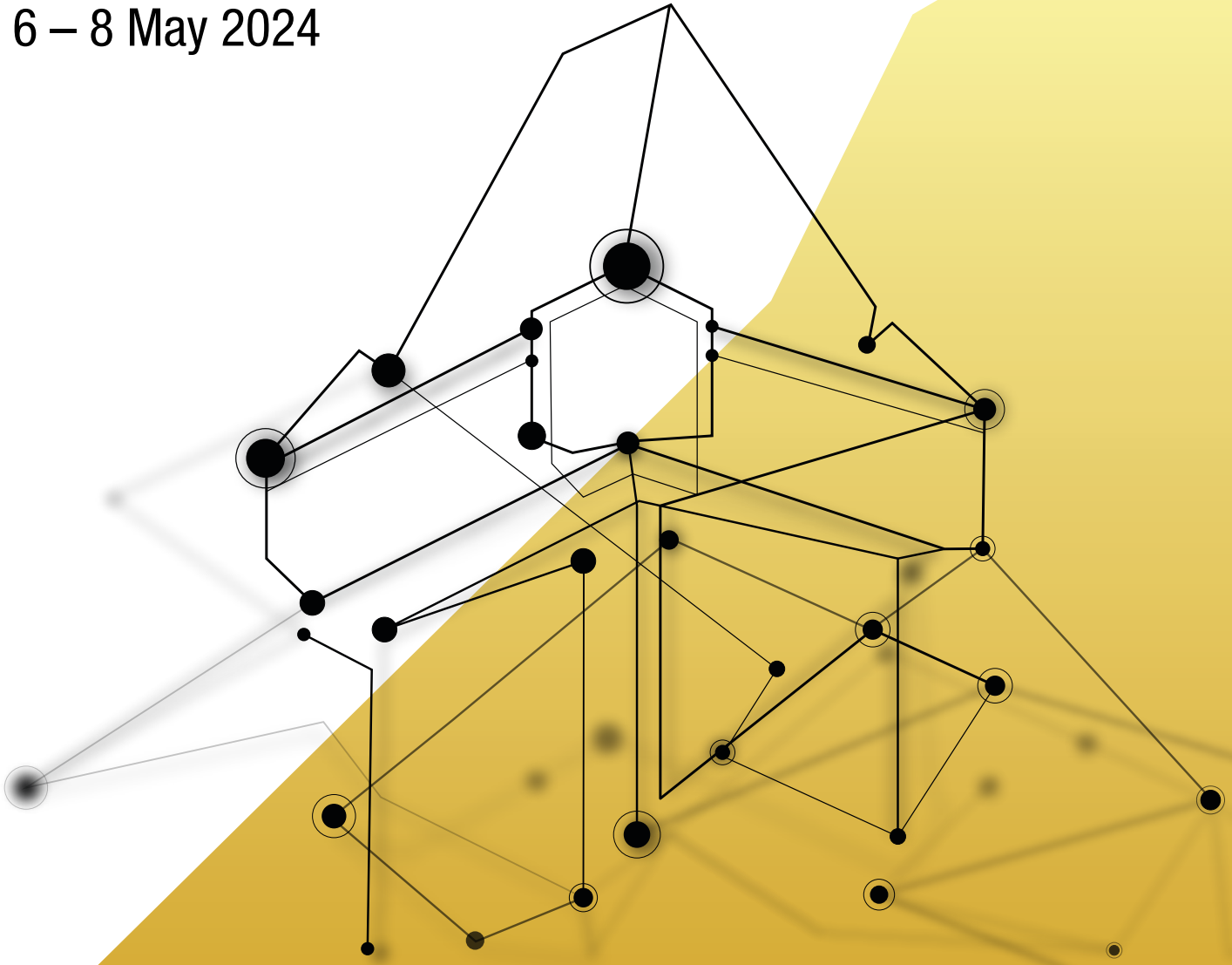
Book of Abstracts

22nd STS Conference Graz 2024

Critical Issues in Science, Technology and Society Studies

6 – 8 May 2024



INTERDISZIPLINÄRES FORSCHUNGSZENTRUM für Technik, Arbeit und Kultur

IAS-STS institute for advanced studies on science, technology and society

STS Science, Technology and Society Unit

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Edited by: Getzinger, Günter; Jahrbacher, Michaela; Prunč, Roman Lukas

Cover picture: STS Unit

2024 Verlag der Technischen Universität Graz
www.tugraz-verlag.at

ISBN 978-3-99161-004-5
DOI 10.3217/978-3-99161-004-5

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Cancelled Stream and Sessions: G, A.4, D.1

Keynotes

Hydrogen visions and projects between past, present and future

Kornelia Konrad

University of Twente, The Netherlands

The hydrogen hype is in full swing, as visible in policy strategies and diplomacy, support programmes, projects being planned and built, media and academic debate, company strategies and investments. Hydrogen visions in Global North countries like Germany or the Netherlands currently focus on decarbonizing otherwise hard to abate industries, such as steel or chemicals. These visions often include large scale globalized green hydrogen production and transportation systems connecting industries in Global North countries with production sites in Global South countries with promising profiles of renewable resources like wind and solar. These visions differ from those that fuelled former hydrogen hypes, suggesting some caution in how confident we should be about current visions and priorities.

In my talk, I will take concrete visions and projects of hydrogen projects in the Global South as a lens to study and discuss how these projects are taking shape and how they are debated in the different countries involved, drawing on media, document and interview analysis. These visions and projects can be considered as socio-technical futures in the making – reflecting their status of discursive visions, expectations and imaginaries, and at the same time materializing in the form of agreements, roadmaps, contracts, studies, financial arrangements and grants, land assigned, technologies being built, infrastructures planned etc. While a lot of the discussion around green hydrogen in Global North countries relates to more or less shiny visions and high-level ambitions on mitigating CO2 emissions, debated largely in research, policy and industry circles, controversies around concrete local projects in a country as Namibia revolve around distribution of benefits and financial risks, governance and transparency, fair use of resources, environmental impacts or the relation between serving local needs or export. Further points addressed will be the variety in visions and projects, the openings and closures that are likely to be created for future energy systems and how old and new colonialism is discussed in both Global North and South countries.

On tech trials in the public sector and the politics of falsifiability

Noortje Marres

University of Warwick, United Kingdom

In this talk, I examine two recent controversies about tech trials in the public sector in the UK to develop an analysis of the politics of technology testing and counter-testing “beyond the laboratory": the NHS-Deepmind controversy and the use of facial recognition by the Metropolitan police in London. I will argue that these controversies demonstrate the importance of knowledge politics to the politics of innovation today. In both cases, the very status and definition of the object of technology testing in society became the focus of public contestation. Can tech deployments in hospitals, shops and streets really be defined as test when the consequences for affected parties are real? Do tech trials evaluate algorithmic systems, or are underpinning data infrastructures part of what is being tested? The answers to these two questions not only have implications for the distribution of epistemic power in tech trials, they also determine to a significant extent whether the politics of innovation pursued through tech trials qualifies as authoritarian or democratic. I will argue that ultimately at stake here is the falsifiability of technological propositions. Today’s tech trials are embroiled in a techno-politics of non-falsifiability: even as tech is continuously being tested in hospitals, shops and streets, trial designs render technology unchallengable from the standpoint of everyday life. However, at the same time, these trials *are* being challenged through new forms of epistemic activism, in which the creation of conditions of falsifiability and the articulation of testing facts - the demonstration of inaccuracy, bias and abuse of power - becomes a key contribution of activist intervention.

Collective goods? The making of “population health” in medical tissue and data collections

Erik Aarden

University of Klagenfurt, Austria

Against the background of great expectations associated with the application of big data and artificial intelligence in medicine, various voices have claimed that individuals have a moral obligation to make data and tissue materials available for research. This obligation is not only associated with the amounts of materials required in contemporary medical science, but also with presumptions that science produces a public good called medical knowledge. In my presentation, I critically examine this claim by drawing on four case studies of medical data and tissue collections, asking for and about which ‘collectives’ knowledge on health and disease is created. I present each case study as an exemplar for how infrastructures for the collection, storage and use of population data for medical research are constructed and frame particular versions of ‘collective goods’ in contemporary medical research. I first explore how the multi-decade Framingham Study of the causes of heart disease in the United States may be understood as an infrastructure enabling certain directions for research while restricting others. Next, I turn to the Singapore Tissue Network as an example of the complexities involved in finding shared purpose in the collection, storage and use of human tissue und data. I subsequently discuss the Million Death Study of causes of mortality in India as a case of the construction of populations through health data. Finally, I analyze contested meanings of medical research through the example of the European network of sample and data collections BBMRI-ERIC. While each of these cases is situated in different geographic locations and largely distinct areas of medical research, they jointly illustrate how the making and operations of medical research collections produce particular ‘collectives’ and ‘goods’. These imply distributions of rights and responsibilities that cannot fully be captured in terms of medical knowledge as a public good. The question whether and how people should participate in medical research thus requires more substantial consideration of the distributive implications of how infrastructures for the collection, storage and use of population data for medical research get built.

Postersession

Session Chair: Günter Getzinger, Graz University of Technology, Austria

Exploring Gender Inclusivity in Computer Science Education: A Case Study of an Introductory Course

Mirjam Paales

University of Tartu, Estonia

In recent years, pursuing gender inclusivity in academia and research has become increasingly paramount as one of the key targets for addressing gender equality. A sense of belonging is critical in influencing student success and retention in academic settings, particularly within computer science (CS) (Gopalan & Brady, 2020; Höhne & Zander, 2019). We use our introductory course for CS studies called “Introduction to Speciality” as a case study to shed light on the nuanced aspects of the sense of belonging among CS students and explore how it might be supported through incorporating diverse perspectives, engaging students in critical discussions, and creating a learning environment that values different forms of knowledge.

Utilizing a mixed-methods approach, we conducted surveys with CS students to gather data on their sense of belonging. Preliminary findings indicate that most students express a sense of belonging, and contrary to previous literature (Cohoon, 2002; Master et al., 2016), we found no gender differences in the sense of belonging. Through a deeper qualitative analysis, we seek to uncover the underlying dynamics contributing to the observed variations. We hypothesize that our innovative intro course “Introduction to Speciality” can foster a deeper sense of belonging within CS students identifying as female. Several strategies are employed within the course to support their sense of belonging.

Firstly, as role models play an important part in creating a sense of belonging for female students in CS (Cheryan et al., 2011), we invite a diverse group of guest speakers to the lectures. These speakers are selected to provide insights into their journeys and to inspire students by challenging commonly-held CS stereotypes.

Furthermore, we structure collaborative projects to be inclusive and considerate of different perspectives, taking gender and language minorities into account. We also involve students from previous years as instructors, contributing to diverse perspectives and experiences within the teaching staff.

On the individual level, our course activities are designed to guide students in reflecting on and making meaning of their experiences. This reflective approach enhances self-awareness and fosters a deeper connection to the learning community.

By sharing our experience and good practices, we hope to contribute to the ongoing dialogue on building gender inclusivity in academia and research, particularly emphasizing the intersectional perspectives inherent in the diverse landscape of computer science education.

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Usability of rollators in elderly. A narrative literature review.

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Purpose: Rollators can be considered as the artificial part of a socio-technical human-machine system. Their use (or non-use) has an impact on the respective life situations. They influence health, social participation and thus the quality of life of people who are dependent on support. Rollators can therefore be described as a technology that expands possibilities. On the other hand, rollators can have negative effects if the human-machine interaction is unsuitable, as shown by a Dutch study on rollator-associated accidents. This prompted the authors to ask whether older rollator users even know how to use rollators correctly [1]. The consideration of usability within the development of systems reduces the risk of unsuitable products. Human-centred design approaches assume that a deeper understanding of users, their usage contexts, and the tasks to be solved leads to an improvement in product design and thus to an improvement in usability. Based on the assumption that a comprehensive understanding of users and usage contexts leads to an improvement in usability, the aim of this research was to identify and discuss usability aspects of rollators within the current literature.

Methods: A systematic, narrative literature review was conducted. This strategy offers the opportunity to integrate literature of different epistemological origins and to counteract the often-criticised weaknesses through a systematic approach. Following the PRISMA guidelines, the databases CINAHL, Pubmed and Academic Search Elite were examined. A theory-driven thematic analysis approach was used to synthesise the quantitative and qualitative data and

identify the key themes in this research using a deductive approach. A multidimensional understanding of product satisfaction from the Quebec User Evaluation of Satisfaction with Assistive Technology (QUEST 2.0), with the two sub-dimensions of product and service satisfaction, served as the theoretical basis [2]

Results: No literature was found on the usability of rollators. However, individual usability aspects could be extracted from 45 identified publications using the QUEST 2.0 scale. Usability aspects related to the product service dimension (e.g. repairs and servicing) were addressed less frequently in the analysed literature compared to usability aspects related to product satisfaction (e.g. safety and effectiveness). Statements about a high level of satisfaction with rollators were found. However, individual aspects of satisfaction such as product dimensions (e.g. weight), age-stigmatising design and dependence on environmental factors (poor pavement conditions, difficulty negotiating obstacles) were rated as problematic. In the sub-dimension of product service satisfaction, statements were found about a lack of training, product information, and maintaining. Findings indicate that the use of rollators requires individual adaptation, both in the organisation of everyday life and in the acceptance of self-image. This adaptation is described as time-dependent, so that perceived negative aspects of use (e.g. age stigma) are overlaid by positive aspects and experiences of use (e.g. the opportunity to go for a walk again).

Conclusion: This first systematic, narrative literature review summarizes and discusses aspects of the rollator usability. The detailed and discussed findings pave the way for additional research approaches, but do not allow a general statement on usability aspects of rollators. Nevertheless, the results indicate that a deeper understanding of human-rollator interaction could be beneficial for further development. It also shows that rollators must be understood as product-service systems to achieve an increase in usability. This raises the question of whether usability is understood as a product characteristic or as something that arises during interaction.

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Conceptualising rebound effects as emerging from user learning about smart home technologies

Bryony Parrish

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Smart home technologies (SHTs) use digital interfaces, sensors and networks to enable automation and remote control of devices in the home. Leading low-carbon scenarios expect SHTs to help decarbonise home energy use, including through automating the provision of energy services like heating and lighting only when needed, increasing efficiency by reducing waste [1]. However, such expectations are tempered by the potential for "rebound effects" – increases in demand for energy services accompanying increases in technical efficiency – at multiple scales [2, 3, 4, 5]. Rebound effects have traditionally been understood as the result of economic mechanisms: demand for energy services increases because increasing efficiency reduces their unit cost [1]. However, scholars recognising the limitations of such narrow economic framings have recently begun to expand conceptualisations of the mechanisms underlying this phenomenon [6].

This research contributes to these efforts by engaging with Science and Technology Studies literature that illuminates the potential for intensification of demand associated with new technologies' adoption and use [for example, 4, 7, 8, 9]. Through analysing users' learning about a novel, automated lower carbon home heating technology called smart hybrid heat pumps in the context of a UK-based trial, it proposes a new conceptualisation of direct rebound effects associated with SHTs. This draws on domestication theory [10] and concepts from actor network theory, such as delegation and displacement [11], to illuminate how users' practices may change when new, more energy efficient and smart automated technologies enter "micro-networks" of artefacts and practices within the home [12, p.18]. In particular, it identifies how *meanings* associated with such technologies and expectations about their performance can contribute to shifts in responsibility for financial and environmental economy from human home-makers to the (perceived) capabilities of the new technology.

This builds on work highlighting that demand intensification may result from the promotion of enhanced lifestyle expectations as the main selling point of SHTs [for example, 4, 9]: it conceptualises distinct, though related mechanisms, and provides greater detail on processes by which these mechanisms cause rebound effects to emerge. Illuminating these processes could support actions to challenge rebound effects, for example through informing daily life experimentation. Here, experimentation refers to households reflecting on how and why their daily life routines take the forms they do, then using this understanding to try different ways to improve their sustainability - learning about challenges and opportunities along the way [13]. More generally, this work contributes to illuminate processes underlying societal trajectories of escalating standards of comfort and convenience identified by [7], and address calls to make explicit the social as well as technical aspects of energy efficiency with the aim of avoiding such escalation [8]. By connecting with the expanding literature on rebound effects' underlying mechanisms, it also aims to increase the visibility of insights informed by STS to a wider audience.

Influence of Private Housing Companies on Tenant Sufficiency in Germany: A Comprehensive Analysis within the Framework of Low-Carbon Energy Systems and Climate Change Mitigation

Eva-Maria Grommes, Leonie Bremer, Ulf Blieske, Valérie Varney

University of Applied Sciences, Germany

Sufficiency has become increasingly important in daily life, with people making more conscious choices such as cycling instead of driving [1]. However, structures like laws and market mechanisms often hinder these efforts. In the context of rental properties, tenants' ability to behave sufficiently is limited by the energy condition of their rented property. Despite efforts to ventilate properly or turn off the heating when ventilating, tenants may have to use more energy if their windows are not energy efficient.

This study aims to investigate the extent to which private housing companies influence the energy-efficient refurbishment behaviour of tenants. It puts a special focus on the influence private housing companies have on the sufficiency behaviours of tenants through energy renovations and policies. The residential real estate sector bears significant responsibility to contribute rapidly to achieving the goals outlined in the Paris Agreement, particularly in residential heating, where significant emission reductions are necessary within a short timeframe.

The methodology of the study is based on expert interviews and a chatbot survey with 520 participants. It considers tenants' limitations, both financial and related to construction inconveniences when planning extensive energy renovations [2]. Legislative constraints state that tenants are not allowed to demand energy renovations, although they are obliged to accept various measures [3]. These measures may include potential rent increases after energetic renovations, despite the high price levels in cities in the western part of Germany.

The results from the chatbot surveys align with expert interview findings, emphasising the crucial role of political frameworks in overcoming current obstacles. Economic considerations were found to be the critical factors influencing the decisions of private housing companies regarding energy renovations. The economic viability, competitiveness, and refinancing potential through tenants played pivotal roles in deciding whether to pursue or abstain from energy renovations.

In conclusion, tenants must be informed about the new energy performance of residential properties after energy renovations, in addition to receiving information on general sufficiency. This will minimise the risk of tenants' energy consumption remaining unchanged or increasing post-renovation. This policy necessitates that tenants are willing to live sustainably, and landlords must go beyond mere renovations by actively supporting tenants in their sufficiency behaviours.

This research contributes to the understanding of the role of private housing companies in promoting energy sufficiency among tenants. This is an area that has not been extensively investigated on a company level, as most companies do not yet have concepts in place. It highlights the need for policy changes and increased communication between tenants and

housing companies to empower the socially relevant group of tenants to be able to participate actively in the energy transition. The findings can inform strategies for achieving climate change mitigation goals in the residential real estate sector.

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Challenges and strategies in teaching responsible research practice (to engineering students)

Lisa Sigl

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Translating concepts of Science and Technology Studies (STS) and Responsible Research and Innovation (RRI) into ways of sensitizing engineering students to societal and environmental issues is a challenge that many scholars (in STS and beyond) take on within their academic life course. This poster discusses two challenges related to such teaching settings: First, the challenge of keeping the barrier to engage with these concepts low, while at the same time conveying the systematic, scientific character of analyzing societal and environmental implications of new technologies. And second, the challenge of broadening the scientific view of students to inter- and transdisciplinary perspectives, while the course is situated in often narrowly-defined disciplinary course programs.

Regarding the first challenge, the interdisciplinary, international community of RRI scholars has developed a broad range of methods and tools to facilitate and support systematic reflections on societal responsibility in science (such as represented in the RRI-tools database, and a range of card-based reflection formats; RRI-tools project[1], Moral-IT deck[2]; Intersectional Design Cards[3], Felt et al. 2018). Such tools are an important step towards making often abstract concepts and contents more accessible to people outside STS and RRI (Felt et al. 2022). However, many of these tools are targeted at research professionals, not considering the needs and practical relevance to professionals outside academic research, which is the more usual professional career track of engineering students.

Regarding the second challenge, we can observe a similar growth in tools and methods for conducting more integrated, inter- and transdisciplinary research (td-network and td-toolbox[4], td-academy[5], INTEREACH[6], Integration and Implementation blog[7]). There is to date still little coursework that sensitizes students to the range of competences required for more

integrated perspectives on social and environmental problems, such as social skills, coordination of collaborations, self-awareness and self -management, or interactional expertise (Nurius/Kemp 2019; Gorman 2010, Pohl/Wuelser 2019). This poster explores potential of adapting above-mentioned tools and methods for teaching settings.

This poster addresses a repertoire of ways of dealing with these two challenges (e.g., by reflection tools and case-based learning) and is an invitation to exchange on the strategies and practices of teaching responsible research practices to (engineering) students. While doing so, the poster refers to earlier research on orientation work in scientific communities (Falkenberg et al., forthcoming), re-articulations of relevance in science (Sigl et al. 2023), and a typology of practices and competences related to relevant research (Sigl/Fochler, unpublished).

References:

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[3] https://intersectionaldesign.com/ (22.01.2024)

[4] https://naturalsciences.ch/co-producing-knowledge-explained/methods/td-net_toolbox (07/08/2023)

[5] https://td-academy.org/ (22.01.2024)

[6] https://www.intereach.org/ (22.01.2024)

[7] https://i2insights.org/about/ (22.01.2024)

Teaching Digital Literacy through Participatory Pedagogy

Sérgio Barbosa

IAS-STS, Graz University of Technology, Austria

Since the increased digitization of everyday life, social media platforms have been key tools for how young people communicate and interact between themselves. However, there is little research about pedagogical initiatives that can bring digital literacy to stimulate critical thinking and public intervention around the main challenges of contemporary democracies. The goal of this article is to foster an educational long-term campaign to bring youth digital literacy to the forefront of policymaking in Portugal and broader EU contexts. It showcases the Digital Literacy Pedagogical Sessions (DLPS) to empower and nurture Portuguese youth and address the gap in the literature about long-term digital literacy educational policies. Data from this article is derived from a participatory pedagogy and teaching methods applied at the school level in two academic years: 2021-2022 and 2022-2023. The paper suggests policy recommendations towards the EU Commission and Portuguese Parliament to reflect on how youth can be active promoters and agents to participate actively their own intervention of a fair digital society. At the same time, it argues urgently to foster a long-term education agenda to promote public values as key component.

Awareness, Attitudes and Practice of Open Access in the Humanities – Evidence from Hungary

Mónika Rusvai

Library and Information Centre of the Hungarian Academy of Sciences, Hungary

Open access (OA) is a rapidly evolving publication model that is supposed to aid the democratization of global science by offering a broader platform for research communication. The success of OA initiatives, however, comes down to researchers' underlying perceptions, motivations and behaviours regarding OA publishing. Though it has been documented that the transformation towards OA is a slower process in social sciences and humanities (SSH) research, only a few articles focus on the personal experiences and attitudes of individual researchers – and no such analysis has been carried out in Hungary. The present project aims to fill this gap through a specific, pilot study that maps the main motivators of and major hindrances to OA publishing in the humanities relying on the storied experience of Hungarian publishers and linguists.

Data was collected from 2022 to 2023 via semi-structured, in-depth interviews in two stages. Stage 1 consisted of four interviews with Hungarian publishers: one larger publisher that offers some linguistic journals in its "read and publish" portfolio, another larger publisher that specializes in OA e-book publishing, and two smaller university presses that publish platinum OA journals highly respected within their specific field. Stage 2 included 10 interviews with Hungarian linguists who have records of working with these publishers as authors. In sorting this sample of researchers, the project strived for a variety in age, gender, affiliation, seniority and level of experience in open access publishing. The interviews intended to explore the interviewees' awareness of and general attitudes towards OA publishing, as well as their priorities in scholarly communication and major motivations for OA. Once transcribed, the

interviews were subjected to inductive thematic analysis carried out under a pragmatic, bigQ mindset in order to create a multidimensional picture of the participants' perception. The analysis focused on the researchers' interviews and relies on the publishers' interviews for a broader context and for a different perspective on the Hungarian OA publishing landscape.

Results showed that better visibility appears to be the primary motivator of OA publishing amongst Hungarian linguists. Within the Hungarian academia, funding is a crucial and ethically controversial issue in all subfields of linguistics and a major hindrance to international OA publishing. Interviews also clearly showed that as awareness raisers and information hubs, libraries play a key role in spreading OA publishing in SSH research. Overall, the analysis of the interviews revealed that in order to opt for OA publishing, researchers need to be convinced that there is an actual, professional benefit that they may gain from it.

15 years of NOVA classification of food processing: its role among complex and sustainable dietary quality indicators – a scoping review

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Introduction: It has been 15 years since the introduction of NOVA food classification according to their degree of processing (Monteiro, 2009). While its initial purpose is to identify ultra-processed foods that have been linked to the development of NCDs (Lane et al., 2021), NOVA classification fulfills the idea of holism in nutrition since it groups food by classifying their wholeness instead of reductionist measures (Fardet, Lebredonchel and Rock, 2021). As such, NOVA as a dietary quality indicator has a promising role in sustainable diet evaluation, however, its link to dietary environmental impact indicators is yet to be explored thoroughly (Vellinga et al., 2022).

Aims: The aim of the study was to assess the role of NOVA classification among complex sustainable dietary quality indicators, besides, we purposed to review its reliability according to experts.

Methods: A scoping review was done based on the PRISMA-ScR (Tricco et al., 2018); WoS, Scopus, and PubMed were searched in October 2023 for eligible articles published between 2009 and 2023 with English full-text and DOI number. Out of the total 1612 records, after screening, ~ 85 met the inclusion criteria and were reviewed. Bibliometric analysis was conducted based on metadata to describe the analyzed set of articles: citation trends, most relevant sources, research output / countries and years as well as the relevant keywords and their co-occurrences. The selected articles were reviewed on the basis of (1) general and (2) specific aspects as well as based on (3) supporting and not supporting reasoning of experts on NOVA.

Results: Bibliometric analysis showed that most of the article was published in 2022 and in Nutrients journal and from Brasil, while the average article citation was at its peak between 2018-2020. The review on the general aspects showed that studies applying NOVA and other dietary quality indicators are mostly cross-sectional, concentrating on different population

segments, conducting descriptive statistics, correlations analysis, linear regression models and agreement analysis. According to the specific aspects, most studies aimed their analysis at diet or food level based on survey data or food databases. In majority, Nutri-score and other nutrient profiling systems were applied with NOVA classification, while fewer studies included environmental impact indicators. The applications of NOVA were food classification and ultra-processed food contribution to total diets besides score values. Our review suggest that NOVA is in synergy with nutrient profiling models, however they are not interchangeable but NOVA could be completed with them in dietary evaluation besides environmental impact indicators. Futhermore, the applicability of NOVA classification depends on the data collection, dietary data aggregation level (e.g., food groups), level of analysis, and type of application.

Conclusions: According to the review and reasoning of experts, the NOVA classification is not flawless and has been addressed with criticism, however, holds a valuable place among other dietary quality indicators, being especially promising for the holistic sustainable nutrition approach. The further precision of its classification and application as well as choosing the adequate complementary dietary quality indicators, especially sustainable diet indicators, could improve the quality of sustainable diet measurement. This review summarizes how the NOVA classification has been applied and what are the possible shortcomings and synergies to use it as a sustainable nutrition indicator in complex evaluation systems.

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Lane et al., 2021: https://doi.org/10.1111/obr.13146

Fardet, Lebredonchel and Rock, 2021: https://doi.org/10.1080/10408398.2021.1976101

Vellinga et al., 2022: https://doi.org/10.1186/s12889-022-13282-x

Tricco et al., 2018: https://doi.org/10.7326/M18-0850

This research was funded by National Research, Development, and Innovation Fund of Hungary grant number FK-23 147390

Sex Education in the Age of Chat GPT

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The rapid evolution of technology appears to be in the hands of increasingly younger demographics, with artificial intelligence proving to be no exception. The use of Open AI's ChatGPT is becoming widespread in a range of applications, with adoption as a source of information and exploration for children. Beyond help with homework or exams, ChatGPT's potential as a source of information on sex, sexuality and intimacy is becoming a reality (Lin et al., 2023; Welch, 2023).

In this paper, I examine the use of ChatGPT as a source of sexual education information for school children ages 12-16**.** Building on speculative fiction and thing ethnography methodologies, I engaged in a series of interviews with ChatGPT, adopting the perspective of four different students ages 12 to 16. Though not exhaustive, this method aims to represent different student demographics and the nature of questions and conversations kids engage in

around topics of sex and sexuality. Themes range from sexuality, to puberty, sexual orientation and sexual intercourse. I sought to mimic the types of questions that students could typically ask friends, ChatGPT, or may feel too self-conscious to ask a teacher, parent, or trusted adult. As a result, the content of these inquires is often very personal and intimate, and potentially even embarrassing. They can include topics on being sexually active, what is “normal,” their changing bodies in puberty or struggles with sexual identity.

The findings of this research reveal that while ChatGPT tries to avoid normative concepts of sex and generated inclusive answers, it flagged almost any content about sex as a violation of the platform’s content policy. Furthermore, it presented a contradictory response to other topics, deleting content around sensitive questions relating to vulnerable situations or abuse were deleted, while directing users toward sites like Pornhub in discussions of pornography. Given the findings of my research, I argue that the inconsistencies in ChatGPT’s engagement with questions and the content of its responses may lead children to feel unsettled, shamed or stonewalled when asking legitimate and potentially vulnerable questions. Moreover, as an educator of secondary schools, I compare ChatGPT’s responses to Austria’s current curriculum.

This paper aims to contribute empirical data regarding ChatGPT’s impact on children’s sexual education and questioning. I seek to provide insight into the type of information children can access to through ChatGPT. In conjunction with a comparison of this information against Austria’s school curriculum, I intend for this paper to provide a framework of suggestions and act as a resource for educators, parents, and legal guardians, while highlighting how AI bias and limitations can impact the sexual education and wellness of children.

An immanent energy commons? Comparing renewable energy regions in India, Germany and Australia

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Large-scale renewable energy entails a new wave of enclosures, for a ‘greener’ capitalism. Property use is aligned to capitalise and appropriate wind and solar power, as ecology's 'free gifts'. How is this experienced and contested? What new claims are generated? This paper reports on multi-year research into large privately-owned utility-scale renewables in three contrasting renewable energy regions - Karnataka in India, Brandenburg in Germany and the state of South Australia. We use ethnographic accounts to explore the capacity and agency for energy transformation, asking whether narratives of transition create the foundation for a new energy commons. We find that large-scale renewable energy on the neoliberal model sharpens social divisions and undermines the legitimacy for transition, yet at the same time generates new claims. We demonstrate how corporate renewables relies on state regulation and public infrastructure, and highlight efforts to re-purpose this for wider social benefit. Co-benefits are mobilised as preconditions, regulations are tightened for social and ecological

outcomes, levies and royalties are instituted, and new demands for social ownership are asserted. Crucially, these claims are immersed in the wider climate crisis. The climate commons, expressed in the imperative for reduced greenhouse gas emissions, requires public access zero-cost energy. Electricity in this context is no mere commodity: its conditions of production hold the key to planetary well-being. Energy transition cannot be made hostage to capitalisation and commodification for private investor interests. Renewables abundance is needed, not enclosure. With this we posit an emergent energy commons, as an immanent tendency of energy transition.

Managing Industrial Digital Platform Growth or Generative Dynamics - A Virtuous Loop Approach

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Industrial equipment firms such as robotic arms manufacturers are now making transition from manufacturing and servitization of its own products to orchestrating an ecosystem of partners including other equipment makers and industrial customers to deliver complex value proposition such as digital servitization (Shum et al. 2022)[1]. Such firms are organizing industrial digital platforms to aggregate industrial data across different industrial assets in one side and complementors to analyse the data collected in the other side. An industrial digital platform is therefore fundamentally, or in its simplest formulation, a two-sided marketplace (Pauli 2021). While there is a conventional chicken and egg dilemma embedded i.e., industrial data first or analytics complementors first, there is another source of complexity which makes industrial digital platform different. In essence, an industrial digital platform leader needs to incentivize other equipment makers to share data with its equipment. The more the data sources and the more diverse the data sources, the more value added would be in the servitization solution, and the more likely the platform leader could then attract analytics or apps developers to its industrial digital platform.

The issue of data sharing in the context of digital industrial digital platform is relatively unexplored. In this paper, we propose a fundamental strategy of diversification to facilitate data sharing. The platform leader being an equipment maker first and foremost needs to engage in product diversification to increase the deployment of its products in the industrial setting. Product diversification (Shum et al. 2020, Pauli et al. 2021) refers to designing and producing many product varieties (models) based upon a modular product platform. With more installations, other equipment makers would find it more necessary to be interoperable and share data with the platform leader's equipment.

Similarly, if the platform leader's equipment incorporates more technologies or becomes multi-functional, other equipment makers would find it necessary to interoperate with it. As a result, technology diversification (broader technology base *within* a product) could also incentivize other firms to share data with the platformizing firm. Both product and technology diversification could therefore set off positive indirect network externality, attracting diverse equipment or sensors or data sources to share data.

With a proliferating data diversity or variety and volume, the platform leader could attract complementors in the other side, with increasing powerful analytics technologies such as **industrial artificial intelligence**, machine learning etc. to analyse the resultant BIG data. Since such analytics outcomes or solutions would be implemented as digital servitization solution (on the equipment which has joined the platform, other non-converted equipment would find it increasingly necessary to also join to contribute data and be part of the high value-added servitization solution and to create, deliver and capture value[2] (Madanaguli et al, 2023). A virtuous loop (see figure 1) driven by product diversification and technology diversification could be sustained for the industrial digital platform to scale up.

Figure 1: Virtuous Loop of Data Diversity to Scale Up an Industrial Digital Platform.

The rest of the paper will review the diversification literature (Kodama 1986, Granstrand 1998), and to suggest several onboarding strategies for the platform leader to attract other equipment makers to join the industrial digital platform. Ecosystem integration using boundary resources or technologies (Shibata and Shum 2021, 2022) would also be discussed even though it is beyond the scope to talk about industrial artificial intelligence or other analytics technologies. We will wrap up with real-world industrial digital platform cases (Pietila[3] 2018) in different sectors in Europe and Asia, and to interpret them according to our virtuous loop framework.

[1]https://www.researchgate.net/publication/360546284_An_exploratory_investigation_of_firm_level_transition_to_an_open_cyber_physical_system_and_implications_to_digital_servitization

[2] Business model perspective of industrial digital platform.

[3] The case of Stona Enso (Finland).

Stream A: Open Science: Rethinking the Science and Society Relationship

A.1: How do geographic imbalances in mainstream scientific knowledge production impact sociotechnical change in lower income countries?

Session Chair*:* Samuel John Unsworth, Chalmers University of Technology, Sweden

Session Chair: Muez Ali, University College London, United Kingdom

A global public engagment process riddled with inconsistencies? The case of the Stratospheric Aerosol Injection (SAI) experiment SCoPEx

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Stratospheric aerosol injection (SAI) is a speculative technology which has the goal of lowering global mean temperature by introducing reflecting aerosols into the stratosphere. As a technology with global implications, SAI is inextricably tied to questions of geographic imbalances in scientific knowledge production. The research community working on this technology has been repeatedly criticized for consisting mainly of researchers based in the Global North. There are efforts to diversify geographic representation within the research community, particularly by providing funding for researchers in the Global South but these efforts are also predominantly funded and coordinated by actors from the Global North, raising doubts about the credibility of such measures.

In my master's thesis I engaged with how SAI is understood differently by different actors. Some see it as a fundamentally problematic technology which should not even be researched, others depict it as a vital component of the toolbox which we need to address the consequences of climate change. In my presentation, I will adress some key findings of my master's thesis, in which I examined one of the most recent planned outdoor experiments of SAI: SCoPEx. In my thesis, I demonstrated how involved scientists, Advisory Committee members and critical stakeholders depict issues surrounding SCoPEx and SAI outdoor experimentation in general. Contextualizing the case with STS-literature on controversial technologies, postcolonial issues, and public engagement, I analyzed data material from websites, documents, and interviews to map out what meanings the different actors attribute to SCoPEx.

Actors involved in SCoPEx tried to initialize a public engagement process which was supposed to address (among other things) the issue of geographical representation; but the thorough scrutiny of this process casts doubt on whether it was successful in truly including relevant publics into the process. In my presentation I intend to give an insight into the public engagement process conducted within SCoPEx and use it as an illustration of how complicated and contested the seemingly straightforward task of geographic representation can be in practice.

Division of Knowledge; how does the hegemonizing of epistomologies create a geographic disparity in scientific knowledge production?

Mohamed Khougali

United Kingdom

Modernisation, industrialisation, improvement are all words used by different people to signify a transition from old to new forms of production. While these nebulous concepts were always in circulation, it wasn't until philosopher John Locke when concepts of waste were introduced to conceptualise a form of property relation that would inform the basis of capitalism as a mode of production. These property relations transform workers into the proverbial ‘horse’ and reduce man’s experience and knowledge as atomistic facts of nature. Apart from the understudied works of Roy Bhaskar, it is generally accepted that when investigating social phenomena, man and society are intertwined in reality. This research will explore these philosophic and historic concepts in detail to inform the hegemony of knowledge production centring around, not just geography, but epistemologies that favour a certain framing of natural and social phenomena; what the research would refer to as the division of knowledge.

Evidence of an epistemic hierarchy in global climate change science assessments

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The Intergovernmental Panel on Climate Change (IPCC) is a global authority in the climate change science-policy interface and their mandate is to provide comprehensive assessments of the state of climate change research. However, there are accusations of an epistemic hierarchy within the assessments whereby certain disciplines and research fields are valued more highly at the expense of others, but they are based on limited empirical evidence. Integrated assessment modeling (IAM) research is a research discipline that shares the paradigm of representing climate change mitigation as an economic problem in a computer model. We study to what extent IAM research has contributed to the evidence base of all IPCC reports on climate change mitigation published between 1990 and 2022 using semi-automated scientometric analysis. Our results show that IAM research was influential in all IPCC assessment cycles, particularly in the SPMs, and that this research was predominantly provided by a highly non-diverse group of males residing in Western institutions. We thus conclude that there was an epistemic hierarchy in the IPCC reports, overemphasizing some perspectives while underestimating others. Its existence implies the scientific and policy consensus for all is defined by a few individuals with highly similar backgrounds, consequently placing those from other affiliations at an advantage. It creates a situation in which science, science assessment and policymaking are done predominately by men from developed countries despite women and from developing country citizens being more vulnerable to climate change. However, there is also some evidence that the hierarchy is flattening due to internal efforts for more diversity by the IPCC.

A.2: Trust within (open) science

Session Chair: Judith Hartstein, German Centre for Higher Education Research and Science Studies (DZHW), Germany

Session Chair: Alexander Schniedermann, German Centre for Higher Education Research and Science Studies (DZHW), Germany

Session Chair: Nathalie Schwichtenberg, German Centre for Higher Education Research and Science Studies (DZHW), Germany

Trust by transparency? How can Open Science tools reform the values for science?

Alexander Schniedermann

German Centre for Higher Education Research and Science Studies, Germany

Within the Open Science reform movement, the notion of trust between researchers is inseparably tied to the notion of transparency. By moving from trust by certification to trust by transparency, Open Science enthusiast removed the traditional role of journals and organizations as certifiers of trustable outputs. Instead of suggesting alternative modes for certification, the promotion of transparency must be understood as an empowerment of the critical reader who questions and reviews rather than trusts the outputs of others (see Vazire 2017).

Against this background, two fundamental issues should be considered. First, the shift from trust-enabling certification to test-enabling transparency increases the labor on all sites, the burden of reporting for knowledge producers, as well as the burden of reviewing for readers and consumers. This harms the goal to make science less wasteful and explains why Open Science often understood as additional work.

Second, transparency as a new epistemic goal for science does not represent a reform of the current configuration of epistemic and social values in science. In that sense, transparency is a meta-value which cannot be used to prevent misconduct, fraud or sloppiness. Even within a transparency paradigm of research, knowledge producers and consumers still must decide on standards for reliable or credible research practices.

Based on qualitative interviews with the developers of a reporting guideline for biomedical publications, I will show how existing standards for transparency are loaded with traditional quality markers. I will argue that these standards keep transparency as fuzzy concept to be effective. By establishing links to previous research about transparency devices, the presentation invites to discuss the overall cost benefit of implementing transparency standards in knowledge production procedures or whether it would be more fruitful to address misbehaviors and fraud more directly.

This presentation is based on:

Schniedermann, A. (2022). Shaping the Qualities, Values and Standards of Science. How Reporting Guidelines Improve the Transparency of Biomedical Research. *Frontiers in Research Metrics and Analytics*, *7*, 846822. https://doi.org/10.3389/frma.2022.846822

Co-creating an inclusive European Science Service for Biodiversity to build mutual trust

Eszter Kelemen, Karmen Czett, Kata Fodor

ESSRG, Hungary

Recognising that science is not the sole source of knowledge along with the rise of fake news highlights the need to address persistent stereotypes and prejudices that impede trust-building. Designed as a bridge between research and policy, the European Science Service for Biodiversity (SSBD), developed by the BioAgora project, seeks to enhance decision-making for biodiversity by fostering a more inclusive and effective collaboration among diverse science-policy-society actors. Underscoring the significance of transdisciplinary knowledge production for a sustainable future, it emphasises the need for transformative governance and a broader knowledge base. To this end, the forthcoming Science Service fosters a knowledge co-production model open to diverse science-policy-society actors. However, building trust among them, especially towards non-scientific knowledge holders poses a serious challenge. As part of the BioAgora project, capacity development needs of diverse stakeholders – spanning the realms of science, policy, business and civil society – were explored through more than 50 expert interviews. The analysis of the interviews has revealed deep-rooted stereotypes and a lack of trust embedded in their dominant narratives about each other, hindering their abilities to successfully co-create knowledge.

Interviewed experts highlighted an increasing polarisation in debates and the lack of mutual appreciation between scientists and policymakers. A dearth of a common language further hampers effective engagement in knowledge co-production and decision-making processes. Pre-existing prejudices and stereotypes limit stakeholders' capacity and willingness to collaborate with others in the science-policy-society interface (SPSI). In the case of business and societal stakeholders, a perception of the impracticality of research creates a further barrier. For instance, in city developments, biodiversity is often overlooked, reflecting a lack of awareness and understanding of environmental issues. Conservation efforts are considered in this context as a cost rather than a benefit, extending mistrust between policymakers and business actors, as well as between NGOs and businesses.

To foster trustful relations in SPSIs, longer term and deeper collaboration is needed, where participants can develop a common understanding and engage in joint problem-solving. Our analysis offers three intertwined strategies to reach this end. First, intermediary actors, bridging the realms of policy, science, and practice, can forge alliances and develop interconnected networks. Second, institutionalised processes that ensure safe collaborative spaces are crucial, preventing the misuse of shared information and mitigating the influence of power hierarchies. Finally, professional facilitation emerges as a vital aspect, as skilled facilitators can bridge worldviews, build trust, and ensure that all relevant knowledge holders are heard in science-policy-society interactions.

The management of knowledge by scientists in participatory procedures and processes

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Karlsruhe Institut for Technology, Germany

As part of the project entitled “Participatory Procedures and Processes in Research Organizations. Impact on Research Agendas and Challenges for the (further) Development of Transdisciplinary Methods” (PaFo) at the Karlsruher Institut for Technology, our research delves into the impact assessment of participatory dialogue formats. For example, citizen dialogues emerge as a salient feature, exemplified prominently within the corridors of the Karlsruhe Institute of Technology (KIT). These dialogues stand as vibrant arenas, meticulously crafted to foster a vibrant exchange between the bastions of scientific inquiry and the broader echelons of public discourse, thereby fostering a dynamic interchange of information and knowledge.

Within this tapestry of engagement, the contours of scientific discourse unfurl, revealing intricate details of ongoing research endeavours across carefully curated thematic domains. Concurrently, citizens are empowered to traverse the realm of inquiry, contributing their individual insights, experiences, and perspectives to the collective pool of information and knowledge. This symbiotic relationship forms the cornerstone of participatory dialogue, wherein the boundaries between academia and society blur, giving rise to a vibrant ecosystem of shared understanding and collaborative endeavour.

Central to facilitating this exchange are the so-called *citizen ambassadors* of the KIT – citizens who voluntarily assume the mantle of institute emissaries, tasked with fostering dialogue, disseminating knowledge, and bridging the chasm between theory and practice. Utilizing their varied professional experiences, these ambassadors play a key role in encouraging engagement, assisting fellow citizens in navigating the complexities of scientific inquiry. Their efforts help foster dialogue and promote civic involvement and scientific understanding within the wider community.

Yet, within the tangible enthusiasm for engagement, one acknowledges the inherent complexities that underpin the role of citizen ambassadors. Balancing the dissemination of knowledge with the preservation of its integrity presents a challenge, necessitating a delicate interplay of communication and stewardship. Moreover, as the discourse unfolds and interactions proliferate, questions inevitably arise regarding the transformative potential of participatory dialogue. Can these interactions transcend the realm of discourse, catalysing tangible action and societal change?

However, amidst the optimism permeating the participatory dialogue landscape, voices of dissent linger on the periphery. Critics raise concerns regarding the erosion of boundaries and the potential for undue influence to subvert the integrity of scientific inquiry. As the boundaries between academia and society blur, questions emerge regarding the sanctity of scientific autonomy and the preservation of its self-regulatory mechanisms. In navigating these treacherous waters, we must tread cautiously, cognizant of the delicate balance that underpins the nexus of science and society.

In my contribution, I aim to present the work of citizen dialogues and the role of citizen ambassadors from an observer's perspective, where the boundaries between science and society seemingly blur, occasionally giving rise to a vibrant tapestry of shared understanding and collective efforts. At the same time, I wish to delve into the intricacies that lie between knowledge dissemination and knowledge management and raise questions about self-regulation as well as knowledge governance: What knowledge do we pass on? Do we, as scientists, acknowledge boundaries? How open is open science? Or does openness pertain to a domain we still prefer to manage ourselves? And what does this management of knowledge ultimately mean for the relationship of trust between science and the public?

Is Trust in Software a Disciplinary Practice? Yes. But no.

Judith Hartstein[1,2], Nathalie Schwichtenberg[1], Alexander Schniedermann[1]

[1]German Centre for Higher Education Research and Science Studies (DZHW), Germany; [2]Humboldt-Universität zu Berlin, Germany

What makes researchers from different disciplines trust in research software? We propose that some - but not all - considerations before software use are to be regarded as disciplinary practices drawing apart the (computer) sciences from the humanities.

The representative DZHW Science Survey provided us with n=1,326 complete responses from researchers about their considerations preceding research software use. On this data, we performed multiple and simple correspondence analyses to explore patterns concerning disciplinarity versus trust in research software.

Our multiple correspondence analysis reveals the relevance of considerations in general as an in-participant characteristic with clear but small disciplinary differences. With simple correspondence analysis, we find that software-literacy-related considerations are disciplinary practices, whereas reputation-related considerations are meta-disciplinary.

We suggest that infrastructure designers should be aware of the pre-established relevance of software-literacy- related considerations in some fields as opposed to others. Now, when manifold overarching meta-disciplinary research (data) infrastructures are developed, this awareness could prevent the research community from reinforcing the divide between the "two cultures". We recommend to put emphasis on shared practices when designing new research infrastructures.

Exploring trust and distrust in public data infrastructures as socio-technical systems

Laura Rothfritz

Humboldt Universität zu Berlin, Germany

In the landscape of (Open) Science, the discourse on trust has been a cornerstone of discussions, emphasizing the importance of fostering reliability and credibility within scientific practices. While existing research has predominantly examined trust in data repositories and public infrastructures (Yakel et al., 2013; Donaldson, 2015; Yoon and Lee, 2019), the ongoing

doctoral research presented in this talk shifts attention towards the dimensions of distrust and mistrust. This proposal is rooted in the recognition that infrastructures, as complex socio-technical systems, not only facilitate the flow of information but can also act as recipients of system trust or system distrust. Informed by infrastructure studies, it emphasizes the embeddedness of scientific infrastructures within political contexts. The central question revolves around understanding how individuals distinguish between their distrust in a political system and their attitudes towards the infrastructures embedded within that system.

In the context of (Open) Science infrastructures, the concept of system trust as a notion of trust in socio-technical systems is important. System trust encapsulates the confidence and reliance placed in the overall functionality and dependability of complex systems (Luhmann, 1979; Giddens, 1990; Möllering, 2001). As users engage with infrastructures, their trust in the system plays a pivotal role in shaping their interactions and decisions. It is conceivable to view trust in public data infrastructures as a manifestation of system trust, reflecting users' confidence in the system's ability to securely and effectively handle information. However, the question arises: can system distrust be theorized when trust in these infrastructures falters or wavers?

The presented research acknowledges the potential for theorizing system distrust, exploring how the breakdown or uncertainty in trust relations within data infrastructures may give rise to a distinct conceptualization of system distrust. This perspective adds a layer of complexity to our understanding of the interplay between trust, distrust, and the systemic dynamics of public data infrastructures, offering insights into the implications of system trust and its potential fragility within the evolving landscape of scientific practices.

An illustrative case study within this research is the Data Rescue movement. In 2016 and 2017, these hackathon-style events aimed to safeguard U.S. federal environmental data, uniting scientists, information professionals, and activists nationwide. Responding to concerns about climate change denial and perceived erosion of environmental protections under the Trump administration, the events were lauded as examples of archival data activism. However, their impact revealed vulnerabilities in federal data infrastructures, particularly in access, amidst budget constraints and staffing reductions. The movement fell short of creating a comprehensive archive, with no endangered data actually deleted. This grassroots activism highlighted the inherently political nature of data management and archiving, emphasizing how mistrust or distrust in public data infrastructures can lead to activities in the realm of data activism.

As trust in public data infrastructures is revealed to be susceptible to fluctuations and uncertainties, this research contributes to the study of trust within (open) science by unraveling the implications of system trust in public data infrastructures and its potential fragility. This research not only broadens the scope of (Open) Science discourse but also enriches the field of STS by highlighting the nuanced dynamics of trust, distrust, and systemic interactions within public data infrastructures. The insights garnered from this exploration contribute to a more comprehensive understanding of the relationships shaping scientific practices, emphasizing the need for a holistic approach that embraces the complexities of trust in socio-technical systems.

Creator, Algorithm and I

Vincent Steinbach, Ronald Staples

Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany

Digital technologies have become a catalyst for profound societal transformations, permeating various facets of contemporary life. This abstract contributes to the STS discourse by focusing on the interplay between digital technologies and the dynamics of knowledge production, legitimization, and dissemination. Drawing inspiration from Polanyi's seminal work on tacit and explicit knowledge, we delve into the evolving landscape shaped by digital tools, with a particular emphasis on the pivotal role played by online videos.

Platforms such as YouTube made the contribution to the web of knowledge simple. Now, scientists are competing with actors from the media, entertainment and other spheres for the dissemination of valid knowledge. Trust seems to be an emotional currency in which views, clicks and links can be translated. The visual and interactive enactment of online videos significantly shapes the chance of building trust and the reception by a diverse audience. On an epistemic level, the visual and interactive nature of online videos influences the format in which valid knowledge is conveyed and disseminated regarding the trust issue.

In dissecting this phenomenon, we examine how the dissemination of knowledge through online videos challenges scientific actors as it is forcing them to shape their content in a formal, media-driven way to compete with other actors on a platform. This raises pertinent questions regarding the building of trust and the legitimization of knowledge in digital spaces. **How are traditional notions of authority and expertise negotiated in the era of user-generated content and algorithm-driven recommendations?**

Our abstract underscores the importance of understanding the multifaceted interactions between digital technologies (i.e. algorithm-driven recommendation) and societal forces for which trust works as a crucial social glue.

We try to reconstruct the connections between the three strings. Therefore, we try to adapt Adele Clarkes Situational Analysis. We think that the mapping strategies can be fruitful, when we ask the questions (1) how traditional notions of authority and expertise are reflected in the videos and (2) in which dimension (i.e. aesthetic, narrative, affective) these reflections are being staged. Consequently, we analyze a sample of varying videos to reconstruct the trust-building staging strategies. We also try to compare the viewers' echo to the videos textualized in the comment section. These are of particular interest, because the comment section is the very place where trust or doubt on content becomes visible for others than the individual user. While working on the specific research questions, we also (3) want to contribute to methodological discussions about the analysis of media objects like videos, their individual structure within a (trust building) media strategy and their impact and interdependence with the discourse in which they occur and which they alter.

The research presented relies on several previously published topics: The edited book “Leib und Netz” discusses the overarching question of how interactional patterns are translated into digital modes of interaction. We discuss the problem of how social and technological interface connect in a paper presented at STS 2021 “Goodbye World. On the Incommensurability of

Technical and Sensemaking Communication". And finally, Vincent works in his dissertation thesis on how different appeals shape the dissemination of knowledge during the CoVid pandemic. Furthermore, more recently we established a research network concerned with questions on digital self-perception.

We invite conference attendees to engage in a nuanced discussion, focusing on specific social fields, phenomena of digitization, and the unique challenges and opportunities entailed in the digitalization of society. By doing so, we aim to contribute to the ongoing dialogue on the transformative power of digital technologies and their profound implications for the production, legitimization, and dissemination of knowledge in contemporary society.

A.3: Challenges and Opportunities for Open Qualitative Research

Session Chair: Matthew Good, University of Oslo, Norway

Session Chair: Nicki Lisa Cole, Know-Center GmbH, Austria

Reproducibility of qualitative research – an integrative review of barriers and enablers

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Many consider Open Science to offer solutions to what is viewed as a "reproducibility crisis" within some fields, by fostering transparency of the research processes. There has been a normative shift among funders, research institutions and publishers towards evaluation, assessment, and reward in accordance with a demand for reproducible research enacted through certain Open Science practices. However, Open Science is predominantly driven by and created for improving reproducibility of quantitative research and does seldomly account for the diverse landscape of diverging epistemological and ontological positions and quality criteria that constitute research broadly. The implication is that non-quantitative research may be evaluated poorly or inappropriately using measures intended for quantitative research.

In response, the TIER2 project aims to increase the re-use and overall quality of research results while centering epistemic diversity to ensure that definitions of reproducibility and expectations reflect the diversity of disciplines, fields, and research practices that constitute scientific research. Therefore, in this integrative review, we aim to identify, evaluate and synthesize conceptualizations of reproducibility for qualitative research, and identify barriers and enablers within this diverse set of research practices and traditions. We further aim to provide insight into the relevancy and feasibility of reproducibility, and the Open Science practices that enable it, for qualitative research.

We conducted the review in three stages:

Title and abstract screening of initial academic and grey literature search results

Full-text screening and data charting of included academic and grey literature

Full-text screening and data charting of snowballed literature from Stage 2

We coded and analyzed the extracted data in NVivo and supplemented this with a quantitative analysis conducted in Python.

Preliminary results for the 254 papers included in this study indicate that a minority frame reproducibility as favorable and/or possible in qualitative research. The authors that frame reproducibility this way typically recognize that it is neither desirable nor possible for all types of qualitative research. For some, it can in fact be both, when open research practices are adapted and then implemented to provide enough information and context about the study to make shared data or materials usable for this purpose. In contrast, most papers either take a critical stance, or do not mention reproducibility at all, instead focusing on other research values that are more relevant and central to the diverse epistemologies of qualitative research, like richness, transferability, authenticity, and reflexivity.

We find that the longstanding pursuit of transparency and accountability within qualitative research are enablers of the (possibility) of reproducibility, and that established Open Science practices like data sharing, preregistration, open methods and open analysis can be useful in achieving them. Traditional practices within qualitative research, like field notes, analytic memos, thick description, research diaries, and researcher reflexivity are already designed to produce transparent and accountable research, which can overlap with and expand upon established Open Science practices.

Key barriers to both open and reproducible qualitative research include the epistemology, the role of the researcher as instrument and the interpretive nature of much qualitative research; that generalizability is typically not an aim of qualitative research, due to its context-specific nature; and specific to data sharing, the imperative to protect participant privacy and confidentiality, the process and scope of informed consent, data anonymization processes and time costs, and the challenge of adequately documenting community research context and researcher positionality to enable reuse. Yet, the literature also contains considerable advice, recommended workflows, and tools designed to acknowledge, handle or even minimize these barriers.

Examining considerations that encourage interest in open research approaches across psychological and educational qualitative research.

Sarah MacQuarrie, Lily Verity

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Qualitative researchers often employ and adhere to epistemologies that respond to different forms of analysis and relate to different considerations across a project. Thus, within the qualitative researcher community, it may be easier to achieve pre-registration for some

qualitative approaches than others and lead to differing levels of interest. By documenting the in-depth decision-making taken in advance, open research practices make clear the scrutiny applied within qualitative research that is often hidden within a project. Qualitative engagement with open research will support researchers who are involved in mixed-methods investigations as well as researchers who focus on qualitative approaches. While reporting standards are being developed and build on earlier accounts for transparency [1] there is much to consider in the content included (or not) within the methodological reporting and considerations in the method and analysis stages of qualitative publications.

As qualitative research is a vast area, we have developed insight and expertise as qualitative researchers in psychology of education through diligent development and application of open research principles in our work. Such insights have also been developed by examining available publications that set out how researchers achieved transparency and rigour in the reporting of their work. Unlike quantitative reporting that can follow expected patterns, reporting of qualitative findings are more varied[2] and may make it time-consuming and challenging to identify and recognise good practice.

We will present an introduction to a set of curated insights regarding open research, qualitative methods and reporting. Such a resource can help provide a template for sharing of such content and encourage examples to be provided by other qualitative researchers thereby stimulating interest in the application of open science for qualitative research (including supporting methodological pluralism). Such knowledge will feed into cultural change by providing accessible insight regarding open research and qualitative research and aim to democratise the access to such knowledge. By encouraging self-reflection across the planning, preparation, data collection, analysis, interpretation and reporting phases of qualitative research, open research principles can be adopted and adhered to in contextually relevant ways. By considering open research within qualitative research as a journey, it is acknowledged to be an iterative process that involves recording multiple stages of clarification and decision-making. Such positioning recognises the multitude forms of decision making and reflective practises that fuel qualitative research and can be supported with such a resource.

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Open Naturally Occurring Data: Challenges and Opportunities

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Open Data practices, understood as making empirical evidence generated during the research process available, accessible, and reusable without restrictions, are a cornerstone of Open Science. But not all types of data lend themselves equally to being shared. Most notably, qualitative data such as audio and video recordings, pose several challenges to data sharing. First, often, the recordings cannot be fully anonymised without losing key details, and cannot be shared due to ethical, privacy, and confidentiality issues (Karhulahti, 2022). Second, researchers are concerned with misinterpretations that can arise from recontextualising qualitative data (Branney et al., 2019). Third, there is a notable shortage of appropriate infrastructure, such as qualitative data repositories and professional support (Humă & Joyce, 2022; Joyce et al., 2022).

Naturally occurring data—that is, audio, video, and digital records of real-life conversations (Potter & Shaw, 2018) —are widely used by qualitative researchers across a range of disciplines spanning communication science, linguistics, psychology, and sociology. Such data provide valuable insights into real-world phenomena, behaviours, and interactions not influenced by controlled (experimental) conditions. Naturally occurring data are considered "high value" due to the costs and time saved in their collection, as well as their potential for (re-)analysis and (re-)use. Simultaneously, the act of "opening up" naturally occurring data presents several challenges – including the well-known clash between data privacy and data openness (Karhulahti, 2022) —which currently restricts their widespread sharing and reuse (Humă & Joyce, 2022; Joyce et al., 2022; Karhulahti, 2022).

Our paper aims to highlight both the main challenges for sharing naturally occurring data as well as the opportunities created by making these data available, including:

(1) reduced financial and time costs associated with the generation of new data

(2) increased collaborations between research teams through the combination of data sets

(3) opportunities to conduct comparative and large-scale studies, thus advancing scientific knowledge

(4) opportunities to replicate findings using different data sets, thus promoting scientific rigour and verifiability of research results

(5) decreased burden on research participants through reducing the need for new data to be generated.

The paper concludes with a review of existing infrastructure and projects that support Open Naturally Occurring Data and with a series of suggestions for future initiatives.

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Unheard, or unspoken? Understanding interdisciplinary qualitative researcher voice surrounding the opportunities, risks, and potential future of open research

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The social sciences continue to move towards more open and transparent research practices. However, changes to date have largely been driven by quantitative researchers, designed with largely quantitative psychological research methods in mind. While open research practices are grounded in principles that are core to qualitative research - such as transparency, validity, rigour, and trustworthiness- current open research practices demonstrate little sensitivity to qualitative epistemologies. Qualitative research perspectives remain largely on the margins of these discussions. Many mandated open research practices (such as mandatory inclusion of raw data policies) centre quantitative research methods, and may threaten the integrity, ethics and rigour of qualitative approaches in the process (Prosser et al., 2023).

Despite the prescience of these issues, qualitative voices have been quiet (if not silent) in discussions surrounding open research, and qualitative researchers are oftentimes considered as an ‘afterthought’ when journal and institutional policies have already been introduced. The nature of the ‘open science’ movement is by name and nature fundamentally positivistic, and finding room for more interpretivist qualitative scholarship in this discussion has historically been challenging (Class et al., 2021). It is unclear whether qualitative voices in this conversation have been minimised structurally, or whether qualitative researchers themselves see moves towards openness and transparency as largely irrelevant to their work.

Much of the current scholarship on open qualitative research is polarised and lacking in nuance, largely representing the voices of those feeling strongly in support of or opposed to open research. The voices represented in these discussions also largely possess significant power within academia and are often in senior academic posts or editorial roles (Bennett, 2021). There may also be large differences in how different groups of qualitative researchers respond to and understand open research practices, for example according to demographic, methodological or disciplinary factors.

In this talk, we aim to raise the voices of a diverse range of qualitative researchers in the open research conversation. We present findings from a survey of over 150 qualitative scholars from across the world, exploring their knowledge of, understandings and expectations of various open research practices. These scholars are from a variety of career stages, demographic groups and qualitative approaches. In this talk, we present a mixed-methods analysis, combining qualitative thematic analysis with quantitative demographic analysis to present new insights about how various groups understand open qualitative research. In doing so, we hope to bring nuance to the open science discussion, and better represent the hopes, fears, and considerations of qualitative researchers.

Our hope is that the results of our survey, alongside our analysis of what open research principles and practices could mean to the qualitative research community, will provide a baseline understanding of the field's current position and enable us to move forward collectively. We also provide suggestions for advocacy, and options for making open research practices and policies more inclusive of ethical, rigorous and reflexive qualitative research.

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Exploring the pl(AI)ground for open quali-quanti datasets in autoethnography

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Opening personal datasets for interpretative analysis allows one to navigate the tension between individual experience and autotheory, and to engage with insights from generative pre-trained transformer tools like ChatGPT. An approach that can contribute to raising critical questions about methodology, ethics and the nature of knowledge in our technology-driven era. This case study is rooted in an ongoing process of quali-quanti data reinterpretation, starting from an autoethnographic experiment on digital disengagement and the subsequent dissemination of results.

More concretely, the author shared with a community of peers a visualization of reactions to a one-month self-intervention of living without a smartphone (https://backlogs.net/interventions/may21/plot_retrospective_categories.html), alongside its open dataset source (https://zenodo.org/doi/10.5281/zenodo.6520231). This was followed by an open access academic publication

in a journal dedicated to methodological innovations (https://doi.org/10.1177/20597991231161093). Over several months, the dataset evolved with retrospective annotations on the experience, linking it to broader theories on human-technology interaction. The experience has culminated in a current guided discussion for reinterpretation, assisted by OpenAI's GPT4 model (https://chat.openai.com/share/5942eff1-7b22-44b9-8164-3f43ff1bd84b), initiated with the STS Conference Graz in mind.

An example excerpt from that human-GPT4 interaction: "[...] *The fieldnotes associated with the subcategory 'Full attention to moment / stimulus' offer a compelling glimpse into moments of deliberate disengagement from digital distractions, facilitating deeper connections with the immediate environment, tasks, or social interactions. Here's a summary and interpretation of these moments: (1) Mindful Presence: Many notes describe scenarios where the absence of the smartphone led to a heightened state of mindfulness and presence. For example, sitting at the table after cooking or spending time in a friend's garden allows for full immersion in the current activity or environment. (2) Social Engagement: Instances like talking with a friend without the interruption of a smartphone or waiting to go out, highlight the importance of social connections unmediated by digital devices. These moments foster genuine, undistracted interactions. (3) Nature and Outdoor Settings: Several notes mention being outdoors, in gardens, or at a BBQ, suggesting that natural settings and outdoor activities particularly encourage full attention to the moment. (4) Creative and Reflective Activities: Moments spent writing in a café terrace or contemplating after ordering a book on digital minimalism reflect a conscious choice to engage in activities that require or benefit from undivided attention*".

Facing the known limitations and complexities of sharing open qualitative research in the social sciences and humanities, this experimental approach to self-research and meta-analysis represents a highly situated inquiry mode, with diverse accounts of the ethical, practical and epistemological dimensions of knowledge co-production underpinned by radical openness. It also addresses expectations and limitations regarding reproducibility and the (re)use of empirical knowledge from an (auto)ethnographic perspective, as well as the privacy and ethical considerations when the subjects of study are also the researchers. Additionally, in line with other current trends in participatory research, like co-creation and citizen science, this experience can suscite new inquiries about the viability of novel analytical tools in the era of AI hype.

This open qualitative research case can therefore contribute to critical perspectives, methodological and epistemological discussions, as well as narratives of failure in the development of similar experiences. Furthermore, the author aims to participate in the related workshop to share and discuss learnings from other open qualitative datasets produced and shared within the context of STS research. These datasets range from interview excerpts (https://doi.org/10.5281/zenodo.5543445) to research diaries (https://osf.io/z2jg4/) and handwritten reactions to a photography exhibition (https://doi.org/10.6084/m9.figshare.24851352.v2).

Protocol Sharing for/as Ethnographic Collaboration: Lessons from EMERGE

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Long in the shadow of data sharing, methods sharing is an Open Science practice that is recently gaining attention in its own right. For qualitative research, where reproducibility is typically not a criterion of research quality, sharing detailed methods information helps readers to assess and contextualize research findings as well as adapt methods for reuse in other settings. Today, novel qualitative methods are commonly shared in handbooks or specialized journals, but these publications fail to capture how standard methods are actually used in practice. Among ethnographers, this type of knowledge is more often transmitted informally as expert practices that characterize distinctive approaches to ethnographic work, or more recently and tentatively institutionalized in ethnographic labs, studios, and other spaces for horizontal learning.

One possible source of inspiration for methods sharing in Open Qualitative Research are step-by-step protocols, sets of instructions that encode sequentially ordered procedures for action across a wide range of domains and media. In the life sciences, for instance, protocols were once kept at the laboratory bench in paper format but are increasingly hosted in digital repositories as openly accessible research artifacts. This presentation reports on the background, process, and expected outcomes of an initiative to experiment with protocol sharing at EMERGE (https://www.emergematrix.org), a matrix of five ethnographic research spaces in the United States and Canada. Over the course of the 2023–2024 academic year, each research space prepared a step-by-step protocol for a method of ethnographic collaboration that it has employed successfully. After receiving structured feedback on the protocol from other members, each research space will share their protocol in a public workspace on the methods sharing platform protocols.io. From there, the protocols can continue to be versioned and forked by other users.

In this presentation, we discuss practical, ethical, and epistemological issues that arose over the course of this initiative, including the value of protocols for use at different research stages, tensions between normative ideals of exhaustiveness and evocation, and ways of “hacking” a platform not initially designed for qualitative research. We also describe our process of documenting this initiative in a way that will bear credit for the participating researchers, particularly those at earlier career stages. More broadly, we reflect on whether and, if so, how to advocate for protocol sharing as a routine practice in ethnographic research, without crowding out methodologies that are difficult or impossible to codify.

FAIR Archiving, Safeguarding and Stewarding of potentially identifiable qualitative data: a discussion of a case study

Peter Branney[1], Nikki Moore[1], Gabby Keating[1], Elizabeth Walters[1], Kathryn Francis[2], Carole Binns[1]

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Arguing that data should be 'as open as possible, as closed as necessary', the British Psychological Society's Position Statement on Open Data illustrates - like many other guidelines on research data - researchers responsibility to balance the need to make the most of data with the need to protect those who are potentially identifiable. Nevertheless, the notion of balance can seem to present a dichotomy - to share or not - when qualitative research often involves multiple sets of data with differing sensitivity (an audio file, an original transcript, a deidentified transcript, etc.). While the data archiving arguably harks back to the Sweden's freedom of information Act in 1766, it's contemporary history is located in digital technology and open science. After briefly outlining this history in this presentation, we will turn to explore the combined potential of the FAIR principles of data stewardship - Findable, Accessible, Interoperable, and Reusable - and the notion of 'levels of access' to consider the archiving of a multifaceted mixed qualitative and quantitative study (Keating et al., 2022; see also Branney et al., 2022).

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Towards more reusable qualitative data at your local institution

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Qualitative and context-sensitive data are, as the term(s) suggest, contextual, here-and-now specific and often person-identifying. This raises a number of problems for reuse and multiple uses of these data and creates barriers to transparency and reproducibility of qualitative research. Additionally, researchers and students who work with qualitative research are still not oriented towards data sharing and reuse, not trained to practice open qualitative research, and very often not aware of each other’s challenges and opportunities for support within their local academic institutions.

To tackle these issues, we have started a local QualiFAIR project as a hub-node infrastructure at the University of Oslo in Norway. This university-wide project focuses on making qualitative and context-sensitive data more FAIR (Findable, Accessible, Interoperable, Reusable) as well

as raising awareness about both the need for sharing and reuse of qualitative data as well as its possible limitations.

QualiFAIR is organized into five thematic areas: 1) Ethics and privacy, 2) Copyright, 3) Data management, 4) Infrastructure and 5) Metadata. Each area has responsible groups that drive the work in the hub. Working groups are assembled from academic, technical and administrative staff at the university, comprising of researchers, engineers, librarians and research administrators from a number of disciplines, including anthropology, political science, medicine, linguistics, psychology, music research, theology and education. In this way, QualiFAIR's efforts connect staff across different positions and units within the university, and project's outputs are to serve the community across fields and levels of expertise.

In this talk, we will briefly describe the project aims and structure and share main lessons learned in the process of helping to make qualitative data more FAIR within a local academic institution that can be of use for qualitative researchers as well as open science community. Presented lessons will focus on five main areas: 1) Building a network of diverse actors involved with qualitative research across disciplines and institutional units; 2) Developing skills in qualitative data sharing and reuse through local seminars and workshops; 3) Creating local routines, procedures and concrete instructions for making qualitative data more FAIR; 4) Involving researchers and their own projects as case studies for testing new solutions for qualitative data reuse, and 5) Working with institutional leadership and national stakeholders to move towards new policies and national solutions for qualitative data sharing and reuse. Based on the presented lessons from the project, we will indicate future directions for the efforts focusing on making qualitative data more reusable within local institutions as well as in qualitative research community more broadly.

DIY Academic Archiving: A seedbag for rethinking and remaking open qualitative research

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Inspired by Ursula K. Le Guin's 'carrier bag theory of fiction' (1986), we explore how digital platforms can carry our research data and support and/or hinder the ethical sharing of open data in qualitative research. In doing this we re-orient accounts of open qualitative data away from the unwanted impositions of funding bodies, away from new injunctions in research governance to create open data, and away from heroic tales of new tech possibilities. Instead, we tell another story of qualitative data sharing and reuse by drawing on the undisciplined theory and praxis of community archives, and feminist, queer and decolonial archivists, as offering more promising sites of inspiration for social scientists. In this paper, we recount our own process of creating an online DIY archive of qualitative data, which opened us to DIY archiving's potential to invent new traditions for (public) sociology (Moore et al. 2021). In applying archival theory and practice and learning about the affordances, challenges and opportunities of open-source platforms such as Omeka, we opened up the black box of the archive for ourselves, exposing the archive not as a place or a repository. Rather, the practice

of archiving emerged as a method for engaging with and transforming data, and indeed social science research practice. We take up the Feminist Data Manifest-No's refusal of harmful data regimes (Cifor et al. 2019), understanding DIY Academic Archiving as a form of refusal, a refusal of new modes of data extraction and a refusal of conventional ethics in qualitative research which have traditionally sought to destroy data under the guise of a supposed ethic of 'care' for research participants. Such commitments to an ethic of care-full risk imagine and manifest new intersectional feminist worlds. An ethos of everyday social research and community archiving, as opposed to conventional open data schemes, encourages practices of re(f)usal that enable redirections, creating new possibilities through play with data and platforms. DIY Academic Archiving offers a creative and fertile practice allowing experimentation with data, crucially learning about the changes bound up in archiving and strengthening commitments to take care-full risk with sharing data. We suggest that such practices offer a way of valuing our data, and our research participants, in ways that understand archives as seedbags for 'telling the stuff of living' (Haraway 2016: 138). DIY Academic Archiving then is not so much a refusal of open qualitative data, but rather a commitment to the building of new and just data imaginaries where alternative social worlds are documented.

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A.5: Cultural Contexts of Science-Making: The Fragmentation of the Science(s)-Public(s) Relationship in the Digital Age

Session Chair*:* Martin Jordanov Ivanov, Bulgarian Academy of Sciences, Bulgaria

Session Chair: Yuh-Yuh Li, National Sun Yat-sen University, Taiwan

Session Chair: Svetlomir Zdravkov, Bulgarian Academy of Sciences, Bulgaria

Session Chair: Petya Klimentova, Institute of Philosophy and Sociology, Bulgaria

Attitude of vaccination and belief in science and traditional knowledge

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National Sun Yat-sen University, Taiwan

The study examines how science is embedded in a specific society. That is, the attitude of science is culturally dependent. We focus on the relationship between the attitude of vaccination and belief in knowledge of science above. The study addresse two questions: 1) Is the attitude of vaccination related to knowledge of science? 2) Is the attitude of vaccination related to knowledge of other beliefs (such as trust in some specific social groups)? The data is from the Wellcome Trust's Global Monitor 2018 of public attitudes to science and health. The Wellcome Trust's Global Monitor data offers a unique platform to assess this issue on nationally representative surveys of people aged 15 years or older in over 140 countries with a sample size of 144,000. We answer the questions from global, regional, and national perspectives, respectively. We use regression analysis for the statistical analysis. We create a general model with country fixed-effect for pooled data. The significance of the study is that it contributes to the literature on health communication and shows how knowledge of science and social belief separately influence individual health behavior.

Health Advice and Misleading Experts on Social Media: Cases from the US and Turkey

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Interest in health and wellness advice has surged in popularity with the increasing emphasis on the onus falling on the individual in parallel with neoliberal health policies as well as the proliferation of a plethora of information on the social media globally. While it may seem that health communication via social media platforms such as Youtube pertains to Open Science practices and grants egalitarian access for a majority of the population, it nonetheless carries the potential for disseminating misinformation and sets the stage for false marketing claims and utter pseudoscientific material. Fact and fiction is blurred by fundamentally two obvious expertise mechanisms; one being actual health experts such as medical doctors who nevertheless wish to profit from the popularity of health and wellbeing issues as well as other experts who capitalize on medical advice despite their PhD level credentials in other subjects other than the medical. In this paper, I present the findings from case studies that exemplify the rhetorical and discursive tactics from the two sets of experts previously mentioned,

highlighting some of the striking misinformation contained within each. The case studies will be Dr. Joseph Mercola who was a very influential figure in the spreading of conspiracies such as anti-vacccination and regularly peddles information such as the health hazards of 5G and plans of Big Pharma to the global elites via various social media channels. Dr. Oz, an MD celebrity running in 2022 US Senate election in Pennsylvania as a Republican candidate is well known for recommending non-evidence backed alternative therapies and healing. For the same set and the other set of experts with no medical credentials, I will present a number of local examples from Turkey to understand the similarities and differences in style with their American counterparts. These examples demonstrate the fine line between good and bad health advice that propagate in the name of the openness of educational resources to the general public.

Between the Lines: Exploring Science Narratives in Bulgarian Mass Media through Embedded Topic Modeling

Svetlomir Zdravkov, Martin Jordanov Ivanov, Petya Klimentova

Bulgarian Academy of Sciences, Bulgaria

In the digital age, the portrayal of science undergoes dynamic transformations across various online media platforms, contributing to a fragmented landscape of science images. With their concise formats and emphasis on viral content, social media platforms often present science in bite-sized, sensationalized snippets. These fragments, laden with visual appeal, aim to capture attention but may oversimplify or misrepresent complex scientific concepts. Popular media, particularly in its convergence with science, demonstrates a unique fragmentation. In these spaces, science intertwines with diverse topics such as politics, religion, astrology, mysteries, and more. This amalgamation often blurs the lines between factual reporting and sensationalism, creating a mosaic where science is both an information source and a tool for entertainment.

The science images thus produced across these varied online media types reflect the multifaceted nature of public engagement. New methodological challenges emerge for studying the Public understanding of science. We propose a novel approach to dissecting the representation of science in Bulgarian mass media by employing embedded topic modeling. It uses the professional leveraging tool BERTopic, a very effective natural language processing instrument. The scope of our inquiry is to analyze around 350,000 newspaper articles (between 2018 and 2023) in which the terms "science" and “scientist” are mentioned, aiming to unveil hidden patterns, thematic clusters, and underlying narrative structures. This technique detects groups of articles sharing similar topics and reveals the underlying structure of science-related content in Bulgarian mass media.

The topic modeling creates categories inductively. Hence, it is susceptible to differences in the conversations about science across different articles or periods. It can capture variations in language use, emerging trends, or shifts in focus, providing valuable insights into the evolving nature of science narratives and detecting the fragmented and hybridized nature of science images.

To improve the interpretability of our results, we suggest a two-step methodology. Initially, we will compute the center of each cluster to identify the most exemplary articles within each thematic category. Second, we will apply semiotic analysis by using Greimas's semiotic square, a semiotic theory derived from a structuralist perspective, which offers a powerful lens for qualitative analysis. This research framework allows us to explore the relationships between concepts, identify contradictions, and reveal the implicit meanings embedded within the discourse on science. The semiotic square representation of models would unravel the nuances, contradictions, and underlying ideologies that shape the narrative surrounding science in Bulgarian mainstream media.

Our study will yield valuable insights into the multifaceted ways in which science is portrayed and perceived within the Bulgarian public domain. Combining embedded topic modeling and qualitative analysis offers a comprehensive understanding of the prevalent themes and the discursive strategies employed in the representation of science. Thus, we will address and discuss some prevailing topics within the context of Public understanding of science, such as the decreasing authority of science and scientists in the public discourse, as well as the increasing role that the various audiences are playing in the construction of the image of science/scientists. By unraveling hidden patterns and exploring the intricate relationships within the discourse, we aim to contribute to a nuanced understanding of how science is framed and interpreted in the Bulgarian public discourse. Ultimately, this study will inform media practitioners, policymakers, and the public, fostering a more accurate and productive dialogue around scientific topics.

Exploring the Impact of Open Science and Cognitive Factors on Belief in Conspiracy Theories: Insights from European Countries

Ahmet Suerdem[1], Svetlomir Zdravkov[2], Martin Jordanov Ivanov[2]

[1]Istanbul Bilgi University, Turkiye; [2]Bulgarian Academy of Sciences, Bulgaria

Open science has the potential to enhance trust in the epistemic authority of science through transparent and comprehensive information sharing. However, caution is necessary as Lewandowsky (2022) cautions that open science can inadvertently fuel conflicts, misinformation, and politically motivated science denial. The impact of open science on conspiracy theories is multifaceted; while it can serve as a tool to counter the spread of conspiracy theories, it can also inadvertently propagate pseudo-science. The COVID-19 pandemic has demonstrated the grave consequences of pseudo-scientific theories targeting specific research, underscoring the need for open science to proactively address these challenges in a constructive manner while addressing the challenges posed by conspiracy theorists who challenge the authority of science.

This presentation explores the impact of cognitive and evaluative aspects of science in everyday life on belief in conspiracy theories. Media exposure enhances science literacy but can also increase skepticism towards scientific knowledge credibility. Engagement with science can foster critical thinking, yet conspiracy beliefs may spur political engagement. The relationship between deference to scientific authority and conspiracy theories is nuanced, highlighting power dynamics. Values, ethical concerns, scientific optimism, and ideology

further shape beliefs. Examining the interplay of these factors and socio-demographics, we explore belief in conspiracy theories and science denial across European countries.

Data: Special Eurobarometer 516 European citizens' knowledge and attitudes towards science and technology. The surveys in this dataset provides an insight into topics related to perceptions of science and technology, including the abovementioned ones.

Variables: Dependent variables (proxy for conspiracy theories) "The cure for cancer exists but is hidden from the public by commercial interests" ; "Viruses have been produced in government laboratories to control our freedom" and "Climate change is for the most part caused by natural cycles rather than human activities". Independent variables are selected from the items representing the topics of concern.

Analysis: We have conducted regression analyses to observe the relations between the dependent and independent analysis. To observe how different European countries group in terms of their similarity or dissimilarity on different items about topics of concern, we used cluster analysis.

Results suggest that belief in conspiracy theories decrease as media interest to scientific discoveries. On the other hand, the mean of this interest is also important: using blogs for information has positive effect. Items related to deference to science have positive coefficients with conspiracy items. Regarding the cluster analysis, although they change according to topics, in general countries are classified into three groups: North and West Europe, Mediterranean and East and Central Europe.

The findings from this study highlight the importance of media interest and the role of blogs in shaping belief in conspiracy theories, suggesting that the dissemination of scientific information through credible sources can potentially mitigate conspiracy beliefs. Additionally, the identified clusters of countries provide insights into regional variations in belief systems and the potential influence of cultural and socio-political factors on the acceptance or rejection of conspiracy theories.

A.6: Panel Discussion: Pros and cons of conceptualizing openness as a moral economy of science

Session Chair: Thomas König, FORWIT, Austria

Session Chair: Magdalena Wicher, Institute for Advanced Studies Vienna (IHS), Austria

Session Chair: Bart Penders, RWTH Aachen University, Germany; Maastricht University, The Netherlands

Session Chair: Jonathan LoTempio, George Washington University, USA

The session organizers follow up on the idea of framing “openness” as an emerging moral economy in science. The first iteration of this idea has been published as a conference paper with the proceedings of STS Graz 2023 (Koenig et al 2023). There, we trace a line from the mostly implicit mentioning of openness in the Mertonian norms to current policies and mandates from governments and funders that make openness explicit - mostly under the label of Open Science. We suggest that the combination of incremental and radical changes to scientific practices, together with said mandates and policy instruments, have lead to an environment where openness abounds.

One advantage of using “openness” instead of Open Science is because the former term allows for more distance when it comes to analyzing the contemporary scientific practices, science policies, and semantics of science that revolve around the gravitational center that is commonly put as Open Science. We invite prospective discussants to read our target paper and consider it as the focus for abstracts or papers related to openness as a moral economy of science. Specifically, we wish for perspective discussants to consider this key passage from our paper:

“Openness has transitioned from a facet of consideration within this sedimented set of norms to a concept which stands by itself (i.e., a moral economy in the making). Why? We attribute the answer to this question to three main factors:

Over the course of the past seven decades, the societal context in which science is embedded has entirely changed.

As a related consequence, scientific practices have been developing in numerous niches and differentiated (or, fractalized) into many efforts, research fields, subdisciplines.

The modality of doing science has fundamentally changed due to new media and communication formats, i.e., “digitalization”.”

Stream B: Digitalization of Society, Society and AI

B.1: The Automated Public

Session Chair: Cassy Johanna Maria Elisabeth Juhasz, Maastricht University, The Netherlands

Accountability problems, democratic deficits and use of AI systems for high-stake decisions

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The use of AI systems in the law enforcement sector is nothing new. References to intelligence-led policing and/or predictive policing are abundant, as the vast array of literature demonstrates (Kaufmann, Egbert & Lesse, 2019; Meijer & Wessels, 2019; Egbert, 2018). However, most of this work focuses on discursive aspects of its implementation or on the end-users' practices and justification claims (Lorenz, Meijer, & Schuppan, 2021; Sandhu & Fussey, 2021; Vepřek et al., 2020), with less emphasis on the socio-technical and procedural aspects of these systems' development. On the other hand, analyses from critical data studies and Science and Technology studies (STS) centre around the limitations of approaching black-box systems that lack transparency and explainability as a matter of proposing methods to account for biases and enhance fairness (Selbst et al., 2019). This paper builds on these works and suggests a 2-step analytical exercise. In a first moment, it extends the ethical analysis to the whole life cycle of AI systems, focusing on the accountability dimension. By introducing the notion of located accountability (Suchman, 2002), the goal is to identify the different actors involved in the development process, as well as to scrutinise their moral responsibility. Thus, it addresses problems such as those known as the many hands and the many eyes (Cooper et al., 2022) typical of the software industry and contributes to break into the compartmentalisation that developing AI systems entails (Widder & Nafus, 2023). In a second movement, this presentation offers accountability as the ethical value missing in the debate around AI governance and exemplifies it by looking into police work practices. In addition to artefacts proposed by the forthcoming EU AI Act such as impacts on fundamental rights assessments, data protection analysis and conformity assessment, and the use of user interface tools, this work introduces the notion of distributed accountability. This opens the opportunity for explanation and justification of every decision or action taken in the AI life cycle and complements existing procedures for contest and redress in law enforcement agencies (Bennett Moses & Chan, 2018). This paper concludes studying the potential consequences of such scenario and the effects this could have in the democratic control that citizens can exercise over these authorities.

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Methods from the Past: Revisiting Cross-Domain Impact Assessment Case Studies to Advise the AI Act

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In December 2023, the EU legislative bodies reached a provisionalagreement on the AI Act to regulate AI-driven products, services, and systems in the EU. Employing a risk-based approach, the AI Actshould establish governance mechanisms to implement safeguards for the lawful and trustworthy deployment of high-risk AI systems. One of these mechanisms is a compulsory conformity assessment before deploying high-risk systems (Mökander et al., 2022). These conformity assessments include procedural steps such as requiring technical documentation, automatic logging, and ensuring that training, validation, and test datasets meet quality criteria (Thelisson & Verma, 2023). Notably, the conformity assessment should include a fundamental rights impact assessment, a focal point for our analysis.

Apart from the requirements listed in the commission's and the parliament's AI Act proposals, how the assessment will be conducted is not outlined. While some proposals exist for implementing such assessments, there is a general lack of orientation and evidence-based proposals in terms of what AI conformity as- sessments should look like. In this paper, we argue that valuable lessons can be learned from impact assessments in other domains. We focus on Data Protection Impact Assessments (DPIAs) and En- vironmental Impact Assessments (EIAs). DPIAs were successfully introduced by the General Data Protection Regulation (GDPR). EIAs have been implemented in the EU for 30 years and are considered to have improved awareness of environment-related issues in project designs.

We will systematically survey case studies from these two reg- ulatory tools to produce proposals for the scope, implementation, and methodology of AI conformity and fundamental rights risk assessments. Firstly, we will examine cases in which EIAs have been applied. Approximately 3,000 EIAs are conducted annually in Germany alone (Führ et al., 2023) – a vast pool for us to learn from diverse applications. Secondly, we will examine DPIA case studies following the GDPR, which has been in effect in the EU since 2018. We will outline the differences and similarities among EIAs, DPIAs, and AI conformity and fundamental rights assessments.

Impact assessments are boundary objects (Bowker & Star, 1999), i.e., artifacts that comprise valuable information for different communities of practice and, therefore, need to be adaptable to the different needs while maintaining a certain degree of stability. We will use the boundary object concept as an analytical lens to categorize similarities in impact assessment objectives and their manifestations across corresponding domains. We will conduct a multi-case study analysis using inductive thematic analysis to identify and explore themes and patterns across these selected cases. After examining these case studies, we will pinpoint crucial factors and dimensions influencing challenges and learnings.

We will propose policy and implementation recommendations for conformity assessments and fundamental rights impact assessments within the AI Act using these insights and the identified key dimensions. We argue that drawing lessons from past impact assessment regulations can contribute to formulating an adequate legal framework for AI products in the EU.

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Understandable algorithms – How can governments explain algorithmic processes to citizens in an understandable way?

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Governments are increasingly using digital technology in the form of algorithms in decision-making. Algorithm use by the government can yield benefits: algorithms have the potential to make decision-making cheaper, faster, more objective, and more predictable. However, the use of algorithms also raises issues; Among other things, about guaranteeing privacy and the transparency and traceability of the way in which decisions are made. Algorithms make decisions with consequences for citizens. It is problematic if the content of an algorithm are not or difficult to access for citizens.

The Dutch government therefore wants to provide insight into which algorithms it uses and for what purpose. It wants to do this by mapping all the automated selection processes used by the government and putting them in a register. Governments are being called upon, currently on a voluntary basis, to register their algorithms. A year and a half ago, MPs submitted a motion to make the algorithm register mandatory. The government wants to comply with this, but does not see such an obligation taking effect until 2025 at the earliest.

The idea behind a transparent government is that if government organizations show citizens (and other stakeholders) what decisions are made, how they are made and what the results are, people will automatically have more trust in the government (Grimmelikhuijsen, 2012). Transparency is therefore used in practice as a standard tool to increase trust. (Grimmelikhuijsen, 2013).

In the context of algorithm transparency, the Ministry of Justice and Security distinguishes between '*technical transparency*' and '*explainability*'.

Technical transparency refers to the inclusion of all technical data of an algorithm, right down to the source code. *Explainability* refers to explaining how the algorithm works to the interested

citizen. In addition, there is the issue of the target group. Which citizen needs which explanation at which stage of the decision-making process?

The aim of our project is to get a grip on meaningful explanations of algorithms. In our research, we are looking for methods for professionals to be able to provide contextual explanations about the algorithm and the context in which the algorithm was used.

That is why we would like to develop a method with which we can facilitate a conversation within government agencies about vision and interpretation of transparency towards citizens. We want to develop a method in which, based on a dialogue with a diverse group of internal stakeholders within an organization, we discuss the process in which the algorithms are used to develop actions for making the algorithmic process understandable to citizens. In the method, it is important to make a distinction between different internal and external target groups. It also seems important to make a distinction in the degree of digital literacy of the target groups; you explain an algorithm differently to digitally literate citizens than to digitally illiterate citizens. In addition, it is important to make a distinction between the degree of impact of the algorithm on daily life and the degree of politicization of the policy area (de Bruijn et al 2022). Algorithms with a socio-economic impact therefore seem particularly interesting to explore. .

We ran a first pilot at the Dutch Tax and Customs Administration in conversation with stakeholders involved in creation and maintenance of a specific algorithm (a rent allowance). It turned out that the method still needs some more structure / standardization. In addition to the Allowances Department, we are looking for three other government services so that we can compare and formulate guidelines for developers and policy officers. In the next phase we will be able to update our method and test it.

Exploring Stakeholders' Perspectives on User Involvement in Designing Digital Public Services for Older Adults

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The number of digital public services has increased rapidly during the last decade to serve citizens. Digital services, covering a wide set of services from health to taxation to social care, hold the promise to increase well-being and inclusion. However, not everyone has the same opportunities to utilize these services. Therefore, attention must be paid to potentially vulnerable groups, including older adults. Drawing from the Access Rainbow Model, we investigate user involvement in designing digital public services for and with older adults from the perspectives of various Finnish stakeholders. By combining these perspectives, this research offers new information on the principles to enhance access through user involvement in digital public services. First, (1) we ask what the typical challenges for older adults are accessing digital public services according to the stakeholders. Second, (2) we explore how stakeholders view the involvement of older adults in designing digital public services. Our research data consists of 20 semi-structured interviews conducted in 2021 among Finnish stakeholders from local-, regional-, and state-level public administrations and non-governmental organizations, forming a pivotal group of stakeholders to the acquisition and

design of digital public services. Based on our inductive thematic analysis, we argue that despite recognizing the heterogeneity among older adults, stereotypical assumptions continue to influence the design process. The results of this study indicate that the standard of 'one size fits most' was seen as the most reachable outcome to meet the needs of various users at present. As no one has presently claimed the responsibility for involving users in the design process, user involvement was viewed as a valuable yet currently unimplemented practice. We also found that more collaboration, support, and continued involvement of stakeholders are needed throughout the acquisition, design, and implementation of digital services. Additionally, results call more attention to how decisions are made at the governance level to ensure access to digital public services for older people. Designing digital services that accommodate the different needs of various users and involve stakeholders throughout the design process remains challenging. To achieve the ultimate goal of universal access, digital inclusion should be considered comprehensively, taking into account the socio-technical aspect, digital literacy, and technical implementation. Reflecting this, it is necessary to shift the focus from merely attributing difficulties to the users or the lack of their skills, as the responsibility lies also on those who acquire and design these services, emphasizing the significance of user involvement and user-friendly design. In the future, more research is needed to evaluate the outcomes of collaborative design projects and their implications on older adults' well-being and digital inclusion.

B.2: “Code is Law” Revisited. STS Perspectives on the Digitization of Law and the Legal Sector

Session Chair: Nikolaus Poechhacker, University of Klagenfurt, Austria

Session Chair: Lukas Daniel Klausner, St. Pölten University of Applied Sciences, Austria

Session Chair: Elisabeth Paar, Universtiy of Vienna, Austria

On the Relationship of Code and Law

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At first glance, the functioning of “code” and “law” might in some respects be similar: both are rules-based, yet complex and thus somewhat obscure to the people subject to them, and with both their application is perceived as inescapable when wanting to be part of (an increasingly digital) society. This is what prompted Lessig to famously equate “code” and “law”. Only, when looking closer, the equation does not add up. Despite the continuing importance of the syllogism for legal argumentation, the interpretation and application of legal norms requires more than applying (formal) logic, as legal norms, by using natural language to express normative claims are frequently vague, ambiguous, and context dependent. Moreover, law, in contrast to code, presupposes a possibility to disobey without changing the rule. Allowing for breaches is, thus, not a bug, but a feature of (legal) normativity, something Möllers called the “possibility of norms”. And it is this freedom of choice for the “bad man” (Holmes) not to adhere to the law, which distinguishes it from code. Thus, law is not code, and code is not law.

Nonetheless, in the digital era, both concepts are closely entangled. Thus, this paper will look into the relationship between code and law from two angles: The first angle will be law as something to be “regulated” by code. Thence, we will ask the question as to where and how code does, could, or might change the way the law is made, interpreted or executed. The second angle and the core of the paper will look at the opposite direction, namely as to how law “regulates” (and/or “should regulate”) code. The starting point is again the observation that the application/implementation of code is not at the disposal of the individual (Bezemek). However, code increasingly controls everyday life and “decisions” made by code potentially affect individual rights, discriminate for inappropriate reasons and are neither comprehensible nor controllable. As such, there are parallels to 19th century absolutism, where monarchical power was basically unrestricted.

This prompts us to pose the question of whether the power of code can and should be contained in similar ways as the achievements of modern democracies under the rule of law contained absolutist powers. In other words, is there a case to be made for a freedom vis-à-vis code, much like the freedom vis-à-vis the state, which modern fundamental rights catalogues provide? When acknowledging the possibility of fundamental rights violations by systems of code, it also prompts the question of whether those who provide such systems should be bound by fundamental rights in much the same way as the three branches of government (Montesquieu) are. If the answer to one of those questions is in the affirmative,

how can it be ensured that individuals can defend themselves against the external determination by code? Is there a case to be made for participatory involvement vis-à-vis code, similar to the claim for democratic co-determination?

Codes of the lawmakers: Some narratives German members of parliament follow when regulating digital innovation

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One facet of the process of sociotechnical co-production are national legislative regulations. As many authors have shown, every new law is the outcome of an intricate, socially driven process. Using Lessig's idiom code is law as my main conceptual lense, I want to contribute to this panel not by investigating code that acts as law, but by scrutinising the law-making process of laws concerned with code/digital technologies. Specifically, I want to identify some prevalent narratives about the relationship between digital technologies and state regulation put forward by politicians when they reason and justify new legislation. The material I will use consists of a preselected corpus of approximately 200 parliamentary speeches delivered at the Bundestag, which all explicitly engage with various digital technologies (from broader discussions about e-government or big data to very niche applications like automated water locks or the digitisation of historical books).

Oftentimes erroneously perceived as an arena for politicians to finally conclude a political debate, parliamentary addresses in Germany serve a different purpose. They do something just as important from a democratic standpoint, as they are primarily used as a space to make public the assumptions, beliefs, expectations and imaginations behind new laws. By contextualising new laws, putting them in larger contexts and weaving them into wider narratives about society and the digital, politicians implicitly and explicitly convey via the talks their imaginations of the future the debated law will enable or prevent. Now Lessig was more or less exclusively concerned with the USA and its constitution, but had he considered the German political landscape instead, the Bundestag had been one of the places where he would have wished to see more heated discussions about what values state regulation can and should (not) impose on 'the Net' and its architectures, that is, its code.

I am interested to see how these imaginations affect what has been described as the repertoire of the possible, for which I consider two dimensions. Firstly, it is about the repertoire of problems that digital technology purportedly can or cannot solve, or what's generally rendered im/-possible through technology/code. Secondly, it is about the repertoire of what is rendered im-/possible or sensible to regulate in digital contexts. Taken together, I am trying to generate some insights on German lawmakers' ideas of how politics should act and regulate in a world that increasingly runs on code.

In my concluding remarks, I will argue that this look into the protocols of parliamentary speeches starting from Lessig's publication in 1999 up until 2021 shows that the debate of how to best regulate digital technologies is in some ways astonishingly stagnant and very changing in others. My key point will thus be that politics in Germany is still grappling immensely with the idea to regulate a space that it still often imagines as chaotic and inherently resistant to

regulation, although the narratives do have changed somewhat in the recent years in a direction that Lessig implied 25 years ago. While the members of parliament not surprisingly aim to regulate such processes deemed disorderly or even harmful, they do struggle to tackle these issues on the level of digital architectures. This struggle is closely tied to the observation that the way politicians in Germany understand digital technologies and especially the internet as a social ecosystem has in fact evolved surprisingly close to Lessig's apprehensions about law prioritising commercial interests over those of common good.

A New Empiricism in Law? Predicting Court Decisions as a Challenge to the Is–Ought Distinction in Legal Theory and Practice

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Scholars increasingly use statistics, machine learning (ML) and correlative methods in general to predict the outcome of court cases ("judicial prediction"). Some prominent examples include attempts to predict decisions by the US Supreme Court (Guimerà and Salas-Pardo 2011; Katz et al. 2017) or the European Court of Human Rights (Medvedeva et al. 2020). Some of these studies rely on actor models to predict the behaviour of judges in relation to other judges, others employ natural language processing models trained on past jurisprudence of the court in question. What these approaches to "computational law" (Hildebrandt 2020) all have in common is that they project empirically observable past events onto a normative assessment of the future. Predicting court decisions represents a new and automated form of legal realism introduced into the system via (seemingly) objective methods of ML and statistical analysis and challenges the traditional understanding of judges and the judicial process as a social institution.

This development therefore raises a number of questions: How does this "technological turn" impact legal reasoning? What if the courts themselves employed such methods? Can tensions between the normativity of the law and the use of empirical assessments be resolved? And how can we think about this from a socio-legal perspective?

Creating legal norms goes beyond extrapolating judgements from previously decided cases. Crucially, it requires the court to exercise authority in selecting one from multiple legally sound outcomes. It needs to take into account the characteristics of each individual case and (at least in general) be open to reasoning from first principles. Therefore, using statistical, ML and similar approaches in legal reasoning raises fundamental questions about the legitimacy of such methods to make law.

In our article, we hence first analyse some of the attempts at predicting legal decisions, aiming to carve out epistemic similarities in their approaches to computational law. Here, we build on insights into the interplay of the normative effects of both technology and the law (cf. Hildebrandt 2008 or Radder 2009). We then contextualise our findings in relation to the distinction between "is" (fact) and "ought" (norm), using theoretical frameworks provided by Hume, Kelsen and Weber. Finally, we explore whether statistical and ML approaches to computational law lead to a discursive closure (cf. Habermas) by closing legal reasoning off

from new arguments and interpretations. This, we argue, would put our current democratic-institutional understanding of law into question.

Digitalisation Beyond the Bench: Exploring Denmark's Judicial Modernisation through the Criminal and Probate Programme

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The global shift towards digital transformation in the public sector has pushed the Danish public sector to the forefront of government digitalization efforts (Schou and Hjelholt, 2018). While significant progress has been made in many areas within the Danish state, the Danish court system has lagged behind, as shown in the report of the Council of Nordic Ministers "Digitalisation of the Courts" from 2022 (Waage and Motzfeldt, 2022). The "Criminal and Probate Programme" initiated by the National Council of the Judiciary of Denmark (the Danish Court Administration) aims to address this lag through six releases in the period 2022-2026. This will include the innovative "Criminal Case Divider", a digital solution designed to optimise and modernise courthouse proceedings and administration by sharing data both vertically and horizontally between state institutions, marking a pivotal step towards interoperability within the justice system.

This paper explores the socio-technical landscape of the digitisation of the justice system by examining the development, implementation, and integration of the Criminal Case Divider technology within the Danish courts. Through document analysis, expert interviews, and fieldwork observations in different courthouses and the Danish Courthouse Agency in the spring of 2024, it critically examines how the digitalisation of the legal landscape occurs and asks whether the pursuit of modernisation prioritises ethical considerations such as algorithmic bias, transparency, and accountability. By drawing on ethnographic empirical material, the paper contributes to Science and Technology Studies (STS) by offering insights into the mechanisms of governance within Denmark's vast legal apparatus.

From the concept of 'code is law' (Lessig, 1999), the project embellishes the notion to 'code is court', asking how and what digitalisation imposes on the everyday working practices of the court. It argues that the emergence of digital and automated systems redefines the structure and practice of the justice system while reshaping data sharing dynamics among State institutions. Interoperable digital systems challenge existing structures and cooperation dynamics, redefining the roles of justice system actors. Drawing on sociotechnical imaginaries (Jasanoff and Kim, 2009), this paper investigates implicit understandings and embedded relationships. It scrutinizes collectively imagined social orders within the digitalization of Danish courts, emphasizing interoperability's transformative potential. As such, this research underlines the importance of understanding the impact of digitalisation on the administration of justice.

In summation, this paper highlights the multifaceted implications of digitalization in Danish courts, emphasizing the need for a holistic understanding of its sociotechnical dynamics. By unravelling interoperable dynamics and sociotechnical imaginaries, it offers valuable insights into the transformative journey of the Danish justice system from an STS perspective.

B.3: (Responsible) Standardisation of Disruptive Digital Technologies

Session Chair: Kai Jakobs, RWTH Aachen University, Germany

It's not only about technology! Educating future standards professionals

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Today, technical standards in the digital domain are developed mostly by engineers and computer scientists, typically employed by large manufacturers. These standards are primarily guided by technical expertise and economic interests, with societal considerations commonly neglected by technical working groups (WGs). This oversight is particularly noticeable in the standardization of disruptive technologies like Artificial Intelligence (AI), which is increasingly integrated into products and services across various application domains.

To address this gap, scholars advocate for broader stakeholder involvement, including citizens, NGOs, unions, (local) administrations, as well as professionals such as lawyers, sociologists, and philosophers (Fomin, 2023; Jakobs, 2020; Williams & Edge, 1996). The recently approved H2020 project Edu4Standards.eu ("Education for standardization in the EU") aims to address the shortage of standardization experts in the EU. It focuses on developing an Innovative Teaching Concept on Standardization (ITCoS) and implementing teaching pilots to demonstrate its effectiveness in meeting the EU's standardization needs. The primary goal of ITCoS is to establish a "global reference point" for educational institutions seeking to deliver standardization education.

In academia, the concept of competences establishes a teleological link between education and the job market: to have the competence to perform the job successfully, one must possess a range of relevant skills and knowledge (Roberts, 1997; Blanka et al., 2022, p. 10). Orientation of educational programs to expected skills, or competences, has become an established practice in Europe (Biggs, 2011; Finster & Robra-Bissantz, 2020) and globally. One popular model for competence-based curricula developments is the "backward design" model, which emphasizes learning objectives (LOs). It defines three stages in curriculum development: identification of learning objectives, identifying required knowledge for the assessment of learning, and devising learning activities (G. Wiggins & McTighe, 2010; G. P. Wiggins & McTighe, 2012).

Edu4Standards.eu will cater to all three stages of curriculum development, with ITCoS development representing the first stage, answering the question of "what do we ultimately want students to know, understand, or be able to do?" (G. P. Wiggins & McTighe, 2012). The primary aim of ITCoS development is to identify factual knowledge and skills (Schwieger & Ladwig, 2021, p. 170) relevant to a broad and heterogenous scope of standardization, encompassing different types of standards, arenas of standardization, and ways to engage and influence the process (Fomin, 2023).

The innovative (and challenging) aspects of ITCoS development are established by the mutual dependencies between three knowledge and practice domains: 1) the types of standards and standardization processes, 2) the heterogenous forms of delivering educational programs, and 3) the versatile regulatory mandates and expectations relevant to education about standards and standardization. These include covering technical and societal aspects of standardization (multidisciplinary orientation), implementing human-centric standardization practices, embedding European core values in standards-development processes, fostering the development of green and digital skills, promoting gender-responsive standardization, among others.

Ethics represents another dimension to consider in this context (Gordon & Fomin, 2019). The European Commission (EC) has long recognized the importance of ethical issues surrounding technology and markets, as is evident from numerous policy documents (European Commission, 2021). EC's recent call for boosting standardization education to address the shortage of professionals explicitly refers to ethics as a key element in standardization-tailored education. This makes it imperative to determine the place of ethics in ITCoS and the extent to which standardization professionals require ethical competencies to address the emerging challenges.

Bringing standardization back into the platform discourse

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Standardization relevant to digital transformation, increasingly, take the form of digital platforms. Digital platforms and their associated ecosystem are powerful "innovation engines" for the transformation of private life, the public sector and business organisations. Digital platforms represent a new sociotechnical phenomenon opening up new modes of value creation, service delivery and third-party contributors' role.

The literature on digital platforms is predominately found in the two fields of organisation/ management/ strategy/ economy (e.g. Gawer et al 2009) and information technology/ information systems (e.g. Constantinides et al 2018).

However, as Lietveldt and Schilling (2021, p. 1530) note, "[m]any articles published today on 'platform competition' would have been termed 'standards battles' in the 1990s'', which is to say that the booming platform literature has largely overlooked the rich, sociotechnical literature on standardization.

Our aim is to revitalize the discourse on platforms by drawing on insights on standardisation from STS. Specifically, the process of standardisation necessary for establishment and cultivation of digital platforms (such as APIs, application program interfaces and SDKs, software development kits) is seldom if ever thematised as a process of standardisation (exceptions include Pujadas et al. 2024).

We study the emerging phenomenon of domain- or industry-wide digital platforms and their ecosystems consisting of a large numbers of software systems running on top of the platforms which are developed mostly by large software companies and used by large industrial

organizations. We will focus on two issues: how a focus on digital platforms may represent a powerful strategy for combining the development of a stable standard (i.e. the platform's APIs) with rapid innovations, and how the control and ownership of the platform raises challenges for standards governance.

We will explore these issues based on an analysis of two ongoing efforts. Our first case is the maritime/shipping industry. The EU emission trading system (ETS) is now in effect. ETS is a 'cap and trade' system: ship owners have to pay emission tax to national authorities, report emissions to local authorities (as well as national authorities and international bodies. The new reporting demands cause significant changes to the existing patterns of data use and reporting, and we see already a significant number of industrial initiatives on data-centered innovations. Many of these initiatives aim at developing digital platforms as hubs in larger ecosystems and infrastructures facilitating the required verification and reporting of emissions data as well as assisting the industry in reducing their greenhouse gas emissions.

Our second case is an industrial consortium with about 100 members from the whole ecosystem of actors within upstream oil and gas i.e. oil operators, oil service and technology vendors. The ambition is to work out a standard in the form of a specified model of the subsurface domain (geology, rock types, wells, equipment) which acts as a platform with an API offering services to access, share, analyse and present geo-data.

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Between market-creation and techno-ethical entanglements – Insights from AI standardisation processes in Germany

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In the last decades, the process of standard setting has emerged as a pivotal mechanism in the realm of technology governance within the European digital economy. It is transitioning from being a specific concern of industrial self-regulation to a domain characterized by active policy-making and political regulation in which collaboration and competition among independent entities becomes increasingly significant (von Ingersleben-Seip 2023). In context of the recent AI Act, the EU actively uses the standardisation ecosystem to develop and establish harmonized technical standards to specify the regulative obligations for AI systems such as, for instance, human oversight, accountability, or data governance (Vries, Kanevskaia,

and Jager 2023). Using technical standards for their regulative means, the EU is trying to encompass both: market creation through better legal certainty and regulatory oversight through clear product safety requirements and risk management.

In doing so, EU regulators resort to standards as a means of consolidating expert knowledge on an emerging technology transferring questions of technical specificities outside of the realm of the AI Act (Laux, Wachter, and Mittelstadt 2023). Companies, on the other side, might participate in standardisation efforts to influence the design of a standard in their own interest. They engage in a dynamic interplay of competition and cooperation as they strive to advance their multifaceted business and political objectives. In many ways, standardization serves then as a locus of ‚real rule-making,' (Veale and Borgesius 2021:105) having a crucial role for governmental bodies, corporations, and other actors in shaping the design and use of digital technologies. Due to their particular form, technical standards, invariably encapsulate commercial interests, political inclinations, or moral assessments (Lampland and Star 2009). This inherent characteristic endows standards with significant regulatory influence but also political power. This becomes especially apparent in the standardisation of AI systems. Because of their complexity, ubiquity and possible adaption in ethically sensible domains, their standardisation is struggling with the increasing entanglement between normative considerations, political decisions, and technical details in the construction of AI systems (Laux et al. 2023).

This paper discusses then the interplay between different corporate strategies, civil society positions and respective regulatory efforts in using technical standards for the regulation of AI systems in Germany. It is then interested in the 'design mode' of standards (Fried and Glaa 2020:8) and its connection to the forms of regulatory design and socio-technical imaginaries in the context of EU digital policy-making. Thereby, it builds upon qualitative interviews with companies, civil society actors, governmental representatives, and standardisation organisations as well as a document analysis of different standardisation draft and position papers from civil society, companies, and science. Standardisation is seen as an intrinsic part of the co-production of AI systems by shaping and constraining their technological affordances (ten Oever 2021). Following recent debates in STS-scholarship, I try to think about these processes as forms of problematisations (Laurent 2022:11). This is the case, on the one hand, with regards to questions of democratic legitimacy and the political interventions of the EU in their aims of market-creation. On the other hand, it is about recurring distinctions between technical and political specifications of AI standards and the apparent failure to actively involve civil society actors due to their mere normative expertise.

Disruptive Regulatory Developments in Pursuit of a Responsible European Standardisation System?

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In 2022, the European Commission published the Standardisation Strategy which explicitly called for improving upon the engagement with civil society and users in the European Standardisation System. Literature indicates that an unrefined approach to boosting non-technical representation in technical standardisation, for example from the users need not necessarily be beneficial.[1] At the same time, academic scholarship has also brought to attention the significance of adequate representation and involvement of societal stakeholders in standards development for the purposes of augmenting 'the legitimacy, the acceptability and the effectiveness of standardisation.'[2] This contribution takes note of the key moments and developments during the Strategy's preparatory phase and since its publication. The contribution expects that a focus on this time period may offer an 'epistemic window'[3] into the legal and regulatory issues, dynamics and responses that undergird the recent regulatory pressure to strive for a substantial strengthening of the involvement of the civil society experts even as technical experts and economic interests are adapting to a shift in the European standardisation landscape, especially within the European Standardisation Organisations (ESO). In particular, this study shall also focus on the changes in internal rules and decision making procedures within one of the ESOs, the European Telecommunications Standards Institute (ETSI) which drew significant scrutiny over its perception of being industry-driven in the wake of the Strategy. The study shall rely on desk research and empirical qualitative research, to widen our understanding of the implications of regulatory episodes on internal decision making within ESOs, and shall aim to identify key lessons for policy practitioners and standards professionals.

[1] See Jakobs, Kai, Rob Procter, and Robin Williams. 1998. "User participation in Standards Setting—the Panacea?" *StandardView* 6(2): 85–89. https://doi.org/10.1145/301688.301693

[2] Eliantonio, Mariolina and Annalisa Volpato. 2022. The European System of Harmonised Standards: Legal Opinion for ECOS.

[3] de Vaujany, François-Xavier, Vladislav V. Fomin, Stefan Haefliger, and Kalle Lyytinen. 2018. "Rules, Practices, and Information Technology: A Trifecta of Organizational Regulation." *Information Systems Research* 29(3): 755-773. https://doi.org/10.1287/isre.2017.0771

B.4: AI and Society: Trust, fairness and transparency

Session Chair: Bernhard Wieser, Graz University of Technology, Austria

Surrogating Life: how Digital Extractions of Living in AR Repurpose Embodiment Forms

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Humans' will to immortality is civilizations driving force; historically technoscientific projects have been associated with the mastery over nature and death (Cave, 2020). Today, some transhumanists aspire to realize forms of immortality through a speculative procedure referred to as mind uploading – this refers to an extraction of cognition to non-biological substrates (Gaitan, 2019). Recent advances in generative AIs and Augmented Reality (AR) marks a new chapter in the "technosciences of death"[1], where conceptions of life, death, and their material anchorage shift. In this vein, digital extractions of the living are opening horizons for the gestation of novel embodiment forms as lively extensions of dead and dying bodies.

Some years ago, Jane Bennett noted the following in her classical study, *Vibrant Matter*: "the more we learn about mater, the more forces we discover in it, so that the empty conception of a dead extension completely disappears" (Bennett 2010: 92-93). Digital extractions of living have been rapidly proliferating in the contemporary technoscape. This can be observed, for example, through AI chatbots such as Replika, where the founder and some users create living actors/figures of the dead. It can also be seen through sociotechnical imaginaries of future haptic technologies where a desire for recording and storing personalized touches (e.g. a hug, kiss, or stroke) to be sent and replayed has surfaced – and if realized would afford people to stay 'in touch' with loved ones who have lost their corporeal presence. At the forefront of these moves, deepfake immortality (Burema 2023) seems to offer previously inconceivable pathways to reinvent bodies, lives and practices of death and dying. Consequentially, one may assume that repurposing vitality by means of digital extraction and deepfakes becomes a way of surrogating life. Within these novel technoscpaes, defined by digitization, unprecedented conceptions of death and dying and possibly their overcoming precisely by means of AR emerge. The human body, long thought to be the site of our being (Merleau-Ponty [1945] 2012) but also of our dying, is redrawn while opening new ways to conceive immortality but also materiality.

Whereas biomedical advances have indeed crafted conceptions of immortality and possibilities of the body's being reengineered (Lafontaine 2009: 298; Landecker 2007), the current expansions of generative AI and some forms of AR associated with such projects invite to rethink how living is digitally extracted and whether such developments lead to potential digital enclosures. Due to these transformations, forms of life surrogacy but also of new embodiment emerge and need to be critically examined. The aim of our presentation is precisely to address these societal challenges and inquire into how AR projects related to conceptions of immortality sociologically translate corporeal surrogacy and its associated forms of embodiment.

[1] Panel 263, 4S Conference Honolulu, 8-11.11.2023.

Ethic valuation and agency distribution in AI-powered human resource management

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With the implementation of artificial intelligence (AI) in various fields and organizational settings, attention has been given to the problematization of its ethical value. From the view of the techno-solutionism (Atanasoski & Vora, 2019), AI should be applied not only to facilitate work, but omit human biases and achieve diversity. However, studies find out AI system also generate and reproduce human biases, such as gender, nationality, age, social class and nationality (Chan & Wang, 2018; Keding, 2021; Lambrecht & Tucker, 2019; Lepri et al., 2018), making more discriminative decisions than human beings (Crawford, 2021; Eubanks, 2018; O'neil, 2017). To make up this ethical drawback, another idea "human in the loop" has been brought up by the mainstream (Grønsund & Aanestad, 2020), that human intervention and oversight should always be prioritized in the in the decision making process.

This controversy through the AI-human interaction thus leads to a problematic tendency in science and technology studies (STS) to position the individual actors (human and AI) at either top or bottom of moral hierarchy, treating them as having pregiven outcomes and biases. To remedy this analytical impasse, this article borrows the concept "style of valuation" (Fujimura & Chou, 1994; Lee & Helgesson, 2020) to analyze how human actors value AI technology dynamically in practices. The empirical case in this article is thus the interaction between HR practitioners and AI applications in the hiring and recruitment activities, examining how human actors struggle with valuing the features and qualities of the AI tools regarding to the ethical consideration of decision making. In other words, what do HR practitioners perform as a proper distribution of agency between human and AI to achieve not only the ethical usage but also produce a fair result? By identifying the co-presence of several different modes of interactions with the same tool, this article shows how the value of AI ethics are perceived and represented dynamically through the daily interaction.

There are two key findings from this article. Firstly, AI technology, human actors (HR practitioners), organizational settings are valued in multiple ways under the implementation of the same AI application. There does not exist a stabilized understanding towards "ethical AI usage" through the configuration of AI, human actors and organizational settings, and the distribution of agency even varies individually because of different expectations and positioning toward AI. In the specific case on HR practitioners, it is more complicated to configure the agency distribution as decision making has been segmented through the processes and also entangled with the organization structure. Secondly, the key terms of AI ethics, such as fairness, diversity, accountability, all have plural values generated by situated interplay among users and AI. AI ethic is thus heterogeneous, irreducible to a single reality and open to future becoming. Rather than tying the sociotechnical system of AI to one set of values, this article thus proposes a broad understanding of AI-human interaction following the multivalence of AI in practice.

A Transparency Label for Promoting Adequate Trust in Web Search

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In recent years, search engines have become important in a lot of aspects of our daily lives. Current web search engines are operated by a few gatekeepers that are often focused on commercial success, which results in limited and manipulated information access, barely facing societal and ethical values. Furthermore, the emergence of Artificial Intelligence (AI) added an extreme amount of AI-generated disinformation to the Web, which makes it very difficult to adequately determine which sources and messages can be trusted. Additionally, current search engines are black boxes, lacking transparency in their behavior, data collection, and algorithms (e.g. Hamilton et al., 2014 - doi: 10.1145/2559206.2578883). Despite these problems, search engine users place a lot of trust in search engines, while knowledge about the functionality and underlying mechanisms is rather low (e.g. Schultheiß & Lewandowski, 2023 - doi: 10.1177/01655515211014157). This circumstance can lead to biased or uninformed decision-making (e.g. Epstein & Robertson, 2015 - doi: 10.1073/pnas.1419828112).

In the context of the European research project OpenWebSearch.eu, an open web search infrastructure is being created that addresses the trust and transparency shortcomings of existing search engines. OpenWebSearch.eu aims to create an open web index that serves as the basis for web search engines. Application developers can download parts of the index, in order to create a search application that focuses on a particular topic. A trust and transparency concept has been elaborated that stimulates and supports transparency features of these search applications, in order to overcome aforementioned issues.

The goal of this concept is to promote transparency and adequate trust in Web search. To achieve these goals, we created a transparency framework to provide guidelines for search application developers and to increase adequate trust of the end-user. To this end, we identified relevant issues and questions related to trust and transparency in Web search and clustered them into three categories: (a) information on general Web search, (b) information on the specific search application and (c) content characteristics of the presented search results. To address these questions, we identified four specific methods: (1) Explanation relates to giving information by explaining and providing information with general or specific explanations. (2) Exploration relates to the user-interaction with the application and the possibility to control the search process (e.g. through filter options). (3) Process-data relates to providing additional useful information from analyzed content data. (4) (Self-)Reflection promotes critical thinking, digital information literacy skills and a mindful interaction with search tools.

Adequate trust of the end-user is promoted in two ways. First, the addressing of the questions or issues of each category by the application developers leads to transparent information about the search application and the search results. Second, the extent of addressed issues and answered questions results in a “transparency label”, where all of the information is summarized in an illustration and is made visible for the end-user. This illustration provides an overview of the transparency level and serves as a certificate that can be used to compare search applications regarding their transparency.

The trust and transparency concept has been applied in two different use cases. The first use case includes a science search application in the field of environmental and geo-science, which enables users to search for publications, research data, and spatial map-based information. The second use case includes a location-based search that enables users to search for restaurants and shops in the close vicinity by exploiting personal preferences. Transparency labels have been created for both applications to demonstrate the overall concept. The work follows an ethics-by-design approach as applied in previous projects (reference anonymised).

Privacy enhancing Technologies: socio-technical reconfigurations of trust

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Privacy-Enhancing Technologies (PETs) are changing the scenery of data protection and privacy. By aiming to tackle security safeguards and, correlatively, a high level of confidentiality, PETs seem to fit perfectly our current European legal landscape that requires to adopt technical solutions that protect personal data. From data obfuscation technics, to encryption and distributed ways to access data, PETs are fostering not only scientific but also regulatory enthusiasms. Offering an apparent turnkey solution for preserving private life when personal data are being processed, PETs are taking the fore front of privacy researches. They even tend to shift away privacy discussions from personal rights realisation (such as the rights of access, the right to object to processing or to correct data) to technical upstream measures. In this regard, only few researches have explored the underlying assumptions of that shift and its potential impact.

Building on studies on the governance of science and technologies, our panel seeks fill this gap by questioning this shift and more precisely PET's impact on agency. Various questions can be addressed: Are personal rights on data processing still relevant? Can PETs foster them or do they reconfigure their effectiveness? Are PETs taking over current regulatory stand on data processing such as the European Health Data Space? What reconfiguration are at stake? Should regulatory answers to privacy concerns be transformed as well by taking into account PETs as object-agents?

Stream C: Towards Low-Carbon Energy Systems and Fighting Climate Change

C.1: Understanding low-carbon transitions in the Global South: Policy, Politics, and Decolonization

Session Chair: Dwarkeshwar Dutt, Indian Institute of Technology Delhi, India

Session Chair: Anita Pinheiro, Ashoka University, India

Cartoons Matter: The Effectiveness of Nudges as a Tool to Promote Energy-Saving Behaviours

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In the theory of behavioral economics that studies the decision-making process, the interest in information containing a specific message is increasing, letting the recipient understand that it is in his interest to change his current way of proceeding, the so-called nudges. The use of this type of psychological treatment in economic research, but also in public life, is based on the belief that human behavior is largely influenced by the environment in which a given person is located. Proper use of nudges in practice can effectively influence the imagination of recipients, and thus the perception of a given phenomenon and decisions made by them in a specific area of life.

This paper deals with the issue of the effectiveness of non-financial tools for shaping behaviors consistent with the public interest. It presents the results of pioneering, in the case of Poland, comprehensive research involving representatives of 130 households, the purpose of which was to examine the impact of receiving graphical and text nudges on methods of reducing energy consumption. The analysis of the research results showed a change in behavior to more energy-efficient, among others in categories related to heating, ironing, lighting, the use of chargers and devices powered by them. On average, a household whose inhabitants received nudges during the experiment used 18.5% less electricity than in the control group. This is of particular importance in the conditions of the necessary and urgent reduction of energy demand, resulting from the need to quickly reduce dependence on energy sources from Russia. In the population of men and residents of single-family houses, a positive percentage change in behavior was recorded in all categories. The Cochran Q test result suggests that sending nudges promotes positive energy habits among households. There are significant differences in changes in energy saving habits between women and men (most notable for heating behavior, which men improved four times more than women).

Critical Perspectives on Small Country Strategies in Climate Negotiations; What Alternative Strategies Are Possible?

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Small nations in the Global South are essentially bystanders in the global discussion and response to climate change. Agreements from COP1 to COP29 reflect the political economy of socio-technical systems, including systems of energy, mobility and manufacturing. Wealthy countries, heavily invested in fossil fuels such as Saudi Arabia, Australia, Norway and the United States of America have a stranglehold over the international negotiations, with the result that meaningful change cannot take place through this forum. The strategy of small nations has been, unsuccessfully, to attend the climate summits and negotiations with the begging bowl, attempting to gain support for initiatives such as the proposed loss and damage fund. An important question is "what strategies would be more successful?". This paper argues that the small nations need to be more collective, forming internal and external alliances for their energy transitions by appealing to the broader electorate within developed countries. Based on insights from a South African study on concentrated solar power and the political process through which budget decisions are taken, a more strategic approach, which recognises the intransigence of developed countries, but that this position is itself dynamic, is recommended. The essence of the argument is drawn from the framework of historical institutionalism and is based on secondary data analysis.

"Everything needs time" or "we don't have time": Sociotechnical imaginaries of energy systems change related to electricity and cooking services

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Which actors and places are envisioned to drive transitions towards sustainability in the Global South? We address this question by exploring the characteristics of energy systems change in Rwanda envisioned by geographically dispersed actors, including actors in both higher and lower income countries. We draw on various empirical data including interviews, observation and document review, with the scope framed by the Rwandan government's 2024 energy targets. Our study proposes two sociotechnical imaginaries of change which approach agency, location, scale, temporality and directionality differently. The first envisions private sector-led rapid adoption of externally developed technologies at scale to meet the cost-oriented demands of passive user-consumers. The second envisions more temporally ambiguous and heterogeneous domestic development of solutions to address localised understandings of sustainability. The first imaginary is associated primarily with employees of externally headquartered organisations. This imaginary's temporal and scalar alignment with global sustainable development agendas and finance appears to close down the second imaginary. Externally envisioned change situates agency either in the country's capital Kigali or outside Rwanda altogether. We argue that enacting such change risks more capital accumulating externally than internally; and subsequent reproduction of problematic historical socioeconomic

relations between higher and lower income countries. Our analysis demonstrates the politics encoded in the spatial and temporal aspects of imagined futures, as well as who imagines them.

Labour and Climate Change: (Re)Imagining Coal Mine Workers in Just Transition Trajectories in India

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The transition from a coal-based economy in India comes with considerable challenges, which "just transition" narratives spearheaded by thinktanks and research and advocacy groups have highlighted. The coal sector remains a significant provider of employment in coal-rich regions in India, and consequently the conundrum of the future of labour in a post-coal economy features in just transition narratives. On the ground, as coal communities grapple with mine expansions, land acquisitions and the increasing precarity of existing land-based livelihoods, concerns regarding jobs and livelihoods loom large.

Post-coal futures envisaged in policy documents and just transition narratives tend to define 'labour' as workers employed in the coal sector and aligned industry. Recommendations for accommodating concerns of labour therefore focus on "reskilling" and on creating "green" jobs. This definition of labour, which is also articulated by trade unions in India, is however limited by its lack of engagement with and acknowledgement of the interconnections between various sources of livelihood in coal-rich regions in India. It fails to recognize the multiple ways in which coal communities navigate life between formal and the informal economies, between agrarian, land-based livelihoods, temporary jobs within the coal economy and other non-farm employment in the Global South. This paper, using frameworks of social movement unionism as well as a definition of 'class' as a social relation rather than as a structural location, argues that reworking of the definition of 'labour' and thus of trade union praxis can lead more involved integration of coal workers' voices in just transition narratives.

The paper begins with understanding how labour is framed in Just Transition narratives. It asks: How has 'labour' been defined in just transition literature in the Global South and the Global North? What are the key characteristics of labour just defined, and what are the key differences between framings of labour in Global North and South (if any), and the key recommendations for labour that follow, especially for labour in the Global South. The paper then proceeds to document responses of trade unions in India, focussing on the centrality of jobs in public articulations in coal regions, referencing secondary literature as well as fieldwork conducted in coal regions. It shows how the desire for jobs in the upcoming mines drives powerful narratives around coal, and documents what trade unions are saying (or not) about the future of coal and future of livelihoods in a post-coal economy.

The paper then proceeds to document the nature of labour and labouring in coal regions in India. It asks: What is the nature of labour, jobs and livelihoods in the coal fields? Based on fieldwork in coal regions and on secondary data from existing literature on formal/informal labour, it suggests the existence of a diversity of livelihoods in coal regions, wherein people depend simultaneously on coal mines, on agricultural land as well as on trade to make a living.

What then, is the nature of the ‘working class’ in the coal field in India? How is this working class formed? How is this different from ‘old’ working class conceptions which included primarily industrial wage labour? What are the implications for this new understanding of the ‘working class’ for just transition narratives? In dealing with these questions, the paper argues that a reworking of existing notions of ‘labour’ and of trade union praxis can result in fresh policy recommendations as well as a more involved engagement of trade unions in climate and just transition narratives.

The effects of energy accessibility on income inequality in Latin America and Caribbean countries

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Transitioning to clean energy offers multiple benefits: curb Carbon Dioxide emissions, foster job creation, and provide affordable electricity. However, such a transition can also intensify inequalities. Indeed, addressing income inequality is vital to avert political and economic instability, which can obstruct poverty alleviation efforts.

This article explores the intricate relationship between energy access and income inequality. The focus is on Latin America and the Caribbean (LAC) nations that experience disparities in energy access and income inequality, more specifically, Bolivia, Brazil, Colombia, Costa Rica, El Salvador, and Honduras. While some urban areas in the region enjoy reliable and modern energy services, many rural and marginalized communities still lack access to electricity and clean cooking fuels. This disparity in energy access within a single region provides a clear context for studying its impact on income inequality. Furthermore, many countries in the LAC region struggle with income inequality and are characterized by various energy access and income distribution policy approaches. Lack of access to modern energy services, often prevalent in marginalised communities, hampers well-being, health, and economic prospects.

Econometric models, correlation analysis, and Granger causality tests are employed using data from the six LAC countries, analyzing the period between 2000 and 2019, aiming to respond to the following research hypothesis:

H1. Does access to electricity have an impact on the Gini Coefficient?

H2. Does access to clean cooking fuels have an impact on the Gini Coefficient?

H3. Does access to electricity impact the access to clean cooking fuels?

The results reveal that the link between per capita GDP and income inequality varies across countries, being responsible for increasing disparities in some and reducing disparities in others. Granger causality tests revealed that the impact of energy access on income inequality also varies by country, with Bolivia experiencing a causal relationship where increased access to electricity led to reduced income inequality. At the same time, Costa Rica and Honduras exhibited a mutual causation, suggesting a feedback loop between energy accessibility and income inequality. Income inequality is responsible for Granger causing access to clean cooking fuels in Brazil, Costa Rica, and Honduras. In Costa Rica and El Salvador, electricity

access Granger caused the access to clean cooking fuels, while in Honduras, they mutually Granger caused each other.

These findings confirm the three hypotheses related to the relationship between the variables — however, the impact direction changes from one country to another. It underscores the need for tailored strategies and policies to improve access to electricity and address income disparities in the LAC region, as energy access can both impact and be influenced by income inequality, ultimately contributing to a more equitable and sustainable impact.

This article emphasizes the potential of clean energy access in income inequality reduction and offers recommendations to policymakers. Despite focusing on LAC countries, these findings have broader implications for other middle-income countries. It also underscores that strategies to diminish income inequality through enhanced energy access must be tailored to each country's unique context.

Cobalt as a Political Artifact: Revealing Equity Gaps of the Sustainable Development Movement

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Cobalt is a critical mineral; its role in modern renewable energy technologies is crucial for humanity's drive toward accomplishing the UN SDGs. However, the 2002 Global Witness report exposed human rights violations in DRC; economic vulnerability, conflict, rape, child labour, and food insecurity. It is a matter of concern that such ironies are embedded in the global economy. In this paper, based on the arguments of Langdon Winner in a Marxist framework, I explore cobalt as a political artifact and how it can reveal equity gaps of the energy transition. To do so, first, this paper presents a theoretical framework based on Marx's arguments of three interacting forces and associated despotism. To begin with, based on the Marxist institutional framework, this paper illustrates the exploitation in DRC that is embedded in cobalt building on Amartya Sen's conceptualisation of freedom as development. Then, based on Winner's arguments, this paper emphasizes cobalt's flexibility as a political artifact on the political implications of artifacts and assesses the political implications of cobalt in the institutional framework. Furthermore, based on the dynamic implications and Sheila Jasanoff's co-production, I put forth the 'political overlapping' in cobalt. Lastly, I bring forth her arguments on Socio-technical Imaginaries (STI) to identify the equity gaps of the sustainable development movement in the context of the cobalt economy.

'Asia as a Method' in Understanding Low-Carbon Transition in the Global South: Decolonization, Dynamics of Power and Development

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The history of environmental degradation in India has been often linked to the British rule. Britishers legitimized their rule and environmental degradation by providing commercial towns,

new industries and infrastructures, such as roads, railways and educational institutions. During this period economic development occupied a significant part of policy, both in terms of agenda and debate. However, in spite of all these efforts, India's poverty rate at the time of British departure was at 70 per cent. This eventually resulted in India's focus on poverty eradication, achievement of modernization through industrialization and economic growth as India's primary national purpose post-independence.

Similarly, China was a very poor country at the time of its establishment in 1949. Hence, Mao Zedong, the founding President, through many ferocious methods focussed primarily on building the economy. As is often attributed to the Mao's war against nature, environmental concerns were ignored. In late 1970s, China adopted reform and opening up policy and began to shift from a planned economy to a socialist market economy. Following which, China further witnessed serious environmental degradations like dying of sea-lives in polluted Dalian Bay and foul smell in fishes in the polluted Guanting Reservoir. The concept of "environmental protection" was not familiar to most Chinese people before 1970. The term "public hazard" or "公害" was commonly used to describe environmental pollution that occurred in other western countries.

Both India and China have rejected the binding limits on its emissions due to their need of development as a means of poverty eradication. Both also held the West responsible for the historical emissions and doubted the international institutionalization of climate change mitigation as 'an attempt to curb their economic growth'. They have also questioned the concepts of 'development' and 'climate change mitigation' given by the West. While climate change was seen as a problem and responsibility of the global North, the way climate change threatens the livelihood and survival of the vulnerable communities, makes it imperative to study and include the concerns and voices from them, which still have neither been fully reflected in domestic environmental policies nor seriously transmitted to the international negotiations table.

In this paper I use mixed approach (quantitative and qualitative) to understand and anlyse the concerns and voices of the most vulnerable communities from India and China. I use my language abilities (Chinese, English and Hindi) to carry out the qualitative analysis of local news and survey of some of the most affected region (e.g. cancer villages). For quantitative analysis, I rely on nationally and internationally recognised institutions like Government Reports and White Papers, UN, World Bank, IMF, IEA etc.

This study attempts to explore the perspectives from the most vulnerable communities in the global south, especially from India and China, on low-carbon transition. In the process it attempts to study the role of power dynamics (including the colonizer vs colonized to that of within the colonized world) in decolonization and development. This also explores the framework of 'Asia as Method' given by Chen Kuan-Hsing, in analyzing and understanding common concerns from global south, and in further strengthening the concept of decolonization of low-carbon transition.

Green Energy Landscape in India: The Case Study of Wind-Solar Hybrid Energy Systems

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The quest for sustainable and resilient energy systems has pushed nations to explore innovative solutions that harness the synergies of diverse renewable resources. This study is a focused examination of the Indian experience with Wind-Solar Hybrid Energy Systems (WSHES), providing insights into the challenges, triumphs, and key learnings. Moreover, it draws parallels with the experiences of other countries, enriching the discourse on the global trajectory of wind-solar integration. India, a nation marked by both rapid economic growth and an expanding energy appetite, has strategically embraced WSHES to enhance energy output while mitigating environmental impact. It unravels the Indian narrative by delving into the policy frameworks, technological advancements, and market dynamics that have shaped the country's WSHES landscape. The key considerations include grid integration strategies, land-use optimization, and overcoming intermittency challenges. The case studies from India will be explored to illustrate the practical implications of WSHES deployment, offering valuable insights into project successes and challenges.

The technological dimension of WSHES will be a focal point, with an exploration of advancements witnessed both in India and globally. From innovative hybrid designs to sophisticated control systems, it will highlight the technological strides that have contributed to the efficiency and reliability of WSHES. Furthermore, it will scrutinize the socio-economic implications of WSHES adoption in India and other countries. By examining job creation, community engagement, and the overall impact on local economies, it will underscore the broader benefits of transitioning to hybrid renewable energy systems. This holistic perspective aims to guide policymakers and industry stakeholders in understanding the multifaceted advantages of WSHES beyond the realm of energy production.

Policy frameworks play a pivotal role in shaping the trajectory of renewable energy adoption. The significance of stable regulatory frameworks, incentives, and collaborative governance will be emphasized as crucial elements in driving sustainable energy transitions. Taking a comparative stance, it navigates through the experiences of other countries that have pioneered wind-solar integration. Case studies from global leaders such as Germany, China, and the United States will be presented, showcasing diverse approaches in different geographical, climatic, and economic contexts. This comparative analysis aims to distil common trends, identify best practices, and unravel unique solutions adopted by various nations. In summary, it provides a nuanced exploration of the Indian experience with Wind-Solar Hybrid Energy Systems, offering valuable insights into policy, technology, and socio-economic dimensions. By juxtaposing these insights with global experiences, it contributes to a comprehensive understanding of the challenges and opportunities in the evolving landscape of WSHES, promoting a shared vision for a sustainable and resilient energy future.

Estimating the labour impacts of low-carbon growth pathways in India

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Large-scale and rapid reduction of global fossil fuel use is required to meet the temperature goals set by the Paris Agreement. Fossil fuels have been essential and central to the growth of developed and developing economies. However, the historical, and current use of fossil fuels across countries is not uniform. Countries in the Global North are carbonized industrial economies. These countries have enjoyed the non-restrictive use of fossil fuels which aided their process of industrialization. Consequently, these economies are also responsible for a majority (48%) of the historical cumulative emissions of CO_2 from fossil fuels and industries (CO2-FFI) between 1850 and 2019 (IPCC, 2022). For these developed countries, decarbonization implies a transition from a fossil fuel-intensive energy system to a non-fossil fuel one. However, the rest of the world, i.e., the Global South, is yet to be carbonized or only partially carbonized as their process of industrial development is still underway or in many cases is in very early stages. For these developing countries, therefore, the challenge is multifold. They may have to forgo the use of cheap, mature, and locally available technologies and fuels while they aspire to reach levels of economic and human development similar to that of developed countries. We, therefore, use the framework of 'low-carbon development' in this paper to analyse the implications of climate action for developing countries, instead of the framework of 'just transition'. This is not simply a difference of nomenclature, but a conceptual departure in terms of how climate action must be understood in developed vs. developing and least-developed economies.

Forgoing the use of fossil fuels can impact the entire economy based on a country's national circumstances, production processes, resource and technological availability, and labour dependencies. Coal is one of the core sectors of the Indian economy, constituting more than 72% of the total energy produced domestically in 2021 (MoSPI, 2023). The coal sector in India is largely a publicly-owned sector that is highly labour-intensive. It employs more than 0.29 million workers in the government-owned mines alone (MoC, 2023). Whereas, the renewable energy (RE) sector is an emerging sector in India despite the growing deployment of solar and wind-based power plants facilitated by government policies and fiscal incentives. Most of the current RE-based power plants are privately owned and require minimal labour for their operation and maintenance. The majority of the jobs generated in the sector are short-term jobs concentrated in downstream activities such as construction, installation etc. Given the significant disparity in the nature and employability of these sectors, it becomes important to understand the potential impact of forgoing the use of fossil fuels in the near term.

In this paper, we present a mathematical simulation model to assess the employment and cost implications of low-carbon development in India. We use this model to construct three different energy mix scenarios for India for the year 2030: 1) The Central Electricity Authority's (CEA) RE-driven scenario 2) India's Nationally Determined Contributions (NDC) scenario 3) Coal-based development scenario for India to estimate the job gains/losses and the costs associated with each scenario.

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The political economy of mini grid electricity development in Kenya

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Accessible and affordable energy services are a prerequisite for socioeconomic growth and poverty reduction. Yet it is estimated that 600million people in sub-Saharan Africa will not have access to electricity in 2030. Recent research suggests that universal access to electricity will be achieved through a mix of centralized and decentralized systems, and that the diffusion of these technologies is a socio-technical process involving multiple actors. These actors including firms, networks, energy users and government agencies interact within a political landscape to deliver innovation within energy service systems, thus factors related to political economy can impact on the process of innovation and warrant analysis. This study aims to provide an understanding of the political economy factors that can influence the emergence of mini grid electricity systems in the African context. Using Kenya as a case study, the study uses Technology Innovation Systems lens to identify how political economy factors influence actors, networks and technological learning related to mini-grid development and dissemination. Result shows that despite the presence of some favorable conditions for innovation, political economy factors significantly impede the deployment of mini grids in Kenya. Power and vested interests have created negative competition between public and private developers, limiting knowledge and information diffusion between actors and stalling mini grid developments where they are most needed.

Coal mine closures in Sounda: Implications of deindustrialization on mono-industry landscapes

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This paper delves into the profound impact of deindustrialization on Sounda, a once-thriving coal-based census town in Jharkhand, India. Sounda's trajectory from a bustling economic hub, characterized by coal mining activity and vibrant local communities, to its current decline is a poignant example of the complex consequences of deindustrialization. The closure of all four coal mines in Sounda, driven by economic unviability and resource depletion, has caused a series of unprecedented challenges. The town, closely intertwined with the coal mining industry, now relies on the grim prospect of a single functioning coal siding. This study conducted 25 in-depth interviews and 03 focus group discussions involving diverse local stakeholders, including community members, political representatives, civil workers, and trade union leaders, to understand the complexities of deindustrialization in coal regions. The closures have led to mass migrations, unemployment, business closures, crumbling public infrastructure, and severed connectivity. The landscape is now a remnant of old industrial sites that stirs up memories of its vibrant past.

Nevertheless, communities are finding innovative ways to reconnect with the natural ecology amidst deindustrialization. Abandoned mining pits have become opportunities for fish culture, demonstrating some resilience in the face of industrial decline. This paper explores the multifaceted effects of deindustrialization in coal regions, unveiling the intricate relationship between industrial decline and local life. Additionally, it provides insights for future transitions away from coal, informing us on the impacts and navigating the challenges of deindustrialization.

Methods of evaluation of intellectual capital in context of climate change.

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In the context of ongoing climate change and countries' efforts to mitigate its impact, as well as strategic decisions to develop a green economy, comprehensive research is being conducted in Armenia. They are aimed at developing the most effective policy for the distribution of energy resources, taking into account the specifics of development and long-term planning of economic progress.

An earlier analysis of existing energy resources, both renewable and non-renewable, and the prospects for their use from the point of view of the transition to new conditions for economic development, allowed us to conclude the following. Nuclear is the one of the main sources of energy in the country and is aimed at increasing capacity. Transition to a green economy in countries with a similar distribution of energy resources like Armenia, with an increase also solar and wind energy, can proceed more smoothly and with less negative consequences than in countries with hydrocarbon fuel energ(Nalbandyan, 2023).

An assessment of the distributional consequences for the transition period showed the need to consider the possibilities for harmonizing various forms of capital: natural, intellectual, physical, financial, human. (Nalbandyan, 2022) Moreover, among those noted, some are easily assessed and analyzed trends in change, but such as, for example, intellectual - it is complicated.

It is difficult to evaluate their, to find a unit of measurement, to develop evaluation criteria for a reliable objective value. It is rather problematic to objectively measure the experience of an employee, his knowledge and skills. At the same time, it should be taken into account that intellectual capital, unlike physical capital, is evaluated both in value and non-value. If we compare it with financial capital, then we can say that the intellectual one is aimed at the future, and the financial one is identified with the performance in the past.

Intellectual capital is usually considered in the form of a combination of physical, intellectual and creative capital. If formulated collectively, it can be characterized as the innovative and creative abilities of people to create economic benefits - both in tangible and intangible forms.

Capital assessment is, of course, financial, but also has non-financial forms. According to modern research, more attention is currently paid to qualitative indicators rather than quantitative ones, that is, non-financial capital. Financial valuation is an estimate of the value of intellectual property. It includes predictive, practical and simulation methods. There are also components of intellectual capital, such as consumer, social, technological, spiritual, emotional, human and structural. In the context of climate change and distributional impacts, technological, spiritual, emotional and social components are of particular importance. It is necessary to focus specifically on these component forms for a detailed assessment of both possible positive and negative distributional consequences during the energy transition period. For a harmonious transition, it is necessary to ensure comparison and balancing between technological solutions, the growth and development of technological capital and taking into account the emotional and social components. Moreover, the assessment method should take into account the peculiarities of economic development of countries, the distribution of energy resources, the level of freedoms, the national characteristics of society, and the characteristics of mentality. That is, it is proposed to consider a model for balancing and assessing intellectual and human capital for countries with a pronounced fuel system of economic development and countries with a system of predominantly using renewable energy sources in the transition period. The main principles of intellectual capital management are: flexibility, internal competitiveness, consistency, decomposition, the principle of incentives, the principles of environmentalization of education and the economy, balancing ecological-economic scientific and production programs.

C.2: Limits to green growth and its induced conflicts of biomass use

Session Chair: Raphael Asada, University of Graz, Austria

Session Chair: Annechien Dirkje Hoeben, University of Graz, Austria

Session Chair: Tobias Stern, University of Graz, Austria

Discovering the Transformative Bioeconomy Discourse in contemporary discussions around the bioeconomy

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The survival of countless species on this planet – including the homo sapiens – depends on the relationship between humans and their environment. The forum in which these societal relations to nature are being both negotiated and materially expressed is that of (political) economy, so the stories that are being told in there are of particular importance to the quality of life on earth. The most powerful imaginary which has shaped human activity for the past 250 years has envisioned the human as a rational individual, making decisions for their personal gain based on the assumed availability of complete information, which has led to an atmosphere of paradigmatic profit-maximization, growth-orientation, and competition, with as little influence as possible from non-economic institutions. This neoliberal ideology has put the environment under considerable pressure up to a point where the supporting ecosystems are not any longer able to provide for the survival of our civilization, and pushed the state and its functions back into a position where even democratic principles are at risk.

With respect to environmental sustainability, the largest threat arises from the use of fossil resources for energetic and material use. A proposed solution therefore aims to replace these non-renewables by biogenic resources with the so-called **Bioeconomy**. Because plant-based resources regrow and, in that process, even capture atmospheric CO2, they would halt or reverse climate change and contribute to solving related crises such as biodiversity loss or freshwater depletion. However, this narrative has been criticized to employ a simplistic understanding of the environment, neglecting the ecological consequences of its approach, essentially worsening ecosystem degradation rather than improving environmental health, and foot on an inherently unsustainable ideology in pursuing continuous economic growth and superiority of competitive principles. Regarding the societal challenges, the dominant bioeconomy imaginary further entrenches global inequalities through a continuing exploitation of the global south, and the erosion of societal institutions and democratic principles through unquestioned utilization of established power relations and dynamics.

Alternatives to mainstream bioeconomic narratives on the other hand draw from the rich inter- and transdisciplinary history of transformation research, ecological economics and political ecology in an effort to create a more realistic imaginary which is in line with planetary boundaries and social sustainability. This holistic approach attempts to formulate the foundation for a sustainable economy based on a perception of human civilization relationally emerging from a socially constructed environment, in which it is nevertheless biophysically

embedded, to reach a globally cooperative, fair and just *good life for all* within planetary boundaries. The concept of the **Transformative Bioeconomy** summarizes the discourse surrounding these principles in a comprehensive concept, and represents the core preliminary finding of an ongoing PhD-research.

This contribution to the STS conference aims to highlight recurring themes and propositions found within this discourse. Central topics include reframing the human-nature-relationship as a symbiotic community, transdisciplinary and process-based onto-epistemologies, pluralistic worldviews, post-materialism and post-growth, regionalization and participatory approaches to policy-making. The talk will present concrete measures such as an expansion of economic performance indicators beyond GDP, bans on advertisement, strict price regulations and emission or extraction caps, integration of subsistence and other non-paid work, democratic organizations of enterprises and profit-sharing, functional and structural complexity reduction, strengthening of personal relationships, non-consumption based subjectification, and transparency, honesty and moral integrity in public and private discourses.

Bridging biodiversity and business: an in-depth analysis of biodiversity assessment tools

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The role of business in driving and preventing biodiversity loss has moved into the spotlight. Several industries can generate impacts which lead to the deterioration of ecosystems, either as a fundamental part of their business model, or through particular unsustainable practices. With the increasing demand on products from the bio-economy, this industry may also increase its impacts on ecosystems e.g. by raising resource exploitation. As a result, there is a need for more in-depth research of how businesses can engage in reversing nature loss and turn to become nature positive and identify opportunities for green growth. A starting point is to monitor negative impacts on biodiversity, and positive effects of management and protection measures. Biodiversity indicators have been developed for specific businesses based on natural resources sectors such as forestry and agriculture. However, how they can be used by businesses to track their progress remains a challenge. Forests worldwide are utilized to generate pulp, lumber, and bioenergy. Intensive, industrial forestry has changed forests all over the world, resulting in the creation of managed stands and more or less altered forest landscapes with potential heavy impacts on biodiversity and ecosystem services.

To understand current developments and methodological approaches in biodiversity assessment this study analyses the Science Based Targets for Nature (SBTN) toolbox. The toolbox contains 45 biodiversity assessment tools. This sample was selected because SBTN delivers one of the most comprehensive guidelines for measuring operational impacts on the environment. According to SBTN, the tools listed in the toolbox were chosen after multiple rounds of research within the SBTN network, which indicates a certain quality of the tools.

In a first step, the tools were qualitatively analysed using background papers on the tools and method explanations. In a second step, multidimensional scaling techniques (MDS) were

applied to compare the tools in a holistic view. The analysis encompassed the biodiversity assessment methods used in the tools, specific biodiversity topic, skill requirements, accessibility, user interface, integration of a map, developer, and geographic scope. The MDS shows tool groupings and allows to visualise the differences between the tools graphically. Overall 394 comparisons were made.

The results show the different approaches to assess biodiversity and allow to evaluate the extent to which the tools differ. We identified different groups. First, there is a large pool of software and web applications that deal with biodiversity. Second, there is a wide range of datasets that address biodiversity issues. Third, there are groups of assessment tools which are methodologically similar. The following methodological focal points were identified: Life Cycle Assessment (LCA), Multi Regional Input-Output (MRIO) Analysis, approaches dealing with Geographical Information Systems (GIS) and indices evaluating biodiversity condition. The indicators used to measure biodiversity are also differentiated and are often calculated using specific metrics.

This research contributes insights to the field of biodiversity assessment, offering managers and scholars a well-informed overview of methodological developments in biodiversity assessment by reviewing the most recent tools in this field. By combining qualitative analysis of the tool functionalities and multidimensional scaling, the study aims to generate an understanding of the tools and thus also facilitate a decision-making basis for tool selection in order to fulfil a specific purpose and set goals in the assessment.

Holistic and Integrated Sustainability Assessment for Bioeconomy and Societal–Ecological Transformation

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The social, economic and ecological relations in global capitalism have condensed into a socio-ecological crisis, since the unequal satisfaction of societal needs seems to be directly linked to a massive transgression of planetary boundaries. Germany exceeds the planetary boundaries by a factor of about 3.3 and a decoupling by this factor is implausible by purely technological means. This calls into question not only the concepts of Green Growth, but our entire current economic system.

We first introduce the double decoupling and societal-ecological transformation approach to this fundamental problem: in addition to a necessary technical decoupling, there is a need for a societal decoupling of the satisfaction of societal needs from an increasing production of goods (suffiency), and thus a transformation that goes beyond the existing economic system. Against this background, the container term bioeconomy can be understood as a sustainable use of renewable instead of fossil resources. However, sustainability is not an intrinsic characteristic of the bioeconomy, but must be defined, analyzed, evaluated and interpreted.

For this purpose, we secondly present an integrated sustainability framework with clear and applicable definitions of sustainability: the long-term and global fulfillment of societal needs and well-being as an end (social sustainability), long-term stability of our environment as a

basis of societal reproduction within PB (ecological sustainability), as well as technologies and economic structures as efficient, effective, sufficient and just metabolisms which enable the fulfillment of societal needs within PB (economic sustainability).

In order to asess and analyze integrated sustainability, we developed the Holistic and Integrated Life Cycle Sustainability Assessment (HILCSA) as a transdisciplinary and critical method for the analysis and evaluation of socieal, ecological and economic sustainability of concrete production and consumption systems in the bioeconomy and beyond. HILCSA integrates social, economic and ecological LCA in a common goal and scope, life cycle inventory, life cycle impact assessment, results and interpretation. This fully software implemented and databse driven assessment method entails a set of 102 quantitative and qualitative indicators capable to address societal needs by 24 indicators, economy by 56 and the PB by 22, as well addressing 14 out of 17 SDGs.

We applied HILCSA in two case studies in context of bioeconomy. In the first case, a comparison of wood building products with conventional steel beams showed that renewable bio-based construction materials can have a better holistic sustainability than fossil-based products for nearly all indicators. In the second case, we compared liquid biofuels as a drop-in alternative to substitute fossil fuels in the transport sector, showing some contributions to the SDG but significant sustainability risks of such biofuels. Through this quantitative and qualitative sustainability assessments we identify synergies and hot-spots of bioeconomy production systems on a detailed and aggregated level.

Measuring how bioeconomy contributes to sustainable consumption and production achieving the Sustainable Development Goals, HILCSA can provide an information and decision basis for stakeholders such as politics, society, research and organizations.

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Myopia-induced supply bias and limiting conflicts: a review of the bioeconomy's growth limiters

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Bioeconomy research has tendentially been biased towards its more supply-side aspects and has perceived the bioeconomy's growth limiting factors (limiter) rather narrowly. A literature review was conducted to identify and classify limiters' effects (supply and demand) and factors they depend on (anthropogenic and biophysical), hopefully providing a more holistic overview. The results indicated a clustering of limiters conditional anthropogenic factors impacting the supply side, but the biophysical supply limiters were also well represented. On the other hand, limiters impacting the demand side were barely observed in the literature, reinforcing the impression of supply-side bias. It was also clear that demand-effecting limiters conditional on anthropogenic factors were significantly more represented than their biophysical counterparts. The latter was barely represented in the literature, indicating a research gap.

Given this research gap, we suggested the inclusion of non-anthropogenic consumption as limiters to help fill the void that is the biophysical demand limiters category. Non-anthropogenic consumption was also suggested to emphasise the competing biomass demand of humans and other organisms, including organisms that aggressively compete with us (pests) and the biomass consumption needed to maintain non-anthropogenic biomass generation. It is, therefore, not just a matter of non-anthropogenic consumption limiting the growth by its existence but also its absence.

The literature also indicates that the transition to a more productive bioeconomy could spark conflicts between traditional and industrialised bioeconomy stakeholders as the former get pushed out by the accelerating technology treadmill and competition for productive areas and biomass. The conflict might also involve not only the stakeholders themself but also third-party actors, who might take issue with the development either on cultural or environmental grounds as the traditional bioeconomy might be economically unproductive, it tends to hold great cultural and sentimental value, and the more modern bioeconomy iterations often ends up being extractive contributing to the depletion of the underlying resource bases. It was concluded that such conflict might negatively impact the legitimacy of the growth-optimistic bioeconomy visions (which have primary sector productivity as a primary focus) as long as inequality and ecology issues remain.

The bioeconomy's growth appears limited by more anthropogenic factors than biophysical ones. Still, as these limiters and their associated limits are defined by us, they can be a non-binding constraint by defining a limit less restrictive than the long-term biophysical limits. Furthermore, their necessity would depend on whether functional property markets can impose the necessary incentives.

Two possible explanations for the supply bias were suggested; one is the dominance of growth-optimistic bioeconomy visions (e.g., basis in the weak sustainability conceptualisation), which, due to a belief in the decoupling between growth and environmental degradation, does not view changes to our consumption pattern as a necessity to achieve the transition to a "sustainable" bioeconomy and supply side aspects of the bioeconomy might therefore receive

more attention. The other suggested explanation is based on the perceived immaturity of many more hyped technologies and the fact that the earlier stages of the innovation process are usually more associated with supply-push rather than demand-pull factors. This could be interpreted as myopic analysis of the bioeconomy's innovation process.

Negotiating Biophysical Limits of the Bioeconomy in EU Policy

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The bioeconomy is a prominent concept for substituting fossil fuels in various industrial sectors, products, and applications while offering new opportunities for economic growth and socioeconomic development. However, this promissory vision blurs the materiality of biological raw materials. Raising biomass demand in the EU can increase global pressure on land and ecosystems, causing social-ecological conflicts and aggravating crisis dynamics. Against this backdrop, understanding the potential of the bioeconomy in addressing biophysical limits necessitates a thorough examination of powerful actors shaping its evolution. Equally, shedding light on actors promoting alternative visions is crucial to outline perspectives for transformative policies. A few critical studies in political economy and science, technology, and society studies found that interest groups from academia, industry, agriculture, forestry, and governments shaped the growth-oriented bioeconomy strategy documents of the EU and Member States. Furthermore, research highlighted that regulating the bioeconomy at the EU level depends on specific problem formulations and actor constellations in established policy fields like renewable energy and plastics. However, research has yet to assess how these policies tackle the biophysical limits of the bioeconomy.

I approach this research gap by presenting an article we have been working on recently. Drawing on critical policy analysis, we examine how actor constellations address biophysical limits and to what extent they can assert their positions and strategies in conflicts on regulating cascading use and bio-based plastics in EU policy. For our empirical research, we qualitatively analyzed position papers and conducted explorative interviews to identify potential conflicts on biophysical limits. We then conducted semi-structured interviews and analyzed additional position papers to investigate how actors reacted to the conflicts. We grouped actors into three competing bioeconomy projects based on similar positions and strategies. We analyzed recent EU policies in the last step to understand how these projects could shape the two conflicts.

Summarized into a growth-oriented bioeconomy project, agricultural, forestry, and industry actors frame limiting biomass use as a hurdle for a growing bioeconomy. We grouped actors from academia, waste management, and public institutions into a circular bioeconomy project. This project recognizes a limit in utilizing primary biomass due to increasing competition on land and feedstocks. It suggests mobilizing secondary biomass to facilitate a sustainable supply for the bioeconomy. Actors from academia, NGOs, and one employee of the European Commission, summarized in a sufficiency-oriented bioeconomy project, highlight the risk of increasing pressure on land and ecosystems from a growing bioeconomy and emphasize the necessity of an absolute reduction of resource use.

The circular and sufficiency-oriented bioeconomy projects could discursively inscribe their reading of biophysical limits in the analyzed EU policies. Furthermore, current policy even prioritizes reducing plastics over a large-scale substitution with biomass. These findings indicate a potential alliance of NGOs with academia, public institutions, parts of the biomaterials industry, and waste management to push for developing a sustainable bioeconomy. However, examining the recent amendment of the Renewable Energy Directive, similar to other Green Deal policies affecting land use, suggests that actors from the agriculture, forestry, and bioenergy sectors who oppose stricter regulations on biomass use can still weaken them. As a result, regulating cascading use through support schemes denotes an unstable compromise with the growth bioeconomy project that might not hinder energy conversion from primary biomass.

Ultimately, our study expands critical social research on the bioeconomy with an in-depth understanding of nature's materiality in policy processes. Furthermore, our findings highlight the potential and hurdles to advancing the bioeconomy concept to align with planetary boundaries.

C.3: Factors Accelerating or Hindering Organizational and Sociotechnical Transitions Towards Net-Zero

Session Chair: Matthew Phillip Johnson, University of Hamburg, Germany

Session Chair: Gregory Trencher, Kyoto University, Japan

Shaping The Energy Transition in Japan: The Response of City Gas Utilities to Climate Action

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The Japanese government pledged in 2020 for the country to achieve decarbonization and climate neutrality by 2050. While recent climate and energy policy packages anticipate natural gas to play a role in the country’s energy transition and carbon neutrality pathway, a growing number of Japanese cities with ambitious climate goals aim to reduce reliance on this energy source in their municipalities to reduce emissions. These recent developments have prompted a multitude of natural gas industry incumbents’ responses that reaffirm the role of natural gas and its infrastructure in achieving climate neutrality. This paper explores the responses of the gas industry to climate action and sustainability transition efforts while paying a special attention to the established Japanese city gas utilities. It draws on a critical discourse analysis of key business and government publications as well as interviews with several experts to identify a dominant discourse on the role of city gas in climate governance being promulgated by key actors. The paper focuses on Japan natural gas policy during the period of 2012 and 2022 to show how incumbents have attempted to consolidate their position and shape the trajectory of the energy transition at different stages and events (e.g., the Fukushima nuclear disaster, adopting the Paris Agreement and the Sustainable Development Goals). Overall, the

study adds to a growing body of literature on the various forms of incumbency shaping energy transitions by providing a nuanced understanding of issues facing Japanese city gas utilities and their strategies to shape a top-down transition.

Knowledge networks in energy community projects: A configurational study

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Energy communities hold a promise to foster the energy transition from the bottom up. They can increase the share of renewable energy production, increase energy efficiency, decrease transmission losses, and provide benefits by increasing community resilience and democratization. However, energy communities have remained a niche actor in the energy system. Thus, much research has focused on understanding the barriers to communities. The results have provided a wide range of policy implications to support the upscale of the communities.

Learning from others and knowledge transfer is crucial to finding essential information for decision-making and using the best practices from peers and other collaborating actors. The extant literature has recognized that communities combine information from various sources, from commercial and non-commercial actors and intermediary organizations. News, social media, internet searches, newsletters, scientific articles, workplaces, etc., work as complementary sources to get information on the latest technology advances and opportunities. The studies on knowledge transfer aspects in energy communities are scarce and based on a small number of cases with limited generalizability.

In this study, we examine energy community knowledge networks. The data set is based on a survey with 618 respondents and information on 22 community energy projects. The data set was collected in Finland in 2023 and includes various energy-related projects focusing on changes in heating systems, energy technology purchases, insulation, energy efficiency improvements, and charging solutions. We conduct a fuzzy-set Qualitative Comparative Analysis (fsQCA) to investigate organizational interactions and how the knowledge network-related conditions are associated with energy project performance. Our model considers knowledge network size, knowledge importance, knowledge uniqueness, intimacy of collaboration, and collaboration frequency with high project performance. Our outcome variable, i.e., performance measure, considers satisfaction with the project outcome, punctuality of the schedules, and the project's economic performance.

Our analysis did not find any necessary conditions for the high performance. The sufficiency analysis results reveal two configurations associated with high performance. In the first configuration, high-performing projects were able to find important and unique knowledge for their decision-making. In the second configuration, energy communities acquired knowledge from a broad network. They found unique knowledge from the network and created close (intimate) working relationships with the key network actors.

Furthermore, our analysis finds three configurations associated with low performance. The first configuration is based on projects with small collaboration networks lacking essential and unique knowledge. The second configuration also failed to acquire important and unique knowledge but had frequent collaboration within their network. The communities under the third configuration collaborated with a small network, suffered from non-important knowledge, typically used electronic ways of transferring knowledge (e.g., emails), and had infrequent collaboration with network actors.

Our study contributes to energy innovation literature by explaining the causal complexity underlying high-performance projects. The practical implications can help communities and knowledge intermediaries enhance their activities regarding planning, information sharing, and decision-making.

Exploring the mechanisms of 'just' transition in the climate issue field

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There has been significant focus within business scholarship on the urgency of the anthropogenic climate crisis (Whiteman and Cooper, 2000; Wright et al, 2018; Wright and Nyberg, 2017; Soderstrom and Heinze, 2021; Adler, 2022; Nyberg and Wright, 2022; Bai et al, 2022; Kirk et al., 2023). Human activities have continuously contributed to an ever-steeper rise of global greenhouse gas emissions with an ever-increasing threat of long-lasting carbon lock-in effects, which can further lead to catastrophic societal and environmental consequences. Global responses to the climate emergency often favoured and promoted market-based mechanisms – such as the nurturing of clean(er)/green(er) technologies and private regulatory initiatives (Monios, 2023); the latter initiatives and tools aimed to provide incentives and opportunities for diverse organisations to work toward the deeper decarbonisation of their activities with the hope of facilitating net-zero transition of our economies.

Extant research in the field of STS stipulates how energy systems are highly entangled with wider assemblages within the economic, social and political (including geopolitical arrangements) realms; thus, any change to the existing energy system is likely to also alter the economic, political and social domains (Miller et al, 2015). Hence, socio-energy systems are both configured by societal actors but also reconfigure society (Miller et al, 2015). Similarly, clean(er) technologies are not developed and applied in a vacuum; and should not be understood solely as 'neutral' technical components and advancements. Clean(er) technologies emerge from evolving culturally regulated interactions and practices (Sismondo, 2017), influenced by diverse institutional actors within the contentious climate issue field (Hoffman, 1999) and their diverging demands; the knowledge generated to develop clean(er) technologies may thus be framed as 'resource' on which public authorities, companies, alliances and research institutions all have a claim, with the aim to enhance their own competitive capacity (advantage) on the global scene, reinforce their influence in shaping clean transition, define sustainable futures according to their own agendas/interests and ethical assumptions. The latter positions cleantech within our technology cultures both as the 'solution(s)' through which societies are believed to be strengthened when facing climate

events and propelled toward a clean transition, but also as locus of new (skewed) vulnerabilities (Bijker et al, 2014).

The purpose of this paper is to understand how clean technology alliances, which embed private-public actors as their members, shape both the regulatory and economic environment enacted to facilitate a clean(er) transition. More specifically, how do clean technology alliances, given their role as central intermediaries between rule-makers and rule-takers, (re)configure ethical considerations (including normalising novel vulnerabilities) through their efforts?

The paper will be founded on a multi-site comparative ethnography (Marcus, 1995) of cleantech alliances in two countries. This study will rely on both primary and secondary data sources, including: 1) semi-structured interviews with a sample of diverse actors involved in cleantech alliances; 2) observation of meetings, webinars/seminars and annual conferences between these diverse actors; 3) archival data about the cleantech alliances and the climate issue field. The analysis will track diverse cleantech alliance actors' rationale, justifications and actions over time as they negotiate inclusion/exclusion of voices, reconfigure (normalise) vulnerabilities, temporally settle on technologies and an agenda toward 'just transition'.

Consequently, this paper contributes to extant STS research by shedding light on the role and evolving actions of intermediary organisations, such as clean technology alliances, in reconfiguring existing technology cultures and thus, facilitate transitions that suit their own agendas – notably by shaping technological solutions that are guided by their envisioned clean(er) future, formatting a propitious economic and regulatory environment, normalising novel vulnerabilities according to their own underlying ethical positioning.

Prevalent use of low-quality offsets by major companies undermines integrity of net-zero pledges

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As net-zero targets become mainstream, carbon offsets have gained traction as a decarbonisation too, largely because they allow a company to reduce emissions at low cost without disrupting established business practices. Yet a rapidly increasing body of evidence shows that many offset projects are of poor quality and fail to reduce carbon emissions as claimed. Criticism has particularly concerned offset projects involving forest conservation (REDD+) and renewable energy. Not only are such projects unable to remove atmospheric carbon, but previous studies have shown that they are also prone to over-crediting and exaggerating their 'additionality' (i.e. the claim that the project would not have been implemented without revenue from selling offsets).

Within the wider literature on corporate responses to climate change, many scholars have studied trends across the voluntary carbon market at large, methodologies and specific offset registries, where credit retirements are recorded and disclosed. Analyses of firm-level offsetting activities, however, are relatively few. Moreover, scholars have yet to exhaustively study the publicly available data on registries to examine the behaviour of large-scale corporate

offset buyers. With offsets playing a central role to achieving net-zero goals for many larger buyers, there is a pressing need to objectively assess the characteristics and quality of offsets used.

Accordingly, we examine the characteristics and quality of the offsets retired by the twenty companies responsible for the largest volume of offsetting activity on the VCM. We build a novel, publicly available dataset that compiles each company's retirements between January 2020 and December 2023 on the three largest VCM registries: Verra's Verified Carbon Standard (VCS), Gold Standard (GS) and the United Nation's Clean Development Mechanism (CDM). Guided by our research question, 'To what extent do the offset credits and projects used by these companies reflect common standards and principles of quality?', we comprehensively investigate retirement behaviour from five perspectives: (1) emissions reduction approach (i.e. avoidance or removal); (2) project type (e.g. renewable energy); (3) age of projects and credits; (4) additionality of renewable energy projects; and (5) cost of credits.

The analysis reveals prolific retirements of low-quality and cheap offsets. Of the twenty companies examined, none has concentrated its retirements on sourcing offsets that conform to key quality standards in the voluntary carbon market. Specifically, 97.5% of the roughly 134 Mt CO_2e of credits retired since 2020 derive from avoidance projects that do not remove atmospheric carbon, defying calls for a 'shift to removals' by established principles. Furthermore, 80% of credits come from REDD+ and renewable energy, which have a high likelihood of overstating their emissions reductions and over-issuing credits. Our analysis of buying behaviour suggests that many companies have continuously sourced these low-quality offsets because of their low cost. Finally, we find that most offsets derive from aged projects, indicating that the bulk of company spending on offsetting has not supported new investments in climate mitigation.

Our findings reinforce claims that dominating practices on the voluntary carbon market are not supporting effective climate mitigation. Our contribution is to demonstrate that individual companies are a major cause of persisting quality issues because of demand for problematic and cheap offset types known to overstate emission reductions. This finding adds a novel dimension to the extent literature's hitherto focus on supply-side dimensions in the voluntary carbon market such as offset projects, registries and methodologies.

Risk Governance in CO2 – removal services as global means of mitigating climate change effects: the case of Complementary Currencies for Climate Change

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In recent years, Carbon Removal (Carbon Dioxide Removal or CDR) techniques (nature-based) and technologies (industrial-sized) aiming at actively removing CO_2 from the atmosphere have been in discussion. The goal is to reduce the concentration of CO_2 in the atmosphere by achieving *negative emissions*, where more CO_2 is removed than emitted. It includes methods like afforestation, reforestation, direct air capture (DAC), bioenergy with carbon capture and storage (BECCS), ocean-based approaches, enhanced weathering, and more. Also, Carbon Sequestration technologies attempt to capture and store carbon dioxide (CO2) from the atmosphere and prevent it from being released back into the atmosphere. Examples range from storing CO_2 in soils, forests, geological formations, or the ocean, with the goal of long-term storage.

Most of these technologies are highly contested regarding its technical feasibility, economic and energy efficiency, unwanted consequences, and most of all rebound effects (delaying the process of decarbonization). However, even the IPCC states that “Carbon Dioxide Removal is a key element in scenarios that limit warming to 2°C (>67%) or 1.5°C (>50%) by 2100 (high confidence)” (IPCC 2023).

In this sense, this contribution discusses how innovative concepts of “Risk Cost of Carbon” by Chen et al. (2019) attempt to reward per tonne of additional CO_2 mitigation services. The authors propose to grant a price(signal) for “climate mitigation services that can reduce systemic risk to a normatively agreed level” (Chen, van der Beek, and Cloud 2017, 234). With this idea, the authors utilize the social mechanism of a symbolically generalized exchange medium to create a global governance of climate change mitigation efforts. To absorb the uncertainty of long-term efforts, a complicated financial architecture needs to be created, including instruments like “Quantitative Easing” (Esposito 2016) to establish a “Complementary Currencies for Climate Change (4C)“ (Chen, van der Beek, and Cloud 2019). To complement already established measures like carbon taxes (the stick), the RCC approach offers the carrot to create motivation to invest in CO_2 level-reducing activities.

This idea calls for an interdisciplinary effort from economics, physical sciences, sociology, technology assessment and more to work on a common pressing issue: how is it possible to create an immediate resonance from global society to a development with catastrophic outcomes. My contribution wants to present the potential for such interdisciplinary efforts.

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Integration of carbon budgets into regional climate policy: Finding agency to accelerate mitigation

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The IPCC AR5 report’s emphasis on the global carbon budget marks a significant change in climate mitigation strategies, as it highlights the importance of accumulated emissions and the need for rapid climate action (Lahn, 2020). This shift is particularly relevant in Sweden, where the decentralisation of national governance has made sub-national actors increasingly important in developing innovative climate policies. Consequently, there is a growing grassroots interest in calculating carbon budgets for Swedish counties to understand how regional and local efforts can contribute to meet the Paris Agreement. However, integrating regional-level carbon budgets into broader policy frameworks to accelerate climate action presents various challenges. A central problem concerns identifying who has the mandate and authority to expedite mitigation efforts. This paper aims to discern political and institutional agency within the regional governance in Sweden in relation to a mitigation pathway compliant with the Paris Agreement. More specifically, our analysis concentrates on different modes of governance (Bulkeley and Kern, 2006; Elofsson et al., 2018), elucidating the division between direct and indirect agency. Empirically, our study is based on the set of three workshops in the counties of Västerbotten, Västra Götaland, and Östergötland, which included representatives from industries, the transport sector, the energy sector, energy- and climate planners from local and regional governments. Our findings suggest that indirect agency is prevalent concerning technical solutions at the user level, such as electric vehicles or electrified industrial processes. However, this agency is lacking when it comes to interventions on a systemic level necessary to substantiate electrification as a mitigation strategy. Examples include wind power infrastructure, energy storage capacity, and the regulation of electricity use to prevent power peaks. Our findings demonstrate that the use of governance by authority is limited despite being deemed crucial for facilitating a rapid transition. The results also reveal that regional actors capable of exercising authority are similarly dismissive of this governance mode, even though legal avenues exist for its use. Despite these constraints on local and regional actors’ agency to govern low-carbon transition, the results also highlight novel observations concerning governance through agenda-setting and experiment. In particular, the industry sector recognises significant potential in leveraging agenda-setting in relation to current state. This suggests that the industry sector may acquire greater influence in forming future coalitions to advocate for climate action. However, the strategic use of agenda-setting practices might risk becoming a delay mechanism, shifting the focus from immediate action (self-governance) to relying on future interventions by others. In contrast, the public sector exhibits a notable

interest in experimentation, possibly because conducting experiments confined in time and space poses fewer political risks than committing to a permanent solution. As higher-level governance bodies must assist less resource-strong municipalities in horizontal and vertical upscaling (Kern et al., 2023), counties play a crucial role in facilitating social learning through experimentation, which is essential for this governance approach to achieve its full potential. Finally, our findings spark further discussions on which sectors should participate in targeted interventions and the forms of governance required to expedite the transition.

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Taking stock: use and governance of AI for climate action in European cities

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In recent years, many cities around the world have shown interest in AI approaches to help achieve carbon neutrality. For example, European cities worked with start-ups to develop artificial intelligence (AI) prototypes to reduce carbon emissions in the energy and mobility sectors as part of the EU-funded AI4Cities project (2020 to 2023). There is a need for policymakers and researchers in cities to receive overarching guidance or an overview of potential applications, risks and governance approaches. Given the novelty of the field, there is no research that maps how European cities are currently using AI for climate change mitigation.

With this research, we present a first inventory of current practices and governance approaches at the intersection of AI and urban climate action. Our approach involves the collection and evaluation of case studies based on six different cities: Amsterdam, Berlin, Copenhagen, Helsinki, Paris and Vienna. We selected these cities based on their leadership in climate action, experience with AI, and existing expertise in city government. For each city, we conduct several semi-structured qualitative interviews with key practitioners. We then transcribe the interviews and apply thematic analysis to extract relevant data points and themes. We also conduct document analysis of strategic plans and other relevant case study material.

We present our findings in four parts. First, we present specific application areas for AI in urban climate change mitigation based on current practices in the six cities. Second, we analyze local

governments' motivations and approaches to using AI, finding that these are often primarily efficiency-related, rather than emissions-related. Third, we outline key challenges and risks, such as lack of expertise and context-specific ethical issues related to AI. Where possible, we outline solutions to these challenges and risks. Finally, we present the different governance arrangements that cities are implementing around the development and deployment of AI. For example, we outline arrangements that involve collaboration with the private sector, as well as those that focus on internal capacity or collaboration with universities.

Based on these findings, we discuss the opportunities and limitations of using AI, and how the examples from the field compare to the research body at the intersection of AI and urban climate change mitigation. We reflect on the role of the public sector in shaping AI development for the public good, particularly through public procurement, and the lack of civil society engagement. We critically outline recommendations for urban practitioners and policy makers on how to navigate AI governance in the context of climate change.

C.4: New social and technical challenges in transforming the energy system towards greater sustainability

Session Chair: Jürgen Suschek-Berger, IFZ, Austria

Session Chair: Michael Ornetzeder, Austrian Academy of Sciences, Austria

Practicing relational engagement in EU energy project contexts

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A key way to attend to social-technical challenges in the sustainable energy transition, is public engagement. Public engagement is often organised in the format of EU energy projects. However, engagement in those projects has been repeatedly criticised for not living up to its potential to grapple with social issues by being too instrumentally motivated. STS work on relational engagement can help to overcome this critique, as it offers a more reflexive, nuanced, and dynamic perspective. To bring relational engagement into practice in EU energy projects, it is key to consider the implications of the organisational context of EU energy projects. Although STS engagement scholars emphasize that engagement shapes and is being shaped by its contexts, insights are scarce on how relational engagement can be brought into practice in specific contexts. To address this gap, we investigate new ways of organising project contexts to enact more relational STS understandings of engagement. We answer the following research question: *how can relational engagement be enacted in the contexts of EU energy projects?*

To answer this question, we make a novel connection between STS engagement literature and project management literature. We connect those theoretical insights with our empirical analysis of engagement in EU Horizon 2020 energy projects, which adds new insights on how engagement unfolds in this applied context in practice.

We identify three components that combined create organisational forms of EU energy projects that can enact relational engagement: practicing, enabling, and steering. First, to practice relational engagement it is key to reflect and respond upon the way engagement evolves, thereby enacting critical relational thinking as put forward by STS scholars. Second, to enable these relational engagement practices, there should be flexibility for engagement in the project organisation, instead of focussing on predefined engagement practices. Our empirical investigation shows that flexibility is created in a combination of two aspects: the degree of detail in the project proposal, and the degree to which it is allowed to deviate from what was proposed during the project. Third, relational engagement needs to be steered, to ensure that the flexibility is used in a relational manner. One way to steer engagement is through indicators, as engagement practitioners were found to use the flexibility to adjust their engagement practices to fulfil the target indicators. Nevertheless, we found engagement practitioners to go beyond those indicators based on their own skills, pointing to engagement practitioners' skills as another way to steer relational engagement.

Our research shows key elements for new organisational forms of EU energy projects that can foster relational engagement. We offer a more nuanced understanding of organisational contexts in our theoretical thinking about relational engagement. This more contextualised understanding highlights that engagement in EU energy projects needs to fit within the organisational boundaries put by EU energy projects, as engagement needs to fit within the enabling flexibility for engagement, and is steered by the indicators and skills determined in the project. Nonetheless, we do see opportunities for bringing relational engagement into practice in the projects. This requires efforts from both engagement practitioners and policy makers who design the projects. In this way, we contribute to new forms of EU energy projects that can enact more relational engagement practices. This helps to shift away from instrumentally focussed engagement towards more reflexive and nuanced engagement practices, to address social-technical issues in the energy transition in a more responsible and just manner.

Methods for integrating social dimensions into energy system modelling (ESM) – A review

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The scale and buildout rate of renewable energy projects need to increase dramatically over the next decade to meet the Paris Agreement as well as to reduce our dependency on fossil fuels. This transition is shaped by uncertain factors, which include technology innovation, resource availability, and socio-economic variables. Energy system modelling (ESM) has been a key policy tool to study decarbonisation pathways. ESM provides stakeholders in the energy sector with knowledge-based and systematic methods to reach decisions about which technologies to support. However, present-day ESM mainly integrates techno-economical input parameters, whereas social factors, such as local responses to new installations, well-being impacts and social justice considerations are largely understudied. ESM might therefore produce solutions that are not accepted by communities and as a result, could jeopardize

energy transition goals. This paper aims to present a systematic review of literature that has aimed to integrate non-technical (e.g. social) dimensions into ESM. The review draws from a compiled database of studies and reports at local and national levels that have focused on systems with a high share of variable renewables. The paper will aim to provide a critical overview of the state-of-the-art of this growing body of literature, providing an understanding of what social variables have been considered, what methods have been used to gather data and link quantitative and qualitative analysis, and who are the stakeholder groups that have been engaged. The paper will then explore how these new insights are transforming the way we look at energy systems models and outline remaining challenges and avenues for improving the integration of socio-technical parameters. Hence the review findings intend to highlight the importance of considering social dimensions in ESM frameworks and envisioning new research strategies that increasingly involve social groups in the energy transition.

Pathways towards a future vision: A systems based and stakeholder integration approach to avoid socio-environmental conflicts in combating climate change

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While the need to combat climate change gets more and more urgent and timely action is called for also the potential of socio-environmental conflicts becomes a critical aspect in the implementation of climate mitigation policies. To avoid such conflicts, a more holistic approach towards sustainable development and climate-friendly living is needed which includes not only the goal of reducing greenhouse gas emissions but also other environmental, social and economic goals in line with the commitment to the Sustainable Development Goals (SDGs). In Austria, many quantitative models focus on simulating scenarios of different climate mitigation pathways. Considering multiple goals, including environmental or social ones, is often lacking. Hence, the systemic nature of the SDGs is hardly captured in these models. Also, an extensive stakeholder perspective on systems behavior and future visions is rarely considered in quantitative modelling approaches of pathways.

In this research, we therefore put focus on a holistic approach combining stakeholder collaboration with modelling approaches in climate friendly pathway development. First, the stakeholders' system understanding is elaborated regarding four specific aspects which represent all the three dimensions of sustainable development and are often at odds: Energy poverty (SDG1/10), decent work (SDG8), economic growth (SDG8) and greenhouse gas emissions (SDG13). This approach allows us to assess the stakeholders' systems understanding on which their everyday decision making is based on. In further stakeholder workshops the future vision and transition pathways are elaborated applying different methods as art-based methods or storytelling. From this, indicators for the future vision as well as policy interventions are derived.

Accompanying this stakeholder integration process, the results of the workshop are set into a modelling context. In order to take account of the multiple interactions and potential feedback effects that link the four different topics of our concern, we approach the analysis with system dynamics-based modelling. Therefore, the iSDG model for Austria is applied which is a

simulation model that has been used for the analysis of policies for sustainable development in other country contexts (e.g. Allen et al., 2019; for the Austrian model see Spittler & Kirchner, 2022). It consists of thirty sectors that represent the social, environmental and economic dimension of sustainable development and includes a rich feedback structure within as well as between these sectors. Therefore, it is suitable to analyse synergy and trade-off effects of policies and transition pathways as developed in the course of this research and to capture the systemic nature of the SDGs. By applying the iSDG model in combination with the stakeholder integration process we can achieve insights regarding (1) the difference between the systems structure the model is based on and the stakeholders understanding und (2) whether pathways that are elaborated by the stakeholders lead to the envisioned future. Finally, the results will overall highlight synergy and trade-off effects that are to be considered in order to successfully combat climate change in the broader context of sustainable development.

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Navigating social acceptance for large renewable energy technology infrastructures in Austria: A multifaceted analysis of socio-technical transformations and possible pitfalls

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There is vast literature aiming to understand why local renewable energy projects are supported or opposed by local communities (Hall et al., 2013; Walter, 2014; Dermont et al., 2017; Stadelmann-Steffen and Dermont, 2021; Windemer, 2023). The literature has gone beyond the widely criticised NIMBY framing (Xu et al., 2023) and subsumes the public's response to renewable energy technology (RET) mainly under the terminology of social acceptance and, in the local context of community acceptance (Wüstenhagen et al., 2007; Sovacool et al., 2012; Devine-Wright, 2011; Batel, 2020).

However, most of the literature to date relates to RET projects such as wind turbines, in which the factors for the acceptance or rejection of specific projects are worked out. Less literature is dealing with carbon capture and storage (CCS) as a technology to reduce CO2 emissions going beyond RET and questions of social acceptance related to it (for exceptions see.g. Karytsas et al., 2023).

What is true for RETs, namely that there is often a widespread positive public support (at the socio-political level) for renewable energy projects, while projects at the community level are met with resistance, the so called "social gap" (Sposato and Hampl, 2020), does not hold so clearly for other RET (such as CCS projects for example). Therefore, social acceptance has

to be considered in more detail on several levels, of which socio-political factors (e.g. Duan, 2010) and community factors (such as the NIMBY-problem and others; e.g. Kräusel & Möst, 2012; Carley et al., 2020; Foster and Warren, 2022) lie in the center of this contribution. Consequently, this contribution revolves around a comparison of different technology pathways in the light of potential pitfalls and factors influencing public perception and acceptance. We explore factors of social acceptance at both socio-political and community levels in Austria by embedding our empirical research in the state of the art on other more researched RETs. The empirical data deals with capturing both the production of public image of CCUS and its reception in Austria, namely an analysis of media articles and discussions of CCUS in online forums. Throughout this exploration, key factors are identified at each level, which include emotional dynamics, trust, procedural fairness, perceived risk, knowledge and experience. This enables us to unravel the complex interplay of factors essential for attaining social acceptance. Furthermore, a comprehensive media analysis of CC(U)S discourse in the designated country provides valuable insights into public image production, perception, and typical patterns of argumentation of key actors in the discourse. The findings from the most recent discussion on CC(U)S in Austria will be compared to other RET such as wind turbines or fracking.

Our study contributes to the STS state of the art on new social and technical challenges in transforming the energy system towards greater sustainability by shedding light on a topic that is underrepresented in the literature on social acceptance, but (i), is becoming increasingly important in the course of climate protection strategies and (ii) is controversial, especially with regard to social acceptance (iii) on which there are still no data and studies in Austria available. Furthermore, it can be a valuable resource for stakeholders navigating the intricate terrain of large infrastructure projects, emphasizing the interplay between emotional dynamics, mechanisms of trust, and transformation in the pursuit of sustainable energy technologies.

The Role of Digitalization in Reducing Energy Poverty

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Energy plays a central role in modern society, serving as a fundamental commodity that supports various activities such as heating, lighting, and cooking. It is one of the most exchanged assets, satisfying human needs and propelling countless services. The global concerns surrounding the energy system bring awareness of the need to reduce energy poverty. Energy poverty is a complex and multidimensional challenge, with different assessments depending on the context of the study. For instance, for low-income countries, energy poverty involves households lacking access to modern energy for essential activities like electricity and cooking fuels. Yet, for higher-income countries, energy poverty can be described as a situation in which citizens spend most of their income on energy debts or must lower their energy consumption to a level that negatively impacts their well-being, increasing their inability to keep homes adequately warm or cold.

Digitalization emerges as a potential catalyst for a clean energy transition, with the need for alignment between the rapid pace of digitalization and energy decarbonization. Usually called twin transitions, digitalization and decarbonization are often perceived with divergence in what concerns the intensity associated with their deployment. In other words, digital transitions tend to occur faster than energy transitions. Building synergies and fostering connections is necessary to incorporate digitalization into the energy industry. Therefore, new perspectives on the link between digitalization and energy are needed. This article is a step in that direction, exploring the connection between digitalization and energy poverty.

Econometric static and dynamic models are applied, using panel data from 32 middle-income countries to study the impact of the digitalization revolution on energy poverty in its most basic form, considering variables for the population's access to electricity and clean cooking fuels and technologies. Additionally, panel data from the 27 European Union members is used to assess how digitalization affects affordability and thermal comfort. A Digitalization Index, developed through Principal Components Analysis, serves as a proxy for a country's digitalization level, offering a comprehensive view without multicollinearity concerns.

The results reveal that in lower-middle-income countries, where the lack of access to clean energy is more prominent, on average, ceteris paribus, a 1% increase in a country's digitalization level, increases the population's access to clean cooking facilities and technologies by 0.009 percentage points. In upper-middle-income countries, the results are similar, with 1% of digitalization increasing access to electricity on average by 0.02 percentage points. Furthermore, in the European Union, digitalization can decrease the share of households with arrears on utility bills and the share of households suffering from an inability to warm homes properly. More specifically, a 1% increase in digitalization's level decreases households' arrears in utility bills by 0.056 percentage points and the incapacity to keep home warm by 0.028 percentage points.

The impact of digitalization on energy poverty is most pronounced in European countries, particularly in reducing utility bill arrears. Lower-income economies, with less developed digital infrastructure, experience resistance to the effects of digitalization, making it challenging for benefits to be felt or spread.

Digitalization presents opportunities to transform the energy system by providing practical solutions to the energy grid, including changes in consumer patterns and integrating digital technology into infrastructure. The policy implications depend on the context and indicators used to measure energy poverty. While these findings are based on studied digital indicators, literature, and potential implications, they confirm the hypothesis that the digital world can pave the way for energy inclusivity and climate protection.

Trust and participation in the energy community

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Energy communities engage households, businesses and public actors in the generation, use and sharing of renewable energy, and in other sustainable practices such as demand flexibility.

Energy communities emerge in many forms with varying compositions of participants and energy assets, and open opportunities for new actors and roles in the energy community ecosystem. The active participation of energy consumers is critical in the future development of energy communities. However, so far end-users have shown low enthusiasm and engagement in the energy community initiatives. Lack of awareness and trust issues impact participation in the energy community initiatives. Trust and participation are often interconnected and mutually reinforcing. Trust in other actors, technologies and knowledge increases probability of participation, the participation in an energy community may increase trust. However, this nexus is more complex than merely consequential, and requires further analysis in the context of the energy community. This research explores trust and participation as concepts in the energy community based on 96 value-focused interviews with energy prosumers and consumers who are potential participants in the energy community. Analysis of the interviews disclose factors that affect trust and participation in the energy community, and differences between prosumers' and consumers' values. Based on these findings, we propose digital strategies to overcome the hindering factors and enforce fostering factors to participate in the energy community and in the green transition.

Re-accelerating stalling energy transformations by policy intervention: the case of wind power in Europe

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Energy transition is entering a new phase that requires new policies and advances in scientific understanding. This paper is motivated by both policy and scientific challenges, especially obvious in the European Union (EU). The EU needs to deploy renewable energy on a massive scale to simultaneously mitigate climate change and ensure energy security. Yet, the growth of wind power, the most important renewable source, has stopped accelerating (Cherp et al. 2021). This means that the drivers of wind power in the EU are now counteracted by equally strong barriers including social and political opposition, grid integration, and competing land uses. The European Commission (EC) and the member states have adopted and planned a number of policies to overcome these barriers. Are these policies likely to succeed in 'bending the S-curve' of wind deployment and, if so, under what conditions?

This question represents a scientific challenge for the part of STS that focus on policy-driven technologies such as renewables. While different phases of technology development require specific STS knowledge (Markard 2018), current insights on policy-technology interaction are mostly limited to the early (Jacobsson and Lauber 2006) and the late (Turnheim and Geels 2012; Markard et al. 2020) phases. The knowledge gap on policy-technology interaction in mature yet still expanding socio-technical systems hinders the relevance of STS insights to the current policy challenges.

This paper explores the interaction between socio-technical systems and state policies at the advanced growth stages of policy-driven technologies using wind power in the EU as a case. First, we identify policy targets and analyze whether these targets envision a departure from

regular S-curves. We find that seven countries have set national targets to re-accelerate the growth of wind beyond their historical trends. Subsequently, we demonstrate that historical re-acceleration of wind growth involved enacting and then removing policies unfavorable to onshore wind deployment. This approach is unlikely to work at the current phase of wind power development, given the socio-technical barriers it faces. Finally, we identify policies that the EU and Germany are adopting to overcome these barriers. We show that these policies primarily focus on improving regulations, infrastructure and setting aside land for wind power on the grounds of 'overriding public interest', while more seldomly addressing the complex dynamics of socio-technical systems resulting in social and political opposition. By viewing the barriers as largely administrative, these policies do not address socio-political opposition and other emerging phenomena in socio-technical systems. We conclude with a discussion of the research agenda for STS, focused on the interaction between policies and socio-technical systems at the advanced growth phase of policy-driven technologies.

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Navigating justice in low-carbon transitions: insights from European case studies

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As Europe intensifies its efforts to transition towards a low-carbon economy, it is increasingly apparent that transition policies may aggravate existing inequities or create entirely new ones. Movements like the protests organised by the “yellow vests” protests or more recently farmers indicate a growing recognition of this issue. Nevertheless, many transition policies persistently neglect justice considerations. Against this backdrop, our research explores the social repercussions of contentious transition policies in five EU countries.

Our case studies encompass diverse policies: energy-efficient building renovation and the shift away from oil and gas heating systems in Innsbruck (Austria), peat energy phase-out in Ostrobothnia (Finland), the planned thermic ban in Brussels (Belgium), conflicts around wind and solar energy in the Anoia region (Catalonia, Spain), and the solid fossil fuel phase-out in Krzywcza (a rural municipality in Przemysl County, Poland). While all of these policies represent important steps towards climate mitigation, their adverse social impacts could be substantial if justice-related issues are inadequately addressed.

The broad range of case studies demonstrates that achieving a "just transition" extends beyond merely providing compensation for displaced workers and promoting green jobs. It encompasses diverse facets such as rural and urban livelihoods, housing, health, identity, culture, and participation. We aim to broaden the scope of transition studies, which often narrowly focus on technological innovation, by devoting special attention to ex-novation (the abandonment or phase-out of detrimental practices). We argue that this is key to understanding the challenges posed by these transitions, particularly when phase-out policies target deeply ingrained habits and powerful vested interests.

This paper contributes to the ongoing discourse, emphasizing the necessity to integrate justice considerations into low-carbon transition policies to ensure public support and hence the successful and timely implementation of these crucial initiatives. It does so by linking political ecology and just transition concepts with systems thinking tools. Transcending the prevalent technology-centric transition literature, our study develops Causal Loop Diagrams (CLDs) for each case, visually representing the main problem dynamics. These diagrams further enable a nuanced assessment of justice and equity implications, an identification of barriers, and the pinpointing of potential leverage points. Furthermore, following Sovacool's (2021) framework, we examine each case study with regard to four processes—enclosure, exclusion, encroachment, and entrenchment—potentially deepening inequities.

Preliminary findings suggest that the planned policies fail to adequately recognise the vulnerabilities and adaptive capacities of affected population groups (such as tenants, local landowners or commuters, e.g.). As a consequence, the transition policies may deepen both distributional and procedural injustices, which may erode political support for the transition. Using the CLDs as analytical devices, we propose interventions that may contribute to aligning

social and ecological objectives. These interventions involve structural adjustments that go beyond market-based interventions and amend incentive structures so that the benefits and burdens of the low-carbon transition are shared more evenly between more privileged and socially marginalised groups. Finally, our reflections on the variations and commonalities among the case studies offer insights into the broader challenge of achieving a just transition across the EU.

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Place-based resources, actors, and policy participation for transforming power production to clean and renewable sources

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This paper uses networks of action situations (NAS) (Villamayor-Tomas et al. 2015) together with actor network theory (ANT) to identify the decisions that were and are being made in Saskatchewan, Canada regarding power production and explore what future choices are available in the context of climate change. This is an important area of inquiry given the provincial reliance on fossil fuels and the increasing Canadian federal government restrictions and regulations concerning fossil fuels and increasing carbon tax. The future pathway of this province to net zero, like many fossil fuel dependent regions is unclear.

Action situations correlate to decision-making spaces, or “social spaces where individuals interact, exchange goods

and services, solve problems, dominate one another, or fight (among the many things that individuals do in action situations)” (Ostrom 2011: 11). These spaces are influenced by institutions, or stable, collective patterns of dealing with basic social functions—the rules of the game (Lauer et al.2006; North 1991). This paper contributes to the NAS by adding the concept of ‘actants’ or non-human entities that are meaningful and influence decision making. This paper addresses a gap in knowledge surrounding upstream power production projects and planning (as opposed to assessment of post failure projects) and what types of social learning and or formalized knowledge systems can achieve paradigmatic shifts in socio-technical systems.

A theoretical and methodological contribution to NAS literature is made with focus on interconnected human and non-human objects (carbon, hydro, and uranium) or ‘actants’ and the development of discourses supporting or opposing their development. Actants provide the nodes of focus, while discourses explain the development of actants and their links. Identification and explanation of the emergence and recession of actants on the Saskatchewan landscape are analyzed with diagnostics of telecoupled systems, polycentric governance, and flows of faction situations. Focus group and survey data are used to identify future pathways and imaginaries of power production and the actants of carbon, hydro and uranium. Actants of carbon (coal) and hydro are possibly kept alive with carbon capture and storage and import of

hydroelectricity from the distant action situation in a neighboring province (if the necessary infrastructure is built).

While actants of renewables are strongly emerging, so are other clean technologies, depending on place. This expanded theoretical conception of NAS illustrates distant action situations impact on local narratives and decision-making and dynamics of polycentric governance that are neither top down nor collaborative. This theoretical expansion, together with policy framing and participation allows for multiple future pathways (based on NAS nodes), many of which are place based and associated with local place attachment and resource endowments. While there is still a considerable gap between on the ground mitigation and stated goals, focused discussions and participation of people can advance the solution space.

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Designing institutions for Emerging Technologies in the energy transition: Towards a heuristic model

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In an era marked by significant societal challenges, the pivotal role of emerging technologies, particularly in the energy transition towards the 2050 net-zero greenhouse gas target, has garnered considerable attention (Mazzucato, 2021; Ulnicane, 2022; Diercks et al., 2019). These technologies, characterised by radical novelty, fast growth, and profound impact, inherently carry considerable ambiguity and uncertainty (Rotolo et al., 2015). For instance, the Netherlands views the uptake of large-scale energy storage (LSES) technologies, such as flow batteries and hydrogen, as essential to better balance energy supply and demand. Yet, the nascent nature of these technologies poses uncertainties regarding their operational scale and the benefits and challenges of integration.

To effectively harness emerging technologies, it is necessary to make adjustments to institutional design, so as to harness the benefits of these technologies while minimising potential risks (Rip & Kemp, 1998; Mandel, 2009; Chleba & Simmie, 2018). In the literature on institutional design, the term institutional design encompasses both formal mechanisms, such as laws and contracts, and informal mechanisms, such as values and customs, ‘between

actors that regulate their relations: tasks, responsibilities, allocation of costs, benefits, and risks' (Koppenjan and Groenewegen, 2005: 243). While institutions provide stability, they might lack the agility needed for rapidly evolving technologies. In the case of LSES, there are concerns among stakeholders that these technologies could outpace Dutch regulations, potentially stymieing their development.

Although there is a substantial body of research on institutional design in relation to technologies, the focus has predominantly been on established ones (Koppenjan & Groenewegen, 2005, De Bruijn & Herder, 2009). The distinct challenges posed by emerging technologies to institutional design due to high uncertainty levels, especially concerning risk management, regulatory structures, and governance, are somewhat underrepresented in the current literature (Isigonis, et al., 2020; Linkov et al., 2018; Marchant, 2020; Mandel, 2009; Withford & Anderson, 2021). It is insufficiently understood how to manage challenges when designing institutions for emerging technologies, despite the growing importance of emerging technologies e.g., in the Dutch energy system. Therefore, this research seeks to address the following research question: What are the key challenges in the process of designing institutions for emerging large-scale energy technologies and how can they be managed?

Employing Koppenjan and Groenewegen's (2005) framework for analysing institutional design, this paper explores the key challenges posed by emerging technologies when adjusting institutions, focusing on emerging LSES technologies in the Netherlands. Data derived from 31 in-depth interviews and 4 focus groups with LSES stakeholders provides an initial exploration of the current institutional design and its inherent challenges. This is followed by synthesising insights from both the emerging technology governance literature, along with the results of the LSES case study, leading to a heuristic tool for such technologies.

Unlocking Integration: A Case Study on Smart Energy Systems in Austria

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Greater integration of the different sectors of the energy system is seen as one of the key strategies to support the transition to a more sustainable energy system. The rationale behind this approach is to move away from sector-specific approaches, which only consider solutions within sectors, to a more holistic approach across all sectors, allowing for energy efficient and more cost-effective overall configurations.

A classic example is combined heat and power (CHP) technology, which produces both electricity and heat, thus achieving higher overall efficiency. Beyond this example, there are many other possible configurations in which technological applications from different sectors can be combined to achieve significantly higher levels of efficiency. Today, the term "smart energy system" is used in the literature to refer to energy concepts in which different energy forms and sectors are combined with intelligent control technology to create highly efficient overall solutions.

However, a number of regulatory, organisational, economic and technical issues limit the widespread implementation of such solutions. In addition, sector coupling approaches often lead to increased complexity and thus to new and difficult to assess risks.

This paper presents a case study from Austria where the heat, gas and electricity markets have been coupled in several ways. The underlying empirical investigation was carried out as part of the European MATCH project. A total of seven qualitative interviews were conducted during two site visits; with the project manager and two people involved in the project, as well as with three residents of the housing estate. The interviews were transcribed and analysed using content analysis software. In addition, written material (reports, project descriptions) was included in the case study.

In the paper, we argue that the smart energy system studied could be realised because it was embedded in a protected innovation niche and because it could build on a number of pre-existing resources and supportive structural conditions. Our evidence shows that it was crucial for the establishment of the pilot project that the main project owner had a long history as a multi-utility company and that services and infrastructure units had never been fully unbundled in the course of the liberalisation of the energy markets. This reduced potential technical, economic and organisational risks. Financial support from research funds and the manageable size of the project also helped to reduce risks. However, there has been criticism from the end-user side that this solution has created a monopolistic situation. These and similar issues need to be addressed before integrated approaches can be scaled up.

Securing electric power grid – negotiating expertise: the case of Norway

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The growing electrification of society, coupled with the management of new energy resources like renewables and increased electricity demand such as electric vehicles, is reshaping the electric power system in Europe. This evolution involves an increasing integration of sensors, communication, and automation, resulting in a more active and digitalized monitoring and control of the electric power grid. Consequently, we now have a cyber-physical electric power system where the functioning of the physical power system relies heavily on data transmitted through digital networks.

This development increases the number of potential entry points for an attacker and makes the system more difficult to protect. Also, society is more dependent on electric power than ever before, and the consequences of a successful cyber-attack may become catastrophic. Take for example, Russian attacks on the Ukrainian power grid (Kostyuk & Zhukov, 2017), the Chinese attack on the Indian power grid (Sanger & Schmal, 2021), and more recently, the Russian and Chinese-linked cyber groups attack of the UK's Sellafield nuclear site (Isaac & Lawson, 2023).

As cyber-attacks on critical infrastructure become more commonplace and are now considered a «new normal» (Burgers & Farber, 2021), information engineers are actively engaged in developing appropriate methods to assess and reduce cybersecurity risks in cyber-physical

electric power systems. However, there is a limited understanding of how interprofessional expertise is negotiated when assessing social risk associated with potential failures in electricity power supply.

This contribution aims to address how professionals from distinct groups, such as engineers and cybersecurity specialists, engage in the collaborative efforts to enhance smart grid resilience in Norway as a case study. Utilizing the STS concept of 'interactional expertise' (Collins & Evans, 2002) originally developed to comprehend interdisciplinary scientific collaborations, I explore the development of hybrid expertise among electrical power grid professionals through an analysis of cybersecurity practices within a Norwegian grid company.

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Empowering End-Users: Information Campaigns as Catalysts for Energy Efficiency Policy and Behavioural Transformation

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The existing discussion on policy instrument-mix determination is largely dominated by the political factors – power, politics and path-dependence. While these analyses rightly point out the undue influence of politics on instrument selection, they ignore the key role of end-user and society. We divide these two diverse but interconnected aspects (through political economy considerations) as demand-side (end user and society) and supply-side (power and politics) of policy instruments. Such a conceptualization paves the way for our analysis of determining acceptance of policy instruments by the end-users and the role of information and awareness campaigns as the foundational instrument in facilitating transitions.

Our research question specifically deals with understanding the dynamics of ban on incandescent lamps for determining policy-instrument mix for energy efficient building transitions in Austria. Specifically, we investigate – what is the implication of successful ban

on incandescent lamps for energy efficient buildings regulations in terms of policy instruments? Conceptually, we focus on two aspects: 1) technical interconnectedness of the two sociotechnical systems as lighting is nested in the energy system of buildings, and 2) common denominator of end-users and the need of behavioural change.

To answer the question, we utilize a Delphi survey gathering insights from a broad spectrum of stakeholders (total 13 participants) – government representatives (3), citizens (3), practitioners (architects and designers) (3), and policy researchers (4). The objective of the survey was to understand consent and dissent across seven themes such as the overall perception of climate change, current status of LED transition, and expectation of participants in terms of policy instruments to facilitate transitions in buildings based on their experience and knowledge about the LED transition and current buildings transition. The initial questionnaire included 26 statements. In the second round, 7 statements were included based on the consensus reached.

Among the groups, there are significant difference between responses by citizens and government as shown by the result of Dunn test. These differences highlight the differences in supply-side and demand-side of policy instruments. In terms of number of “Do not know/No opinion”, “Citizens” category (4 respondents) across different questions answers with “Do not know” on 15 occasions. The “Government” category results in 0 occurrence of “Do not Know”. Surprisingly, none of the participants mentioned the “kilma:activ” programme to highlight government’s efforts to raise awareness toward energy efficiency. Another important issue raised by “Citizens” and “Practitioners” is the bureaucratic hurdles in availing subsidies, even if awareness about such interventions is high.

Our analysis reveals that information and awareness campaigns (point of dissent) are fundamental for ensuring success of instruments like subsidies, bans and taxes. Such campaigns can not only overcome the challenges of populism, but could also sensitize end-users to translate their knowledge (benefits of energy efficiency and urgency of climate action) into action.

Based on our finding, we design an information and awareness agenda identifying the greater role of different actors and agencies in designing and implementing it. The onus of designing and implementing such an information agenda rests on institutional innovation. In the case of Austria, Austrian energy agency needs to overhaul its awareness campaign to cater the need of greater societal engagement in sustainability transitions. It will require institutional innovation, greater emphasis on streamlining bureaucratic process, coordinating with practitioners, utility providers and retailers, and treatment of end-users and society as an active actor in transition.

We conclude by discussing the implications of our research for policy formulation, emphasizing the need for strategic communication to enhance the public's receptivity to energy-efficient technologies. The study contributes to the broader dialogue on sustainable energy practices, offering evidence-based recommendations for policymakers and stakeholders involved in energy conservation efforts.

C.5: Upscaling Sustainable Energy Tech Transformations: A Comparative Analysis of Demonstrations in the Global North and the Global South

Session Chair: Sandra Hasanefendic, Vrije Universiteit Amsterdam, The Netherlands

The Impact of Consultancy Reports on the Development and Vision of Smart Grids in Sweden

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We need to transform our energy systems. Many factors contribute to this urgency as for instance increased environmental concerns, growing demand for electricity, driven by urbanization, population growth and accompanying housing construction, automation and electrification of industries, and the need for electricity in the transportation sector to enable fossil-free transportation. In Sweden, as in many countries, there is a need to modernize the energy infrastructure. The grid today is not designed to meet the increasing use of intermittent energy sources, higher demand for electricity, the need to reduce the carbon footprint, or the electrification of transportation and industry, leading to major challenges and opportunities for the grid. Here the smart grid is often seen as “solution” for all these interlinked issues. So far “the smart grid” is more of a vision than reality, even though elements of the grid might already be smart. This gives, however, tremendous opportunities for the future of the grid.

This study focuses on the role of consultancy reports in shaping and developing vision of smart grids in Sweden, thus the aim is to understand the influence of consultancy reports on the envisioning and development of the smart grid. We want to explore how these reports can contribute to defining problems, setting agendas, and recommending solutions for the future of the electricity grid in Sweden.

The study follows a qualitative research approach and combines first an actor mapping of key stakeholders, a document analysis of 26 consultancy reports, and 10 (?) semi-structured interviews with (governmental) officials who commission these reports. We conducted a thematic analysis focusing on the content of the reports and the perceptions of (governmental) actors regarding the role of consultants in their work.

So far, preliminary results show that these consultancy reports largely emphasize the technical aspects of smart grids, such as the integration of renewable energy sources, grid management, and balance. Other themes commonly discussed in the reports are the role of Artificial Intelligence (AI) and Machine Learning (ML) in enhancing grid efficiency, the interplay between smart grids and the transportation sector, energy efficiency, and conservation strategies. Also, concerns about cybersecurity and data privacy in the context of increased digitalization is a topic brought up in the reports.

Theses consultancy reports are instrumental in shaping the smart grid discourse as they stand behind all the major governmental initiatives or reports in Sweden. Thus, they not only guide technological choices but also influence policy decisions. The reports highlight the importance of a transition towards renewable energy, efficient grid management, and the integration of

digital technologies. While the reports provide valuable technical insights and recommendations, there is a need for a more holistic approach. Some gaps we have defined concern for instance the socio-economic implications and user engagement in smart grid development. In our study we thus highlight the importance of diverse inputs for policymaking to ensure the successful implementation of smart grids.

Technological-Related Factors and Social Actor Relations Impacting the Upscaling of Sustainable Energy Technology Demonstrations

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Sustainable energy transitions are crucial for addressing climate change through aiding in the reduction of greenhouse gas (GHG) emissions and other pollutants. Europe is facing challenges in meeting the Paris Agreements targets, thus the upscaling of sustainable energy technologies is required. Upscaling, which is defined as the broad implementation of innovations in mainstream applications, becomes critical for sustainable energy technologies to achieve societal impact on a large scale. That said, current research indicates a significant knowledge gap in understanding how to accelerate, organize, and achieve the transition of sustainable energy demonstrations to widespread societal applications. This includes a lack of understanding which technological and social factors stimulate these upscalings.

This research project focusses on the sustainable European island ecosystems, specifically Ameland, a Dutch Friesian Island off the north coast of the Netherlands. Ameland, along with many other European islands, has made significant progress in sustainable energy transitions, committing to reducing CO2 emissions by 95% by 2035 through the installation of a solar park, fuel cells, hybrid heat pumps, and hydrogen energy. This makes Ameland an ideal case study to investigate the technological contexts and social actor ecosystem impacting the upscaling of sustainable energy demonstrations.

The leading research question defining and guiding this project is: How do technological-related factors and social actor relations contribute to the upscaling of sustainable energy technology demonstrations to achieve renewable energy transitions? To provide a comprehensive understanding and to bind the investigation, the research will address sub-questions focusing on technological factors, stakeholder participation, and academic-, governmental-, public-, and private social actor relations.

The investigation will explore the impact of technological-related factors, such as overcoming energy supply intermittency and energy storage issues, as well as social actor relations, like university-industry-government interactions and coordinated flow of demonstrations. The study will clarify the role of these social relations, which are often overlooked, in stimulating the upscaling of sustainable energy technologies towards societal implementation.

The study will contribute to the scientific and R&D management fields by identifying the technological and social factors influencing the upscaling of sustainable energy technologies and identifying lessons from the Ameland island ecosystem to implement on mainland and urban areas. Abductive reasoning will be followed, combining deductions from a literature

review and inductions from empirical data while investigating three successful and three unsuccessful cases of sustainable energy technology upscaling. In doing so, the factors leading to successful broad-scale implementation may be identified.

By addressing these research objectives, the study aspire to provide valuable insights into managing and steering technological-related factors and social actor relations for higher energy transition success on mainland or urban areas. The results are expected to contribute to academic knowledge and practical strategies for achieving sustainable energy transitions globally.

The Role of Pilot and Demonstration Plants in Multi-Sector Engagement: A Case Study of Hydrogen Development in the Netherlands"

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Hydrogen can play a pivotal role in enabling a low-carbon energy transition. The Netherlands is well positioned to assume a leading role in the emerging global hydrogen economy given its infrastructure, industrial base, and renewable energy resources. However, realizing this potential requires addressing numerous technical, economic, infrastructural, regulatory, and social challenges. Water electrolysis is expected to be a key process for sustainable and cost-effective green hydrogen production. But commercial adoption of novel electrolysis technologies necessitates verification, optimization, and upscaling. This highlights the crucial function of pilot and demonstration plants (PDPs) as bridges from concept to commercialization, enabling the stepwise advancement of electrolysis while reducing market uncertainties. While the general promise of hydrogen as energy carrier is still holding, there are tensions and conflicts in the visions on sectoral developments. Opposing views typically relate to multiple aspects like the introduction of hydrogen (which applications it can serve; whether to follow an incremental or more radical innovation route); the role of natural gas and the gas grid; how to use the still limited renewable electricity supply (e.g. for consumers, electric cars or industry) and how to balance supply and demand in the grid; how to come to the transition towards a sustainable process industry; and who will benefit from the introduction of hydrogen. The views relate to multiple sectors and their interdependencies. Our paper analyses the role of PDPs in building multi-sector engagement, using a case study of hydrogen development in the Netherlands. The study is based on semi-structured interviews with diverse stakeholders engaged in PDPs across the value chain. There are some pilot and demonstration projects with different aspects of hydrogen technology in the Netherlands. These projects target uncertainties around technical performance, system integration, infrastructure requirements, business models, and social acceptance. The experiments also encompass diverse production methods, including alkaline, PEM, and solid oxide electrolysis. There is also experimentation with integrating hydrogen into the existing natural gas grid, underground storage, transportation infrastructure, and various end-use applications. The analysis reveals how PDPs facilitate collaboration between public, private, research and civil society actors. Learning by doing enables exchange of knowledge and builds networks. Proactive community engagement nurtures social acceptance. Recommendations include to simplify and accelerate permitting for PDPs, enabling open access to project data, expanding

training programs and simplifying regulations to promote experimentation. Strong policy signals are needed in areas like demand creation, standards, and manufacturing support. While substantial government funding is still needed, scaling up projects continues to face challenges around permitting, infrastructure integration, investment risks and regulatory uncertainties. Addressing these necessitates deeper collaboration guided by PDPs learnings. There are also tensions between visions for sectoral hydrogen applications and differing views on innovation pathways. On the other hand, an urgency exists to accelerate the transition through more radical, multi-sector innovations. Our analysis highlights that hydrogen system building requires understanding complementarities, synergies, and integration across sectors. PDPs engage multiple stakeholders from the public sector, industry, network operators, local communities, and research institutions. This enables coalition building and addresses systemic challenges. In other words, PDPs can act as collaborative learning space to nurture the ecosystem thinking, collaborative ethos and social trust needed for complex transitions like hydrogen. In summary, the PDPs themselves become platforms for orchestrating multi-stakeholder collaboration, exchange, and systemic transition. Realizing their integrative potential would require policy reforms that foster collaborative experimentation, transparent communication, and inclusive governance. Policies that foster experimentation, allow open knowledge sharing, incentivize risk-taking, and enable rapid scaling up of successful demonstrations. Our paper offers insights into how PDPs can pave the path for hydrogen systems to evolve from fragmented niches to coordinated transformation.

Urban Innovation to Address Climate Crisis: Data-Driven Technologies

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It is estimated that 40% of the expansion of occupation in cities is in informal settlements. By 2050, more than 68% (UN-HABITAT, 2020) of the population will reside in urban areas. Due to these projections, the emergence of events related to climate change reinforced the role of the technology initiatives of data collection that will be able to support the research and the measures that will be realised to cope with the crises, especially considering the population that resides in informal spaces and is more exposed to risks related to health and well-being (Kamalipour & Peimani, 2021). The development of technology initiatives has been taking the first steps to face the consequences of urbanisation in the cities and improve the quality of the cities and the well-being of the population. Urban innovation emerges based on a repertory of data to provision effective measures to deal with the challenges of living in cities in the 21st century. The latest CENSO (2022) data collected by the Brazilian Institute of Geography and Statistics brought together more than 111 million addresses in Brazil. This tool mapping data-driven can identify environmental risk areas and formulate assertive public policies to improve the urban condition and the cities and provide a safe place for the population. In the face of new climate contexts, such localities have faced even more critical dynamics when it comes to areas of environmental risk, such as landslides in hillside areas and floods. As a proposed discussion, this work aims to discuss the mitigation of climate risks in the face of urban vulnerabilities in the favelas. In addition, it draws a journey on how to utilise the mapping data to face the consequences of climate injustice and address the sustainable development goals

proposed by the United Nations, with special attention to goals 10, 11, and 13. Furthermore, the pulse of the New Urban Agenda (UN-HABITAT, 2017) goes through the aspects related to the adaptation of climate change and cuts across the approach of reducing disaster risks and promoting integrated urban development supported by data-informed to achieve better and safer cities for all. This paper aims to analyse, as well as promote, debates about the role of digital technology tools development as an essential resource for public governance to mitigate the damage caused by the climate crisis, as well as to guarantee the protection of fundamental rights, such as an ecologically balanced environment and housing for present and future generations.

Upscaling Technologies in the Global South: Demonstrating Three Health Projects

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Demonstration projects are an essential organizational tool for developing sustainable technologies and innovations. Although literature has largely explored the role of demonstration projects proposing dynamics to enable sustainable innovation in the context of Western countries, a gap seems to exists in the study of demonstration projects in the context of Global South. This gap is due to the specific and unique needs that Global South countries, which need to be explored in order to very and tailor made dynamics to enable sustainable innovation. The aim of this work is to present and discuss the case study of three health projects located in Africa. Specifically, the presentation of these case studies will allow the analysis of the unique characteristics and dynamic that enable – or not- the development of sustainable development; as well as identifies gaps in the literature and suggesting aspects that should be considered such as cultural and social factors. The project presented focused on innovations based on a passive design approach, characterized by the use of natural/hybrid ventilation systems, local construction materials and vernacular building archetypes, in conjunction with Infection Prevention Control (IPC) measures set by World Health Organization (WHO).

C.6: Ownership, energy justice and the expansion of renewables

Session Chair: Marco Sonnberger, Friedrich-Schiller-University Jena, Germany

Solar flares: exploring justice issues in India's solar expansion

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Energy is now widely considered to have clear social and political aspects and recent scholarship on environmental studies has started to explore energy's embeddedness in our social organization and its influence on our social relations. The three-tenet framework from environmental justice literature based on three principles of distributional, procedural, and recognition justice has been adapted and used in analysis and illumination of unfair energy practices and projects.

Solar is a significant plank in India's towards clean energy transition plan and central to this transition are solar parks – clusters of solar photovoltaic installations – strategically positioned across the nation. Land conflicts related to infrastructure development are not new in India and are well-documented. Big solar parks that the Indian government is keen on developing require large tracts of contiguous land which are in limited supply in India. Expectedly, large solar parks development is not immune from conflicts and has generated several land-related protests, mostly involving marginalized communities. Frequent land conflicts associated with developmental projects led the government to introduce Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act in 2013. However, the act was applicable only in the cases when the acquisition was of private land. Many of the big solar parks are being developed on government owned land which different communities use for their livelihood. Frequency of protests against solar parks indicates prevalence of injustice as marginalized communities often perceive that their interests are sidelined by the state and the private sector.

The study examines the instances of protests against solar parks in the state of Rajasthan and engages with the following questions: i. How large-scale solar plants impact equitable distribution of benefits and burdens among different socioeconomic groups? ii. What are the key barriers and challenges that marginalized communities face in accessing and benefiting from solar energy initiatives? iii. To what extent do existing policy frameworks and regulations governing solar energy deployment consider the principles of energy justice? iv. Based on the understanding developed from above three questions, how to enhance their effectiveness in promoting equitable outcomes? v. How affected communities mobilize themselves against energy injustices and how successful are their interventions? The study fills a gap in existing literature by bringing attention to solar park justice issues in India often overlooked. It also explores the spatial aspects of justice, dissecting how the geographical distribution of solar parks can disproportionately impact marginalized communities. The study also provides insights for policymakers, offering recommendations to craft more inclusive policies.

Ownership, ‘Spacing’ and Community Spirit – How ‘Energy Sharing’ is changing our Relationship to the World

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Some consider the sharing economy to be the most promising economic model of the future when assuming a shift from private property to a joint use of objects in sharing practices. While the sharing of objects and spaces by various interest groups initially brings to mind formats such as car sharing or home sharing, the practice of sharing energy has also increased in recent years. Therefore, when discussing ownership and justice in the context of renewable energy, it seems worthwhile to take a closer look at energy cooperatives (the variant of ‘energy sharing’ that currently exists in Germany) as a socio-economic system for the use of decentralised (electricity) networks.

Regarding this shift towards sharing, I am particularly interested in the actor’s level, i.e. the phenomenological experience of sharing energy. It is postulated that sharing energy not only changes the technical way in which it is produced and consumed, but also the way in which the members of energy cooperatives relate to the world. Based on Hartmut Rosa's sociology of our relationship to the world, this contribution will therefore analyse the field of energy sharing with regard to the resulting qualitative changes in social, self and object relations.

To examine the effects of energy sharing on relationships with others, on the self-image or on the perception of the material or immaterial environment and to be able to deduce trends in ownership issues, qualitative interviews were conducted with members of various energy cooperatives in rural regions and large cities. Using Ralf Bohnsack's documentary method, these interviews were analysed to gain detailed insights into the micro-social practice of energy sharing, revealing not only the subjects' self-reflective arguments but also implicitly formulated experiences.

The relationship to the world of energy cooperative members and the resulting understanding of ownership appears to be complex and the social practice of energy sharing to be challenging. At first, it seems clear that – unlike in other forms of the sharing economy – ownership is not overcome, but rather strengthened: Cooperative members become co-owners of the production facilities and the electricity generated is considered "mine" or "ours", not only in terms of its production, but also, as we will see, in terms of its use. However, connected to these concepts of the self-sufficiency of "having", interview excerpts also reveal new forms of openness towards the world like shared spatial self-extensions or the self-assignments in the bigger picture – indications that new relationships are developing. Particularly with regard to the relationship to objects and space, this dynamic, which initially manifests itself in local contexts, will be examined in more detail and put up for discussion.

'Doing ownership' in energy transition process: comparing remote communities in Africa and Asia

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Combating energy poverty has a strategic instrumental value and is one of the key targets of UN SDG7'. Indeed, access to energy could foster social justice, economic development, combat poverty and gender discrimination, ensure access to food, and the right to health services. As of 2023, 800 million people among sub-Saharan Africa and rural Asia have no access to the grid-connected electricity and remain in a state of structural deprivation (IEA2023). The energy island concept has been used to identify those communities completely disconnected from the grid or in remote areas where it is difficult to assume the implementation of national or subnational infrastructure in a short time. For these specific areas, the implementation of decentralised solar-based energy systems is considered to be particularly effective in combating energy poverty, strengthening the autonomy of communities and their development capacity while, at the same time, mitigating the impacts of climate change and enhancing adaptation capacities of vulnerable communities. These are goals at the heart of the *African Union's Agenda 2063: The Africa We Want,* and supported by international and European cooperation programs. More specifically, European programs aim to support the development of small-scale solutions based on mini-grids, as well as local and decentralized solutions that guarantee access to energy for people living in poverty and in remote areas.

The European project LoCEL-H2 (Low-cost, Circular, plug and play, prosumer Energy system for off-grid Locations including Hydrogen) fits into this scenario. The project aims to test, in off-grid communities, a clean (100% renewable energy based) energy system that combines photovoltaics with batteries and an innovative green hydrogen production system for kitchen use. Adopting the social practice theory, we will analyse the local relational context to prefigurate the socio-technical innovation, as well as identify emerging forms of power agency and asymmetries in 'governing' technological apparatus. In this respect, the control of energy, its governance and exploitation, seems to be differently related to the twin concepts of *ownership* and *property* as this is the case for the Locel-H2 project.

In this work, we present preliminary results of a joint process scheme that links context-specific qualitative analysis with energy social modeling. Our research focuses on both electrified and non-electrified communities in Pakistan and Ivory Coast, where the notions of ownership and property can be decoupled to understand how each is manifested within the context of socio-technical innovations, particularly in deployment of micro-grid solutions.

One step forward, two steps back: How different owners perceive just transition in Norway

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The ongoing energy transition with increased deployment of renewable energy sources entails an increasing decentralization of energy production. This leads to more diverse forms of ownership of energy production, including an increase of community and citizen owned production. Previous research has pointed out that ownership is central for citizens' attitudes to energy projects. It has also been pointed out that these new forms of decentralized ownership can contribute to democratic and just development of renewable energy. Engaging citizens and stakeholders in democratic processes (procedural justice) is seen as a good solution to rectify unjust distributions of benefits and burdens (distributive justice) in regard to establishing new renewable energy production.

This paper focuses on the owners of renewable energy production themselves and ask whether the attitudes toward just energy transition and citizen engagement differ between public, private, and citizen owners in Norway?

However, Norway is in a unique position regarding ownership and decentralization due to Norway's energy supply in the form of electricity coming from large-scale hydropower plants largely owned by the public. Decentralized power production in Norway is often limited to farmers/landowners in the form of small-scale hydropower plants or on the individual level through solar PVs installed on homes. There has been little incentive for Norwegians to become prosumers due to relatively cheap electricity prices in Norway. Therefore, our inquiry focuses on renewable power production at the scale where the developers need concessions to build. These concessions often require stakeholder involvement in the development process.

The paper utilizes a mixed-methods approach with an explanatory sequential design (two-phase design) where a survey was used to guide qualitative inquiry in the form of in-depth interviews. The survey consisted of a range of questions and statements pertaining to topics such as just energy transition, ownership, and citizen engagement. The survey was sent out to 177 representatives from the renewable energy sector working for companies with concession rights for renewable energy production for the period 2021-2024. The survey had a total of 66 respondents. Next, 31 of these respondents were contacted for follow-up interviews, where we got a total of 17 informants. The informants and participants were categorized after the largest shareholders in their power plants. Then, for the analysis, these shareholders were sorted into three categories: 1) public, 2) private, and 3) citizen.

We find that renewable energy producers in Norway see the balancing act between benefits and burdens as necessary for achieving 'social acceptance' for their projects. Furthermore, they acknowledge the importance of engaging citizens and stakeholders as another important step to garner social acceptance. However, some of the informants were under the assumption that Norwegian citizens are not competent enough (knowledge deficit) to effectively participate in democratic debates and processes regarding renewable energy as these processes and

systems are too complex for the average citizen. Thus, the informants meant these public debates were not fact-based and instead colored by misunderstandings, misinterpretations, and disinformation. Lastly, one of the main barriers for decentralization and establishing more renewable energy production in Norway, according to our informants, is caused by social resistance from citizens and protection groups. Our informants meant that this form of resistance could be explained through a concept such as 'Not-In-My-Backyard (NIMBY). We argue that these producers and owners are practicing a form of mis-recognition of the perspectives of those who oppose renewable energy projects. This is done through valuing certain forms of knowledge and facts over others, as well as simplifying complex reasons for resisting. In other words, there is a recognitional justice problem that needs addressing in the Norwegian energy transition.

Mainstreaming alternative discourses on energy communities. The case of Austria

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In the last four years, ever since Austria has enabled the establishment of energy communities (ECs), their numbers are growing fast, and their role in Austria's energy transition has been much discussed. Taking this public discussion as an entry point and responding to calls for a better understanding of the diffusion of radical niche innovations, we question how narratives around ECs change throughout their introduction and diffusion. Conceptually, we adopt a dialectic perspective of niche diffusion and discursive dynamics in sustainability transitions. Focusing on the case of Austria, we engaged in extensive desk research and conducted eleven in-depth interviews with experts and early founders of ECs to understand the context of ECs. Further, we conducted a thorough discourse analysis of articles from the eight largest daily newspapers between the initial announcement of ECs in 2018 and March 2023. Doing so allowed us to analyze dominant contextual changes and the content-related claims that were made about ECs against the background of these changes. The results show the diversification of initial radical narratives along four phases of development, namely a new decarbonization goal, the transposition of the legislation for ECs, the energy crisis following the Russian invasion in Ukraine, and the relief from the immediate crisis context. We discuss how elements of procedural justice and citizenship underwent significant changes throughout the four phases and how actor roles were reconstructed around early radical narratives and opposition towards these narratives. Finally, we point to the emerging relevance of postapocalyptic discourse in mainstreaming niche innovations. This study enriches our understanding of niche diffusion and discourse dynamics in the governance of the energy transition.

The experience of energy cooperatives in Mexico: a look into new forms of democratic participation and ownership regimes

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In the energy transition context, not only new technologies have emerged but equally importantly have appeared new forms of participation, ownership, and uses of generation systems. Energy cooperatives have become part of the new landscape, capturing scholarly attention. But besides limited expectations, the discussions on energy cooperatives have predominantly focused on Global North cases. In Europe, for example, the boom of the literature on energy cooperatives was boosted by the European Union regulation on energy communities. The lessons learnt in these experiences are, however, hardly applicable in the Global South where energy cooperatives are just emerging and energy systems are frequently characterized by a centralized structure under the control of state-owned companies. Against this backdrop, this article aims to capture the state of affairs on energy cooperatives in Mexico. Different experiences are studied: two energy-related worker cooperatives and one development cooperation project aimed to boost energy self-generation in social economy units and local communities. Given the lack of proper regulation and policy, capacities within the community, economic incentives and other types of barriers, this article shows that the experience of energy cooperatives in Mexico is different from the experiences of the Global North. Yet, there are many elements from the Mexican experience that can enrich the discussion on energy cooperatives, especially concerning debates on energy justice, co-production, ownership regimes, and democratic participation.

C.7: Energy Citizenship and Positive Energy Districts

Session Chair: Vanja Djinlev, ETH, Switzerland

Session Chair: Malgorzata Matowska, Th!nk E, Belgium

Session Chair: Michael Brenner-Fliesser, Joanneum Research, Austria

Cross-sectoral coordination challenges and arrangements in PEDs.

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Energy transitions provide the opportunity for redesigning cities to ensure that energy systems are not just decarbonized and decentralized, but are also democratized (Soutar, 2021). An innovative and promising step into this direction are Positive Energy Districts (PEDs). This paper studies the cross-sectoral coordination challenges of PEDs. Examining the challenges involved in coordinating the multiple stakeholders involved in PED creation contributes to understanding how this cooperation takes place (Hearn, 2022), an area of scant research so far. Thereby, the paper will also provide an important input to the academic debate about the roles of different PED stakeholders in the creation and development of these districts.

There are multiple definitions of PEDs, but broadly speaking these are characterized by producing more energy than they consume, increased energy efficiency, changes in consumer behavior and some element of social justice and energy citizenship (Hearn, 2022). The initial project of 100 PEDs across Europe (Bossi et al.,2020) may become a springboard for the development of many more PEDs such that they may become the basic role model for future neighborhood districts of cities throughout Europe. In order to rapidly transition European cities to mitigate climate change, there is a need to ensure that PED projects are easily replicable, cost effective and socially beneficial. However, it is important to note that the PED concept remains a future goal for most districts and that energy-positivity has yet to be reached by the vast majority of PED projects. Nevertheless, as a concept, PEDs can act as a catalyst for change, stimulating the development of innovative approaches to future living.

A crucial factor for the realization of PED projects as well as for the increasing dissemination and standardization of the PED concept is collaboration with different stakeholders. Therefore, it is important to understand how cooperation occurs in the creation and development of these districts and the barriers and challenges that exist to improved and streamlined cooperation with relevant stakeholders.

The objective of our study is to examine cross-sectoral coordination challenges and successful coordination arrangements in in the creation and development of PEDs. Thereby, we address two research questions:

What challenges does the creation and development of PEDs face in terms of the collaboration (i.e., collaborating) of actors from different sectors (e.g., stakeholders from public administration, politics, business sector, civil society)?

What strategies/arrangements help to overcome these challenges?

We answer our research questions through a series of interviews with stakeholders working both directly and indirectly in 10 positive energy districts across Europe. In our interviews, we ask stakeholders on the importance of energy citizenship principles (Wees et al., 2022) to the growth and replication of PED projects, the emergence of business models, the main challenges that have been faced in collaborations and how these have been overcome. Furthermore, we delve into the regulatory frameworks applicable to different PED cases in order to determine how these may support or inhibit PED development.

Our research is still ongoing, but our preliminary results indicate that PEDs are heterogenous in their approaches and their forms; that they rely on multidimensional collaborations to flourish. Moreover, the results point to different boundary-work strategies that PED stakeholders employ to enable cross-sectoral collaboration (e.g., creation of boundary objects, boundary settings, boundary agents) (Star and Griesemer 1989). Thereby, the results allow for connecting this research to broader debates in STS and sustainability transition research about cross-sectional collaboration and boundary work (Velter et al., 2020). Importantly, the paper will also provide a contribution for policymakers working in PED creation, development and replication by indicating collaboration challenges as well as strategies to address these.

Engagement strategies for citizens in Renewable Energy Communities

Annika Sohre, Iljana Schubert, Adam Hearn

University of Basel, Switzerland

The Clean Energy for all Europeans package (2019) and the Renewable Energy Directive (2018) paved the way for positive energy districts (PEDs) and renewable energy communities (RECs) to become part of the energy landscape of the EU (Hearn & Castaño-Rosa, 2021).

RECs and PEDs are both innovative approaches to foster energy transition and climate neutrality. While RECs are entities that promote cooperation among users in the production and use of locally produced energy, PEDs are systems that produce more renewable energy than they consume, with a focus on energy supplies, demands, indicators, storage, and energy management, and are often designed to include RECs (Trevisan et al., 2023; Kumar & Cao, 2021). Despite the differences, both involve the participation of stakeholders and the use of smart energy grids and new energy vehicles as well as share the goal of promoting renewable energy and sustainable energy practices.

Although progress is heterogenous across different member states, energy citizenship is a shared concern throughout the EU, particularly in such projects. PEDs and RECs greatly increase the complexity of energy markets, whilst simultaneously providing greater energy security and aiding in decarbonization efforts, hence attracting and retaining citizen engagement is vital if they are to become prevalent. Research has shown that members in energy collective action projects engage for various reasons, perceiving different kinds of benefits (Shortall et al., 2022). Although financial benefits are often considered to be an incentive for REC membership, variations in national energy landscapes mean that this is not always the case and that engagement is dependent on both financial and non-financial factors. Furthermore, regional or cultural differences may influence the success rate of commonly

applied engagement strategies (de Witte et al., 2021), such as tailored information and communication campaigns as well as different workshop formats.

In this research, we investigate different engagement strategies applied by seven different PED/REC creators, with varying underlying business models and from six different European Countries. This encompasses strategies to attract new members as well as examining how to further engage with existing members, and the enabling and hindering factors. To this end, we conducted a series of in-depth interviews with major stakeholders involved in the creation of these districts/communities in Ireland, Austria, Hungary, Portugal, Greece and Spain.

Our talk will draw conclusions regarding promising methods to increase engagement, as well as the perceived barriers and success factors. In addition, we aim to provide country specific recommendations regarding engagement, based on our case studies.

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Citizens engagement preferences – Findings from a multinational survey with a Discrete Choice Experiment

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There is now a clear urgency to achieving the energy transition (IEA, 2022). In Europe, for example, the energy production and use sector account for over 75% of GHG emissions. The European commission set targets to accelerate the development of clean energy and to reach 42.5 % renewable energy by 2030 in the Renewable Energy Directive (European Commission, 2018). Within this they establish and include new provisions for Renewable Energy Communities (RECs), which can form part of positive energy districts (PEDs). Increasing citizen engagement in RECs or PEDs is paramount if EU decarbonization targets are to be met through increased energy citizenship. Energy citizenship can be expressed through different levels of engagement and different forms of engagement. These may vary from becoming a member of a REC or PED, participating in different activities designed to inform and lead to a reduction in energy consumption, through actively monitoring or opting for

automation in energy consumption. Whilst there are successful examples of RECs, especially in parts of Western Europe such as Germany and the UK, RECs are still less common in Eastern and Southern European Countries. Cultural and individual differences add to the complexities surrounding engagement levels and forms in RECs and are not yet well understood (de Witte et al., 2021, Hu et al., 2022; Shortall et al., 2022). This hinders the replicability and rollout of successful RECs across Europe.

Our research will provide novel insights into factors influencing engagement and preferences for different engagement levels and forms across 6 European nations. To understand preferences for engagement levels and forms among members and potential members of RECs of different European nations, collect data through a multi-national online survey with a Discrete Choice Experiment (DCEs). We investigate preferences for frequency of engagement (e.g., yearly, monthly, weekly etc.), different engagement forms (e.g., gamification, investment, information); and varying levels of activation and automated energy use (e.g., from automation with no opt-out to occasional monitoring).

To capture cultural and individual differences the online survey collects quota representative data across 6 different European countries (Spain, Hungary, Portugal, Greece, Austria and Ireland) and 4 different pilot sites.

In this talk we will present a summary of the main findings of this research which is undertaken as part of the Horizon Europe ENPOWER project. This study aims to also shed light onto EU country-specific differences as well as provide an understanding of how future engagement strategies could best succeed at increasing energy citizenship.

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Role of the business ecosystem to catalyze energy citizenship in PEDs

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Positive Energy Districts (PEDs) represent a paradigm shift in urban energy transition, aiming not only to meet energy needs sustainably but also to enhance the quality of life for residents and create resilient cities. This analysis explores how PEDs develop opportunities for new business models while improving energy citizenship, with a particular emphasis on the crucial role of the business ecosystem in implementing and scaling these initiatives.

PEDs prioritise decentralised renewable energy production, energy efficiency measures and the implementation of integrated urban solutions. These districts create opportunities for innovative energy solutions that meet the unique needs of urban communities. Innovative companies can tackle these challenges by harnessing the potential of technology not only to address environmental issues, but also to ensure that sustainable energy remains economically viable. While at the same time improving energy citizenship is a critical aspect of PEDs, emphasizing community engagement and empowerment.

This is the case, of several start-ups offering smart energy solutions specializing in data analytics, artificial intelligence, and the Internet of Things (IoT). They are developing products that optimize energy consumption, monitor environmental parameters, and enable intelligent decision-making at both individual and community levels. By empowering residents with tools to manage their energy consumption and participate actively in demand-response programs, they contribute to a more engaged and informed energy citizenship.

In addition, PEDs open up great opportunities for agility and innovation in complex urban development projects. In a PED multiple stakeholders such as startups, local governments and communities can work collaboratively to implement and test innovative solutions. This collaboration can involve pilot projects, experimentation with new technologies, and iterative improvements, ultimately contributing to the scalability of successful models in other urban areas. Public-private partnerships are essential for successfully deploying PEDs. Such collaborations provide innovative companies with the necessary support, resources, and access to real-world testing environments. Governments derive advantages from the entrepreneurial drive, flexibility, and accelerate the development and implementation of sustainable technologies.

In this project, we aim to understand the current business ecosystem of PEDs in Switzerland and Israel. First, we will identify the key stakeholders and understand the relationships and interconnections between them.

Second, we want to identify existing innovative business models related to PEDs and the infrastructure and resources needed to effectively scale them

Finally, we want to analyse how successful innovative solutions can be transferred between countries and how businesses in both countries can benefit.

C.8: Fostering Equity in Energy Transition Innovations

Session Chair: Paty Romero-Lankao, University of Toronto, Canada

Looking for shared representations between experts and locals: the case of agrivoltaics in Italy

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The innovative feature of agrivoltaic systems is the possibility of combining solar energy production with agronomic production: the photovoltaic modules are placed above the ground, which thus remains free for cultivation or grazing. Agrivoltaics is then judged to be a more sustainable Renewable Energy Technology (RET) than its traditional variant, photovoltaic on agricultural land. Nevertheless, in Italy the full picture of this technology remains uncertain: advanced systems are subsided by the State, but communication initiatives between experts and stakeholders have not received the expected feedback.

The goal of this study was to explore which barriers hinder the adoption of agrivoltaics. In particular, we aimed to study the social representations shared by experts, local communities, scientists and decision-makers. We framed our research according to an epistemological framework that lies at the intersection of social representations theory, environmental psychology, and environmental sociology.

We adopted a mixed methods approach. Firstly, we investigated how agrivoltaics is represented among the scientific community. To do so, a literature review was conducted on Scopus and Web of Science using the keyword "AGRIVOLTAICS". Secondly, a total of 40 newspaper articles published between 2021 and 2023 were submitted to thematic content analysis. Finally, 13 experts in the agronomic and energy fields were interviewed to probe the strengths and threats of agrivoltaics.

Results showed that, in scientific literature, this technology has been discussed from an almost purely engineering point of view to the detriment of the potential contribution of the social sciences. The thematic analysis of newspaper articles highlighted different arguments reflecting the social representations of agrivoltaics risks: economic issues (return on investment and impacts on tourism), perception of environmental risks (insufficient agronomic experimentation and land consumption), sense of place (energy justice and threatened landscape). Transversal to the themes emerged the perceived vagueness concerning the regulatory framework of agrivoltaics.

The analysis of the interviews mirrored these themes and captured a few "rhetorical pivots" (thémata) at the core of each argument for (or against) agrivoltaics: economic issues were differently perceived depending on stakeholders' entrepreneurial innovativeness/ conservatism; the impacts on tourism were discussed in terms of loss/enrichment of cultural heritage; insufficient agronomic experimentation referred to the passage/non-passage of agricultural machinery; the theme of land consumption depended on whether rural areas were deemed sufficient/insufficient for meeting the Italian demand of renewable energy; energy

justice was tied to the perception of adequacy/inadequacy of the experts involved in the transition; finally, the idea of threatened landscape led to a problem of familiarity/unfamiliarity. Above all, the vagueness of the regulatory framework concealed an issue of defining the sustainability/unsustainability of agrivoltaics systems.

Addressing these interpretative nodes with the communities affected by the adoption of agrivoltaics is crucial to fostering its diffusion in the territory. The positioning of stakeholders close to one or the opposite pole of the identities thémata is anchored to their specific expertise. This seems to favour a homogamic communication within each group rather than a dialogical attitude. Therefore, it will be pivotal to foster shared representations and community ownership of agrivoltaic technology.

Fusion “just” or fusion “fast”? Sociotechnical imaginaries and the public-private shift in fusion research

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Nowadays nuclear fusion – an elusive source of potentially clean, safe, abundant, and almost inexhaustible source of energy that scientists have been chasing for decades – is often said to having reached an epochal turning point: once the preserve of publicly-funded universities, national labs, and intergovernmental projects, research in fusion is being more and more populated by private companies, most of which are US-based and financed. The perceived change in fusion leadership is strikingly sharp: up to few years ago, the attention of the fusion community was catalysed by ITER, a huge experimental reactor slowly under construction in southern France by initiative of 35 Countries to prove the scientific and technological feasibility of fusion once and for all, while in recent times the hegemony of ITER in the fusion landscape has been challenged by a growing proliferation of private start-ups that are entering the field and claiming that they are capable of building their own fusion reactor, alternative to ITER, and with a sooner, faster, smaller, and cheaper approach. Such a “paradigm shift” in fusion research, as it is framed by private-fusion supporters, begs the question to the outsider: why is fusion so rapidly going private? Or put differently: how to account for these two opposite pushes, one to internationalise fusion and turn it into mega-science with ITER, and the other to de-internationalise it and turn it into a business for private enterprises? Answers to this research question put forward so far appear to be unsatisfactory: the public-private shift in fusion research gets often rationalised to make it perceived as normal, spontaneous, necessary, timely, inevitable, urgent, desirable, providential, peaceful, and mutually beneficial. And yet the two lines of research – ITER versus the start-ups considered as a whole – are entangled in a heated controversy about the proper size, shape, cost, timescale, and innovation strategy for building a proof-of-principle reactor with a net gain, successfully and as soon as possible. After qualitatively analysing the discourses on the changing political economy of fusion research, the STS well-established notion of “sociotechnical imaginaries” is used in this presentation to make evident the conflicting political visions behind the two approaches. ITER embodies in fact a “fusion just” imaginary where fusion is conceived as an arena of diplomacy for science and science for diplomacy to foster international cooperation through a joint scientific project, but also as a collaborative way out from the Westphalian

system of national rivalries for the control of energy and resources, as well as an open-science platform for protecting fusion from the greed anarchy of market competition and industrial property. On the contrary, overall the private start-ups embody a “fusion fast” imaginary where fusion is conceived as a competitive means for national leadership and supremacy over other Countries, where the Westphalian system and the geographically uneven distribution of sources are bypassed by turning energy into a product that can be manufactured by anybody in the world controlling the reactor technology, and where the lead in fusion development has to be handed over to market forces on the assumption they could accelerate commercialisation and make fusion relevant as a climate change solution. Clearly, both imaginaries have their merits and their limitations too, which are here analysed from a critical perspective to show their implications for the social acceptability of fusion, energy justice, climate diplomacy, and science privatisation.

Towards responsible and fair pay-as-you-go energy access in sub-Saharan Africa

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Market-based solutions are playing an increasingly important role in advancing the energy sector in sub-Saharan Africa. This paper focuses on pay-as-you-go (PAYG) energy systems, a market-based approach that enables users to pay for energy in small amounts. Whilst acknowledging the benefits of PAYG, the paper draws attention to six areas of concern about its implementation, including the suitability of PAYG business models to serve the lower-income households, data collection and use, and the characteristics of PAYG energy providers and investors. We outline an agenda for inclusive PAYG energy systems in a proactive effort to shape a rapidly evolving sector. We hope that by anticipating these risks, we can help ensure that the PAYG sector is appropriately regulated and that its benefits accrue to the intended beneficiaries.

A Network for Equity in Energy Sustainability Transitions

Paty Romero-Lankao

University of Toronto, Canada

Climate change impacts the quality of life and economic prosperity of societies across divides of race, gender, and class, yet it disproportionally affects the underserved, who are both least responsible and least able to cope with its consequences. Cities have a central role in the transition to net-zero carbon emissions, but their pervasively techno-centric transition approaches fail to consider the lived experiences of underserved communities. In this presentation, I will explain how a group of social scientists engaged with communities in Los Angeles to operationalize three equity principles in the transition to 100% clean energy by 2035. I will draw lessons on options and barriers to centring equity in technological innovations in energy, such as heat pumps, electric vehicles, and a resilient grid. I will also describe how

these lessons inform the Justice Network for Equity in Sustainability Transitions, a new research program at the University of Toronto. In partnership with underserved communities and city actors, the Justice NEST program will fill a gap by engaging communities to co-create knowledge of aspirations for, problems with, and actions to achieve equitableenergy transitions. Justice NEST will focus on the following inquiry areas,: **(1) public health and well-being**, by analyzing how marginalized communities can reduce energy-related physical and mental stress; **(2) affordability**, by examining ways to alleviate the higher energy costs that often burden marginalized communities; **(3) availability, accessibility, and use**, by exploring how marginalized communities can overcome exclusion to benefit from programs, technologies and innovations; and **(4) jobs and workforce development**, by analyzing how to address employment disruptions and increase job opportunities in a net-zero world.

Unequal Technologies: The case of minerals and (raw) materials in solar power

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In order to mitigate climate change, an energy transition is inevitable. In this paper, we argue that this energy transition needs to break with historically developed structures of production and consumption in order to be truly sustainable, equitable and just.

Since renewable energy systems are an important part of the energy transition, and the biggest estimated installed capacity is solar photovoltaic (8500 GW by 2050), we focus on PVs.

The building of ETIs as photovoltaic needs numerous raw materials. Recent reviews have assessed the minerals and materials needed for PVs under different mitigation scenarios (Wang et al., 2023) as listed here: Steel, Aluminium, Indium, Copper, Solar-grade Polysilicon, Selenium, Nickel, Cadmium, Tellerium, Silver, Gallium, Chronium, Tin, Germanium, Lead, and Zinc. Generally, the maximal annual demand is estimated to strongly increase compared with current production (e.g. Tellerium 372.4%).

Part of the literature discusses also the secure and responsible supply of the needed materials and recognises the rising questions of international equity and environmental justice (Sovacool et al, 2020). However, an analysis which merges technical and social knowledge applied specifically to the materials required for a selected technology seems missing in the literature. We focus on an added layer of complexity including considerations from the social sciences like equity and justice in order to suggest possible solutions.

The theory of Ecologically Unequal Exchange (Dorninger et al, 2021) draws attention to the inequalities inherent in global trade. PV panels, for instance, are seen as a clean energy technology. Yet, they draw on resources from poorer countries, be it labour or land, which is not reflected in the price of these technologies.

Andreas Roos (2023) analyses how the boom of solar technology has led to an appropriation of resources from China. This appropriation has allowed for significantly lower production costs as well as very low resource consumption in Europe itself.

If we look into the three dimensions of justice – procedural justice, recognition, and distributional justice - the production of solar technology relates directly to these aspects.

Procedural injustices are inherent in the unequal structures of world trade, which have shaped processes that exploit natural resources and labour at the expense of poorer countries. This also means that, in terms of distributional justice, the benefits generated by these global processes are distributed unequally. In terms of recognition, the inequality aspects of for instance solar technology are not being recognized. Instead, these aspects are obscured by the clean image of solar technology.

The production and consumption of goods such as PV panels are deeply embedded in social structures. This means that there are many obstacles on the way towards truly sustainable energy systems. Looking at the example of solar technology, it will only become sustainable if it breaks particularly with the structures of global trade. On the consumption side, overconsumption of energy and goods will have to be addressed in order to transition towards sustainability. One possible solution could be suggested by the concept of sufficiency.

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C.9: Hydrogen – Fuel of the future?

Session Chair: Michael Kriechbaum, Graz University of Technology, Austria
Session Chair: Tuukka Mäkitie, SINTEF Digital, Norway

Sociotechnical imaginaries on geopolitical risk exposure with the transition– the case of the solar PV rollout in Portugal

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The unreliable fossil fuel supply associated with high prices of their imports have, in 2022, drawn a renewed focus on the strategic nature of low-carbon energy technologies, beyond climate change mitigation objectives. Consequently, the European Union (EU) strengthened support towards innovation policies aimed at encouraging the rapid diffusion of technologies in the renewable energy sector. Overall, the lack of fossil fuels present on the EU territories, and its vulnerability to geopolitical pressures related to its status as a net energy importer, created a rationale for supportive innovation policies aimed at developing renewable energy sources to mitigate import dependencies, and increase energy security.

Yet renewable energy technologies and sources are more varied than fossil fuels in regards to the variety of forms and business models they can enable. While fossil fuels energy systems all rely on burning different types of fuel (e.g. coal, gas oil, etc) to produce electricity in a centralized way, there exist a myriad of technologies to use renewable energy sources (e. g. wind, solar, etc). Each renewable energy technology can be used in a more vast array of ways, some of which weren't viable in a fossil fuel-centered energy system. With the spectacular drops in the cost of solar PV modules over the last decade, even more different innovative ways of integrating solar PV in the energy mix emerged. On a smaller scale, these include energy communities based on peer-to-peer trading and virtual power plants. On a larger scale, these include large floating solar PV plants and solar-PV-to-green-hydrogen, with recent plans to export green hydrogen from solar PV through intra-European pipelines (e.g. H2Med) from Portugal and Spain to France and Germany.

This article analyses how different materialities of different renewable energy innovations are envisioned in relation to geopolitical risk. The emerging discussion on how renewables will affect inter-country relations is present within critical geopolitics. This article is based on 3 and a half months of fieldwork during 2022-2023, including 42 experts, multi-sited field observation, participatory observation and document ethnography.

This material allowed us to identify 2 dominating ways geopolitical risk mitigation is envisioned with different sets of solar PV innovations. Each of these imaginaries is underlined by different ways of thinking about cooperation and competition between European countries. One of these sociotechnical imaginary positions Portugal as a future energy exporter, namely through green hydrogen (when solar PV from a large plant is converted to gas and exported through a pipeline to France and Europe). Yet the countries they envision exporting to, such as France, strategize its own ways of becoming energy secure and able to export a part of their energy over long

distances, notably through red hydrogen (nuclear to hydrogen). This example points to the lack of anticipation of other countries' energy policies by Portugal in its ambitions to become an energy exporter. Some suggest that this lack of trust in energy cooperation leads Europe to not coordinate effectively to use its resources optimally (e.g. the high irradiation in Portugal and Spain).

This paper contributes to science and technology studies by drawing attention at the fact that it is necessary to look at how ideas of anticipation, coordination and competition should be taken into account in how innovation policy is partly shaped with the implications for energy security and related geopolitical risks in mind.This research builds on earlier research looking at how power is interlinked with innovation policy in the field of energy transitions.

The role of sectoral configurations for hydrogen innovation and value chains

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Despite being the simplest chemical element in the periodic table, hydrogen has complex and interconnecting value chains as a climate solution. For example, its production can take place in a close coupling with input sectors such as the electricity system (electrolysis – green hydrogen) and the oil and gas industry (natural gas reformation and carbon capture and storage – blue hydrogen). Moreover, it can be used in various user sectors, for example as a zero-emission energy carrier (e.g., maritime, heavy-duty land transport) and as an input material to decarbonize heavy processing industries (e.g., chemicals and steel).

Hydrogen thus has a potentially high number of connections and interdependencies with different sectors, each with idiosyncratic and interconnected system dynamics (cf. Hughes, 1987). These couplings with different sectors can be expected to shape the innovation dynamics and expectations of hydrogen as a climate solution and a green industrial opportunity. For instance, the presence and potential to upscale key resources from input sectors (such as electricity), affects the potential to develop hydrogen value chains. The relevance of specific sectors varies between countries and regions, depending on, e.g., the existing industrial structures (e.g., kind of manufacturing in the region), natural resource endowments and utilization (e.g., renewable energy and/or natural gas), and prevailing institutions (e.g., legitimacy questions related to hydrogen). An effective hydrogen innovation governance must therefore understand the specific conditions emanating from the couplings with various input and user sectors (Mäkitie et al., 2022).

In order to better understand such issues, we analyze the effect of sectoral configurations (Stephan et al., 2017) along hydrogen value chains on hydrogen innovation and industrial development in Norway. We utilize a qualitative case study design for this purpose.

At the production side, with abundant and affordable hydropower reserves, Norway in principle has good preconditions for green hydrogen production, but limited grid capacity, stagnating growth in renewable energy production and increasing electricity prices have been seen to challenge its upscaling and reduce its legitimacy. Meanwhile, the country's large and technologically advanced oil and gas industry provides the industrial base, technical

knowledge and infrastructure for potential growth of natural gas reformation and carbon capture and storage. Norway`s historical and current role as a natural gas exporter also shapes the vision of becoming a hydrogen exporter. In terms of hydrogen use, Norway`s frontrunner role in maritime policy and industry has triggered the exploration of alternative shipping fuels, becoming a key driver for the development of hydrogen and its derivatives (especially ammonia) as energy carriers in marine propulsion.

Our results show that the conditions emanating from the specific sectoral configurations of hydrogen in Norway can help to explain the prevailing direction and dynamism of hydrogen innovation processes in the country. We suggest that a better understanding of the sectoral configurations of hydrogen in a given context may support policymaking to foster the further development of hydrogen more effectively.

Timely transitions? Exploring the impact of time-bound targets on visions for the future of large-scale energy storage technologies

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Cutting-edge technologies, such as large-scale energy storage (LSES) technologies i.e. hydrogen and flow batteries, can play a promising role in attaining climate targets. However, due to the emergent nature of these technologies, their future relies heavily on stakeholders' visions. While the literature champions target setting as a means to bring about change more quickly to reach a certain goal, there are also studies that show that predetermined priorities potentially limit stakeholders' ability to envision an alternative future. Little is known about the way in which time-bound targets affect visions for the future. This article addresses this gap by examining the impact of climate targets on LSES stakeholders' visions. Drawing on in-depth interviews with 31 stakeholders in the LSES field in the Netherlands, we identify four distinct visions. In addition, our analysis reveals climate targets' enabling and constraining impact on the scope of change, resulting in visions aimed at feasible and rapid changes. Most interestingly, we find that time-bound targets shape the envisioning process by a) narrowing the envisioning process, b) compartilising the envisioning process, and c) motivating the envisioning of urgent change.

How does the general public in Germany evaluate hydrogen standards and imports?

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In its national hydrogen strategy, Germany has set the aim to establish a global hydrogen market as it expects to import substantial quantities of hydrogen in the future (BMWI, 2020). So far, re-search on these potential imports has focused on identifying countries and quantities to import hydrogen but little has been done on the societal dimension of such new and high dimension trade relations. First studies have pointed out issues of social justice as a crucial element for ac-ceptance and just imports in the export countries (Nationaler Wasserstoffrat, 2021). Developments have so far been different in different world regions and countries,

depending on factors such as the countries' renewable potential, geopolitical past, and international industry relations (Stamm et al., 2023). However, if one takes the lessons from a past topic like biomass seriously, not only ex-port countries have a crucial societal dimension to account for but import countries as well. Public discussion can have a substantial impact on the legitimacy and acceptance of a novel and import-ed fuel. In this early phase of establishing new trade relations and hydrogen standards, it is there-fore interesting to gather the views of the public in a potential key import country. We therefore ask: How accepted is imported hydrogen in the German population and which role do export regions and import criteria play?

On the topic of hydrogen acceptance, the focus in previous literature has so far been mostly on specific hydrogen technologies or applications (Emodi et al. 2021). Additionally, given the uncer-tain future development of both, Upham et al. (2020) have studied expectations around hydrogen fuels. More recent studies have started to elicit general perceptions of hydrogen in the German population and have found a predominantly positive picture, albeit differentiated between applica-tions and groups (Häußermann et al., 2023; Schönauer & Glanz, 2021). No literature could so far be found on the acceptance of hydrogen imports from different world regions and with different standards.

To answer this novel research question, we conducted a representative survey in Germany in terms of age, gender, region, and education level and gathered n = 1,876 complete cases. The survey included both individual items as well as an experimental survey in which we assigned one of four pre-selected world regions to each respondent. We presented four different hydrogen im-port scenarios by varying two variables with two values each: controlled and uncontrolled social standards, and multi-country vs. single-country import relationships; each tied to higher or lower costs respectively. The survey results showed that perceived familiarity with hydrogen remained low (around 81% "not familiar" or "somewhat familiar"). Additionally, green hydrogen received the highest evaluation in terms of attitudes (80 % at or above "rather in favour") while blue and grey hydrogen received lower scores (24% and 12%). When respondents could choose freely, they pre-ferred hydrogen imports from within Europe rather than from other global regions. However, the factorial survey showed that when options were restricted to the four world regions of North America, South America, North Africa, and the Arab States, North America was the preferred re-gion for imports, followed by North Africa. The scenario with controlled minimum standards for social sustainability and contract with multiple countries in a region to ensure resilience and price stability was preferred.

The topic of hydrogen is in a crucial phase where visions and expectations are slowly replaced by materializations. If we understand the public's views now, further research can examine the poten-tial (mis-)match with dominant stakeholder perceptions and provide recommendations for creat-ing a sustainable energy system that takes into account the views of a broad base of actors.

Sociotechnical Imaginaries of Hydrogen Technologies in Poland

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"Hydrogen society" is one of the possible future scenarios associated with the use of renewable hydrogen in the energy transition. The term refers to the use of hydrogen in everyday life by citizens (society) and in industrial/technical applications (economics) (Lin et al., 2020). Many countries - including Poland and EU - already initiated large-scale projects to develop decarbonised societies, focusing on renewable energy, green infrastructure, and sustainable transportation, etc. Thus, new energy technologies will require new ways of understanding language, vision and discursive policies related to emerging innovations and transformations (Upham et al., 2020). Among innovative technologies, hydrogen is identified as a key element in the transition to sustainable energy and climate change mitigation, as outlined in the "Hydrogen Strategy for a climate-neutral Europe" (2020). This strategy positions hydrogen technologies as an essential component in achieving the objectives of the Paris Agreement and the European Green Deal.

The aim of the paper is to present the recent study on "hydrogen society" perspectives in Poland. We use the concept of "Sociotechnical Imaginaries" (STIs) introduced by Sheila Jasanoff and Sanga-Hyun Kim (2009) to understand the creation of a technological future as a key element of social life (Rudek, 2022). STIs – defined as "collectively imaginary forms of social life and social order reflected in the design and implementation of nation-specific scientific and/or technological projects" (Jasanoff, Kim, 2009) – allow for the conceptualisation of possible forms of the future in the study of energy transition.

Our study uses mixed-method approach. First, 24 individual in-depth (IDI) interviews with experts representing industry, transport, public research and development institutions, public administrations and industry associations were conducted to obtain experts' views on hydrogen development in Poland. Then, the Delphi method was used to determine the development of the hydrogen economy in Poland in the next two decades. We engaged 30 experts from the Sectoral Agreement for the Development of Hydrogen Economy in Poland took part in a structured process to evaluate the probability and impact of various factors influencing hydrogen development. The specific statements evaluated were derived from the Polish Hydrogen Strategy, introduced by the Ministry of Climate and Environment in 2022.

The combination of the prognostic dimension of IDI and the Delphi method, which is used in future studies, allows for the presentation of expert STIs at the national level as well as key actors and factors present in STIs. The expert paradigm is one of the most common approach in STIs (Rudek, 2022).

Preliminary research results show that the identified imaginaries related to the development of hydrogen technologies relate primarily to the process of decarbonisation in Poland. More specific subgroups of STIs are related to 1) renewable hydrogen, 2) renewable energy sources and 2) nuclear energy. Moreover, sovereignty of energy technologies, the issue of hydrogen "nationality" and development models of polish hydrogen society and economy are identified as significant STI's.

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Industry first: The Sociotechnical imaginary of Germany as industrial hub and "unsustainabilities" in hydrogen governance.

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Counteracting climate change is one of the major challenges modern societies are confronted with. Vision of hydrogen economy emerged as a promising solution for achieving a net-zero transformation across various sectors. Having been shaped by diverse dynamics over time (Budde & Konrad, 2019), it stabilizes currently in multiple countries as an influential and socially performative vision. However, while the transition towards hydrogen-based energy system accelerates, various prevailing sociotechnical imaginaries influence the shape of the vision.

Against this background, this study investigates intricate ways in which the policy narratives and allocation of resources in German hydrogen-related policymaking has been influenced by the sociotechnical imaginary of Germany as industrial hub, i.e., the conviction that the past and future of German society are tight to industrial production. This research also involves analysis of this sociotechnical imaginagy's historical forms and manifestations in the present material and institutional structures.

Methodologically, we focus on the discourse analysis (Hajer, 1995) of the German policy programs aimed at development of hydrogen technologies (2005-2020). Analysis of the historical establishment and current embedment of the imaginaries is based on secondary literature analysis guided by the principles of theoretical sampling.

Our study indicates that since the formation of the German national-state, industrial consciousness has been inscribed in the structures of the German national-state and society. Despite the overall structural changes towards economy based on service sector, established producing industry remains also nowadays deeply rooted in social consciousness, as well as material, and institutional structures of German society. The industrial imaginary is also

manifested in narratives legitimizing investments in hydrogen technologies and in the distribution of financial resources. These have prioritized support of hydrogen end-use technologies within historically established industry sectors over the years, rather than supporting hydrogen generation technologies.

Given the current underdevelopment of low-carbon hydrogen generation technologies, pivotal for the hydrogen value chain's climate impact, we discuss the extent to which the imaginary of Germany as industrial hub has led to "unsustainabilities" (Markard et al., 2023) in the form of governance of hydrogen technologies over time. In this context, we advocate for governance mode that not only engages with expectations regarding raising technologies (Konrad & Alvial Palavicino, 2017), but also trackless established and taken-for-granted future accounts shaping future visions of emerging and alternate transition pathways (Beck et al., 2021). Furthermore, our study delves into the balance between tentative and definitive modes of governance in multi-technology innovations, aiming to prevent unsustainable developments (Kuhlmann et al., 2019).

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C.10: Towards a sustainable future: facilitating socio-technical change

Session Chair: Peter Obersteiner, Graz University of Technology, Austria

Understanding consumer´s awareness, perceptions and expectations to accelerate grass-based innovations in the Bioeconomy

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The EU has declared the bio-based products sector to be a priority area with high potential for future growth, reindustrialization and addressing societal challenges. In this context, a wide variety of grass-based products are being developed to support the transition from a fossil-based towards a comprehensive bio-based economy. Yet, the market demand for such innovative products remains one of the key challenges for boosting the production and competiveness of grass-based businesses in Europe. To address this challenge, we conducted stakeholder workshops, end-user focus group discussions and consumer surveys to better understand the awareness of end-users, their perceptions and expectations with regards to innovative products based on grass. We identify (i) the current level of awareness of end-users regarding grass-based protein, paper, animal bedding and biochar, (ii) motives for buying, not preferring or even rejecting alternative grass-based products, (iii) perceived benefits and risks, (iv) expectations regarding performance, quality and sustainability of the products in focus, (v) interest in production chains and businesses, and (vi) trust in relevant actors and institutions. The findings underpin previous evidence that emerging businesses can gain a competitive advantage by collaborating with multiple stakeholders and offering users a range of services and benefits associated with the choice of grass-based products. To this end, it is essential that new grass-based products demonstrate attributes and offer benefits that distinguish them from existing solutions, for example by emphasizing carbon fixation, local production, and organic and circular qualities.

Visualising carbon in design and delivery of non-domestic buildings – architects' and engineers' approaches

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There have been accelerated efforts in European policy and practice to measure and simulate carbon emissions from constructing and using buildings. Though there has been a growth of design tools and technologies to better account for carbon emissions, the ways design professionals visualise such phenomena have not been studied. STS studies have for some time established the operative characteristics of visual artifacts and the important epistemic role they play in a range of domains from radiology, neurosurgery, and design to scientific laboratory experiments. Though useful in enabling new understandings of the role visual artifacts play in knowledge processes and practices, there have been few accounts in the

context of design and architecture and none to date examining issues related to low carbon. Studies into architectural organisations further inform the role of visual artifacts in conveying information and enhancing collaborative work during the design process. Nevertheless, visualising and communicating carbon emissions have received little attention or discussion in policy, practice or research domains.

This paper draws on visual descriptive analysis of documentary evidence of 217 visual artifacts, including graphs and imagery illustrations, used in design and sustainability reports to communicate carbon emissions at early design stages across three non-domestic building projects in the UK. The research finds that visualising carbon involves comparisons between carbon information at different scales and temporal intervals of the building performance. Comparisons also included benchmarking the carbon information against guiding standards. The findings further inform that the comparisons were led by the target of diagnosing areas of deficiency in carbon efficiency and justifying design solutions at different building scales and design stages.

Insights from the study help identify the ways visualising carbon may limit or open new design and construction processes, so far overlooked. The findings contribute to knowledge in the area of organisational studies by depicting the engagement with visual artefacts in the context of architectural practices that implement low-carbon design strategies. There are benefits for STS scholars in providing new empirical insights and novel lens for studying visualisation of complex phenomena, expanding understanding of the underlying processes involved.

Enhanced strategies for Meta Governance

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Facilitating regional development becomes increasingly demanding as complexity grows and multi-level and multi actor governance is required to achieve transformational change moving away from fossil dependence and enabling neo-industrialisation. Meta governance is described by Gjaltema et al as a "*practice by (mainly) public authorities that entails the coordination of one or more governance modes by using different instruments, methods, and strategies to overcome governance failures."*

This article will explore how meta governance and perspectives from existential sustainability enables effective facilitation of regional development. The main contribution of the article is a widened array of strategies for meta governance.

In the region where the research is conducted a common energy plan is being established through a joint decision of the more than 10 municipalities. The municipalities are also establishing energy plans as mandated by law, and some are developing plans for windpower. The more than 20 energy companies serving the region are also driving parts of the transition. This multi stakeholder and multi incentive context is complex, calling for refined interventions and reflexive facilitation. Fragility, lack of resources, mandate and knowledge has contributed to systems of powerlessness, slowing down the necessary transition away from fossil

dependence. Regional development and development of energy systems are endeavours of navigating socio-technical systems, with emphasis on both technology, decision making and more.

Meta governance structures are established and are presented in the article. Strategies based in existential sustainability are then employed to enhance the effectiveness of the facilitation, including re-scaling, temporal aspects and a deepened understanding of identities. Together, these are strengthening the capacity for facilitating regional development and transitioning of energy systems.

C.11: Future Mobilities

Session Chair: Anna Schreuer, Graz University of Technology, Austria

STS approach in methodology development of cities' AV readiness

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A crucial challenge in our era revolves around comprehending the influence of technology on our life and socio-technological future. Recent progress in technology has elevated discussions on the interplay between technology and society. A particularly relevant area currently receiving attention involves examining the intersection of technological progress and its potential societal impacts, specifically in the field of autonomous mobility. Science, technology, and society (STS) play a significant role in shaping the future of autonomous vehicles. The development and integration of autonomous vehicles involve intricate technological advancements that must align with societal needs, ethical considerations, and regulatory frameworks. Scientists and engineers work together to push the boundaries of technology, while collaboration with policymakers and engagement with the broader society are crucial for addressing ethical, legal, and social implications. Only by fostering a cohesive partnership among these three pillars (science, technology, and society), we can navigate the complexities and ensure a successful and responsible integration of autonomous vehicles into our urban transportation systems.

The anticipated future prevalence of autonomous vehicles (AV) can significantly reshape the daily lives of urban populations. The increasing integration of autonomous vehicles is a transformative phenomenon that poses both challenges and opportunities for urban environments, urban mobility and city governance. However, this transformation depends not only on technological advancements but also on the preparedness of the population and cities. The readiness of cities to embrace and adapt to this technological shift is a critical factor in determining the success of AV implementation. Cities need to address infrastructure concerns, regulatory frameworks, and public acceptance to create an environment conducive to the safe and efficient operation of autonomous vehicles. As we navigate this era of technological advancement, fostering collaboration between policymakers, urban planners, and the public

becomes paramount to ensure that cities are well-prepared for the future of autonomous mobility. Therefore, it is essential to examine the conditions for the widespread adoption of autonomous vehicles from the perspective of cities as host environments.

In our research, we sought to answer the question of how the readiness of cities for autonomous vehicles can be captured? To address this, we initially reviewed the literature on the readiness of territorial units for autonomous vehicles, extracting 14 pillars from a pool of 234 factors through software-supported structured text and content analysis. As a next step, from a total of 14 pillars, we identified the definitive pillars through consolidations, and subsequently assigned the indicators required for quantification to them. These pillars serve as a framework to grasp the readiness of a city for autonomous vehicles. As a final step, we present how the accessibility of indicators influences the graspability of AV readiness of cities. Our findings can assist in identifying and preparing the necessary considerations for integrating autonomous vehicles into urban environments.

Social LCA: Social impacts of recycling of Lithium-Ion Batteries (LIBs)

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Lithium-Ion Batteries (LIBs) are considered as key technology for climate neutral society and the number of LIBs has increased in recent years. However, the various life-cycle stages of LIBs are associated with environmental and social impacts. In contrast to studies that focus on assessing the environmental impact of LIBs, the analysis of the social impacts of LIBs is still underrepresented in scientific studies. The risks associated with the life cycle of LIBs include, e.g., child labour, occupational hazards, and poverty. Most studies focus on the mining and production processes, but also responsible End-of-life (EoL) solutions are becoming increasingly important.

Improper EoL management of LIBs can have various negative social impacts (e.g., contaminated groundwater related to disposal or health issues related to recycling processes). New battery recycling processes need to be developed to maximize efficiency and recovery rates so that critical raw materials (CRM) from spent Lithium-Ion Batteries (LIBs) can be reintroduced into the economy. Recycling facilities may not be prepared or able to handle these batteries safely, and the social impacts of these new recycling processes are still largely unknown and unexplored.

Social Life Cycle Assessment is a useful method for assessing the social and sociological aspects of products and services and their potential negative and positive impacts throughout their life cycle. Therefore, a S-LCA will be conducted to assess social impacts of the projected “scaled up” recycling steps of LIBs. To perform the S-LCA for recycling processes of LIBs the Social Hotspots Database (SHDB) in SimaPro is used. The SHDB provides insight into social hotspots in product supply chains, covering 140 countries and regions and 57 economic sectors. This database provides an extensive list of indicators (e.g., labour rights, health and safety, human rights, governance, and community infrastructure) which makes it possible to quantify the social risks and opportunities for each process. The SHDB thus offers the possibility of calculating a social footprint, evaluating positive impacts and identifying hotspots.

The expected results of this study will provide an overview of relevant positive and negative impacts related to recycling processes of LIBs. The results can be relevant for setting up new recycling processes and the design of future battery value chains. Given the imminent major disposal problem for spent LIBs, socially responsible EoL solutions are required. Therefore, this study helps to shed light on whether the recycling of LIBs can be beneficial in terms of social impact.

Urban Labyrinth: Balancing Progress and Inclusion on 15-Minute Cities

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The evolution of the urban environment, adapting to new social and technical needs and paradigms, presents a significant urban challenge. From integrating renewable technologies to legislations regulating the number of internal combustion vehicles allowed on the streets, balancing majority social progress with the needs of minorities is becoming increasingly complicated.

This is particularly evident in concepts such as the 15-minute cities, which promote accessibility to services and basic needs within a 15-minute walk or bike ride. The idea of these cities is to create a more human-centric urban environment, reducing reliance on cars, and enhancing local communities. However, it also poses significant risks, especially in terms of exclusion of marginalized segments of the population.

This exclusion can manifest in a lack of access to essential services and opportunities, exacerbating existing inequalities. Particularly, marginalized communities may find themselves disproportionately affected by urban planning decisions that do not adequately consider their unique needs. For instance, if essential services like healthcare, education, and grocery stores are centralized in more affluent areas, those living in poorer neighborhoods may experience a heightened sense of isolation and disadvantage.

The study presented here provides urban technicians with a model to understand the impacts related to changes in the urban construct concerning social injustices, through an Agent-Based Model (ABM) based on OpenStreetMap data. Under this framework, an advanced methodology will be implemented to analyze the feasibility of the 15-minute city concept. These models are characterized by their ability to simulate complex and dynamic interactions between autonomous agents and their urban environment. For this, agents will be defined with differentiated attributes that reflect the demographic diversity and urban mobility, from older people with reduced mobility to young people and adults with different transportation preferences (public, bicycles, electric scooters). These profiles will allow for precise simulation of access to essential services within a 15-minute radius, considering variables such as speed of movement and choice of transportation. This will be achieved through simulations that reflect variations in urban infrastructure and the socio-economic characteristics of the population. Thus, ABMs will provide a crucial tool for the detailed analysis of the impacts of different urban planning strategies on inclusion and accessibility within the framework of 15-minute cities.

A behavioral framework is also developed, defining the relationship between socio-economic level, educational outcomes, disease incidence, unemployment rate, number of vehicles, and other such factors with the degree of integration of the “15’ city” concept. This framework will serve as a guideline for the forward development of ABM, ensuring that the models are grounded in realistic human behavior and social dynamics. Through a series of case studies, various urban configurations will be examined, from densely populated areas to peripheral neighborhoods. This comprehensive approach allows for a nuanced understanding of how different urban designs impact various communities, aiming to serve as a guide for inclusive and conscious planning, considering the needs and limitations of all segments of the population. It emphasizes the importance of creating urban spaces that are not only efficient and sustainable but also inclusive and equitable.

This work contributes significantly to the field of urban design and development by offering a critical perspective on urban demands and mobility. By identifying and analyzing the risks of exclusion and the barriers faced by vulnerable groups, the study not only addresses a crucial gap in the existing literature but also provides practical guidance for urban planners and policymakers to promote more equitable and accessible cities.

Stream D: Gender, Science and Technology

D.2: Gender and Intersectionality in Technology and Innovation Research – The Practical Experience

Session Chair: Anita Thaler, IFZ, Austria
Session Chair: Sascha Fink, Carinthian University of Applied Sciences - CUAS, Austria
Session Chair: Daniela Krainer, FH Kärnten gGmbH, Austria
Session Chair: Clemens Striebing, Fraunhofer IAO, Germany

The Gender Dimension in FEMtech Research Projects – A reflection based on practical experiences

Sybille Reidl, Sarah Beranek

Joanneum Research, Austria

In this contribution, we would like to reflect on the integration of the gender dimension in several FEMtech research projects from both the methodological and practical perspective of the gender expert and social science partner. In doing so, we draw on our extensive personal practical experience from participating in five FEMtech projects (Pyzotex, LightLife, FemCharge, VR4CARE, FairCom) in the fields of mobility, opto-technology, sensor technology, VR and communication technology over the last 10 years.

Methodologically, we would like to look back at how the research processes themselves and the integration of the gender dimension have changed over time. We want to show how we developed our approach from the initial purely gender-based consultancy of an often very quantitatively orientated research project to an interdisciplinary approach with a qualitative social science perspective that in parallel further developed the concept of gender towards diversity, intersectionality and a non-binary understanding of gender. Furthermore, we want to look at what impact these changes had on the gender and diversity-specific results of the research projects.

With a view to practice, we would like to share our experiences and challenges that arise when theoretically designed gender/diversity/intersectionality-sensitive research processes are put into practice. These challenges often begin when working with partners who are new to the topic of gender / diversity and interdisciplinary research and are not only evident in research projects but often also in the application phase. Other challenges relate more to the implementation of research - e.g. reaching and involving diverse target groups or avoiding bias in data collection.

Overall, we can conclude that integrating the gender dimension demands flexibility and responsiveness. No single approach will suffice across diverse projects; methodologies must be tailored based on the content, project team and stakeholder needs.

Gender+ in nanotechnology. A practical experience.

Rita Bencivenga[1], Diego Colombara[1], Cinzia Leone[2]

[1]University of Genoa, Italy; [2]Italian Institute of Technology, Italy

In 2021, Horizon Europe (HE) required gender equality plans (GEP) or an equivalent strategy for public organisations applying for funding. However, the 2022 HE calls for proposals recognised the heterogeneity in the implementation of GEPs across the EU and the persisting structural barriers in research and innovation institutions [HE Framework Programme, WIDERA call, 2022]. To address these challenges, the higher education sector should propose inclusive GEPs that are in line with the new European Research Area (ERA) and the Equality Objectives [Addabbo et al, 2021].

The inclusive GEP of the University of Genoa, Italy, is implementing three transversal pilot actions: at department, project, and curriculum levels. The action at the project level, the Gender+ Action Plan (P-GAP), is modelled on the EU FP6's (2002-2006) requirement [Kalpazidou Schmidt et al, 2020] and integrates gender+ into R&I projects' workplan, attempting to fulfil the EU requirement to include a gender+ perspective in all phases of research, i.e. in identifying the problem, conceptualising, researching, collecting and analysing data, disseminating, and follow-up.

The experience described refers to an EU-funded research and innovation project on nanotechnology, REusable MAsk Patterning, (REMAP), financed by the European Commission PathFinder open programme, whose coordinating partner is supported and advised in its activities by a team of gender studies experts who cooperate for the integration of strategies and activities related to Gender+ and add a transdisciplinary dimension in close collaboration with researchers in organic and inorganic chemistry.

In the literature in the "chemistry field", the need to "fix the numbers" and "fix the institutions" are addressed by reflecting on possible discrepancies in individual performance [Reinhold, 2007] or by highlighting positive results achieved by female scientists [Meng, 2018]. More recently, research targeting the application of nanomaterials has developed an awareness of the importance of gendering innovation [Yang et al, 2021]. However, there is still a lack of good practise that should be followed when conducting EU-funded research.

The inclusion of a gender+ perspective in the research project is not easy in view of the research areas investigated in the project (magnetism, electrodeposition, photovoltaic devices) and the hypotheses to be tested. Nevertheless, even if the initial technology readiness level (TRL) [Mankins et al., 1995], of the research is low, a disruptive impact on society is ultimately expected from this kind of actions when they elapse. Therefore, it is crucial to ensure that the relevant hypotheses and methods are free from gender bias from the very outset. Gender bias may include unintentional flaws in the research design, implementation, interpretation of the results, and validation of prototypes all the way from theory to experiments. Besides the most obvious ethical implications, such careful assessments can bring long-term economic benefits through the value added in terms of expanded market base and commercial appeal of the sought technology. In order to prevent the emergence of gender bias in the research content, it is necessary to reflect on the perspective that has emerged since the 2000s in Gender and

Technology studies, which views technology and gender as socially co-constructed in a reciprocal shaping process (Lohan and Faulkner, 2004).

Based on these premises, to promote a Gender+ perspective, REMAP envisages the implementation of several micro-actions, of which we will focus in this presentation on the project's dissemination and outreach activities.

The initiative aims to overcome the resistance to implementing a gender+ perspective in STEM disciplines [Mergaert and Lombardo, 2014] and to create a fruitful and positive cross-fertilisation between STEM and social sciences, especially gender and diversity studies.

The next steps are to consolidate this initiative through collaboration in other EU funded projects.

Embedding Intersectionality in Research Funding: A Pathway to Inclusive Innovation

Helene Schiffbänker, David William Walker, Julia Greithanner

Joanneum Research, Austria

In response to the growing recognition of gender and diversity as pivotal factors in research and innovation, this paper deals with the challenge to integrate an gender-sensitive intersectional perspective in innovation processes. This form of "Gendered Innovations" (GI) aims to enhance creativity and innovation by integrating sex, gender and increasingly other inequality dimensions into research content and innovation processes.

We approach this challenge from the perspective of policy makers and research funding organisations, who not only establish the policy objective, but also have the ability to offer incentives and assistance to researchers, research organisations (RO) and private R&I companies. Some concrete policies have been implemented by several RFOs for research organisations including universities in the past few years. Studying the practical implementation of this provides first insights in the experiences and needs for working with GI in practice. In our presentation, we will address some of these identified challenges, covering two shifts simultaneously: from RO to private companies and from the gender perspective to an intersectional perspective.

While researchers in HES seem increasingly aware of the need to integrate the gender dimension into their research content, recent research (Schiffbänker et al. 2023) reveals that at the level of reviewers, this awareness was not developed systematically yet. It is necessary to develop a common approach on how to explain the narratives and targets of GI policies to applicants and reviewers. Further, RFOs need support on how to integrating the gender dimension throughout their entire funding cycle, in particular how to translate the policy into concrete instructions for reviewers and to develop indicators that can be applied across RFOs.

In addition, we know little how this works in the business enterprise sector (BES). Gendered innovation policies so far focus primarily on ROs with limited relevance for private R&I companies. There is a lack of policies and of systematic implementation of GI in the private R&I sector. Consequently, there is a lack of data about the status quo: Many companies conduct diversity activities on a voluntary basis without clear monitoring activities. This limits the understanding and application of gender-sensitive approaches in the innovation process.

Beyond this, cultural norms such as Eurocentrism and masculine hegemonies constrain the inclusivity of innovation and overall knowledge production, reinforcing power imbalances that sideline minority groups. This implies a need to include further inequality dimensions that intersect with gender (e.g. cultural background).

Drawing upon empirical data from the GRANteD project, which examined assessment criteria for GI for ROs, we reflect on some learnings that can be used for fostering intersectionality in innovation processes in the business enterprise sector. The overall aim is to develop policies for companies that address the GI from an intersectional perspective.

From Lived Bodies to Inclusive Interfaces: Plessner, Feminist Standpoint Theory, and Gender-Inclusive Design Synergies.

Charlotte Reinhardt

University of Wuppertal, Germany

In this contribution I would like to display the untapped potential of Plessner's (1975 [1928]) *Philosophical Anthropology* in the realm of Software Design. By doing so, I would like to discuss if and how *Feminist Standpoint Theory* (Hartsock 1998) can be linked to this potential to extrapolate theoretical starting points for the development of a truly gender inclusive design process. The topic is grounded in the assumption of software designers unconsciously using a male person as their target user. To overcome this reality the international project *Gendered Innovations* (Stanford University o. J.) offers different checklists on how to implement the gender/sex variable into innovative processes depending on the field of study. Even though the project's website provides a very detailed checklist on how to implement the category sex/gender into a design process, conceptualises gender as a multi-dimensional category and links it to intersectional approaches, the project falls short in acknowledging the existential meaning of the category sex/gender for the process of individualisation and the individuum's access to the world. In my analysis of gendered individuation processes along the line of difference between body, lived body and person I could show that growing up in a binary gendered world produces entirely different individualisation processes for different sex/genders in every of the above named aspects (Reinhardt 2022). A checklist on how to implement gender into any design process, has to start with a conceptualisation of sex/gender, that takes the body experience in a sense of a lived body (Leib) (Plessner 1975) into account.

Furthermore since design is always an economic process and sex/gender is a category that produces groups that are vulnerable to social inequality in different ways, a socially responsible design process has to think sex/gender embedded in its societal and economic environment (Baker 2018: 540).

In the contribution I would like to give a detailed overview of relevant research and would like to show that gender inclusive design has to approach gender analytically on three different levels: First humans have a corporeal-physical sex/gender which means that design has to take the bodily reality into account. Second humans are their sex/gender at the sphere of the living body by performing it, which opens an existential level of analysis. Third humans constantly have to make their sex/gender their own, which causes the need to take into account the volatility of the relation between gender identity, gender norms and gender relations.

Moreover, I would like to show, that Feminist Standpoint Theory is a fruitful starting point for gender inclusive design yet finds its limitations in the specifics of the here underlying gender conception. This submission strives to contribute to the ongoing discourse on gender-inclusive design, offering insights for a more holistic and nuanced understanding of the intricate relationship between sex/gender, technology, and design processes.

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Reinhardt, Charlotte. 2022. *Der vergeschlechtlichte Mensch: Geschlechterdifferenz aus der Perspektive der Philosophischen Anthropologie Helmuth Plessners*. Nordhausen: Verlag Traugott Bautz GmbH.

Stanford University. o. J. „Checklists“. *For Researchers in Science, Medicine, and Engineering | Gendered Innovations*. Abgerufen 22. Januar 2024 (http://genderedinnovations.stanford.edu/researchers.html).

Gatekeeping of Entrepreneurial Living

Cansu Güner

Technical Universtiy of Munich, Germany

Communal entrepreneurial housing, also known as co-living, is considered as one of the current techniques of innovation governance. In co-living spaces, entrepreneurs do not only share entrepreneurial networks or investment opportunities, they also share domestic chores, leisure activities or personal connections. This ubiquitous quality of co-living spaces—which encapsulates entrepreneurship, domesticity, and leisure—provides a great opportunity to understand how innovation projects include gender dimensions, not only in the business realm but also in different aspects of innovation-driven life.

This talk will focus on practical experience on how co-living projects integrate the ideas of gender and intersectionality into their existing constellations. To do so, it especially focuses on the selection process of new residents, building upon the metaphor of gatekeeping which lays out how some people get to be selected to live in a co-living space while others are eliminated within the same process.

I specifically focus on two different parts of gatekeeping: the “embodied gatekeepers,” which includes current co-living residents, as they are often the responsible ones for searching for and deciding upon new candidates. I also explore “values as gatekeeping”, focusing on how certain values inform the selection process.

In the end, I argue that the language of diversity is being instrumentalized in co-living spaces (Güner 2023). However, the idea of diversity in this context often moves away from the

intersectional understanding of diversity which includes dimensions like age, gender, ability, or race. Instead, it is linked with “acquired human capital” (Foucault, 2008, 229), which includes factors like one's background, hobbies, or entrepreneurial interests. In order to explore this new perspective of diversity, I unpack an often-used narrative of superhero teams in co-living spaces.

In co-living spaces, the idea of diversity tends to be based on the premise that the distinctive powers of residents would enrich the community. It is often believed that when residents have diverse interests and backgrounds, it is more likely that the community will be seen as more interesting. That’s why when searching for a new resident, one of the criteria that is promoted is to have a distinctive and heroic quality which sets the applicant different from the existing residents. Inspired by the omnipresent narrative of superhero teams in entrepreneurial culture(s), I refer to this model of diversity as the superhero model of diversity and argue that this model of diversity is not only limited to entrepreneurial living, but it is rather an emblematic social practice of innovative communities in general.

Drawing on feminist techno-science studies, and a nine-month-long ethnography in two different co-living spaces located in Silicon Valley and Germany, this research explores how gender and intersectionality is being integrated into innovation-oriented projects.

Co-creating a 3D printed prosthesis design using an intersectionality lens

Anita Thaler[1], Sascha Fink[2], Daniela Krainer[2], Peter Schubert[2], Julian Bosch[2], Rosmarie Heim[2], Claude Humbert[2], Thomas Rockenbauer[3], Michael Sauer[4], Matthias Sepin[5]

[1]IFZ, Austria; [2]FH Kärnten gemeinnützige Gesellschaft mbH; [3]Luxinergy GmbH; [4]Magna Powertrain GmbH & Co KG; [5]Sepin Orthopädietschnik Sanitätshaus Ges.m.b.h.

The ongoing project PROTEA aims to improve the fit and acceptance of lower leg prostheses by optimizing the prosthetic design using 3D printing and integrating sensors to monitor pressure distribution of the residual limb to identify and localize potential problems, such as pressure or chafing points, in advance. This overarching goal is pursued since 2022 with a human-centered, gender- and diversity-sensitive, participatory technology design.

For this, a transdisciplinary team comprising engineering, physical therapy, orthopedic technology, psychology, movement sciences and gender studies regularly meets and co-creates knowledge in online and face-to-face workshop settings. The gender-sensitive involvement from stakeholders and potential users – with interviews and focus groups - informs the technology development process and influences decisions regarding specific technology designs.

The intersectional perspective of the gender approach of PROTEA became most visible when the team decided in a use case decision workshop on which user group they would like to focus on. For this co-creation workshop, empirical results of user and stakeholder interviews and focus groups as well as literature analysis were translated into diverse conditions and challenges of respective target groups, and questions around potential ethical and societal consequences were raised. The decision for a comparatively larger group of mostly senior users – with amputation mostly due to illnesses, like Diabetes mellitus – was made with the

outlook of being able to make a positive difference for many people, who would need the improvement of prosthesis technology most for their everyday lives. A closer look at this target group showed that it is predominantly older multi-morbid and health-impaired males with lower socio-economic status. So besides biological factors, it is the consequences of combined social factors, which might lead to the challenges of this specific target group.

In our presentation we will present the sociotechnical framework of PROTEA, comprising a detailed requirements analysis which led to the development of personas used by the engineers currently working on a 3-D-printed outer and inner shaft of a lower leg prothesis, and the placing of pressure sensors within the inner shaft.

Negotiating contradictions of classifications for the purpose of self-empowerment

Heike Gerdes

University of Applied Sciences Emden/Leer, Germany

Research project:

“Sociotechnical Practices of Objectivation: An empirical examination of AI-based health apps for diagnosis (STePOn)”

Cooperation project of the Emden/Leer University of Applied Sciences and the Technical University of Braunschweig under the direction of Prof. Dr. Silja Samerski and Dr. Dr. Corinna Bath

Background:

One goal of socio-technical transformation in healthcare is to enable patients to make informed and objective decisions. From the perspective of feminist science and technology studies, our research project investigates the development and use of AI-based health apps for (self-)diagnosis, the so-called symptom checkers. We empirically explore how health knowledge, which is considered objective, is generated sociotechnically both during development and use.

Methodology:

Based on an ethnographic approach and theoretical concepts of actor-network theory and new materialism (Barad), we conduct participant observation and use semi-structured interviews with different users (currently: n=16) and IT and medical experts (n=7) on the development side.

Research questions:

On the development side, we are investigating the following questions:

How are medical classifications translated into technical infrastructures?

What are assumptions guiding development and implementation? Which forms of knowledge, experiences, practices, and potential user groups are included or excluded?

On the utilisation side, the following questions guide us:

How is embodied knowledge translated into the classification system?

How do users negotiate moments of inclusion or exclusion?

How do the apps and associated health practices change ideas and knowledge of bodies, health, and illness?

Results:

In the case of AI-based health apps for (self-)diagnosis, users are caught between the desire to empower themselves and the demanding work of translating and categorising their bodies and (embodied) knowledge into a distorted and unambiguous sociotechnical classification system. This emerges from the situating and assumptions of the developers (Haraway) and is unable to reflect the diversity of life and body experiences. Among other things, mechanical, biomedical-statistical body concepts and neo-Darwinian and gender-discriminatory assumptions are evident. These health apps are therefore normative systems.

Users have extensive knowledge and competences, as well as a capacity for compromise and ingenuity in their categorisation. They negotiate contradictions between their experience, (embodied) knowledge and the existing classification system. In doing so, they take responsibility for maintaining potentially incomplete and discriminatory systems. They do this work for the purpose of (self-)care and empowerment in order to be able to assert themselves as competent in a healthcare system affected by social/intersectional inequality. However, the lack of (digital) health literacy among users is repeatedly emphasised in the public discourse and cited as a social problem or as a basis for legitimising various products. In particular, their strategies of translation and negation can complement the discourse on user competence. Nevertheless, by negotiating classifications and contradictions, users learn to perceive their bodies in a certain way and thus unconsciously in the light of certain norms. They are located between self-empowerment and discipline.

ChatGPT Ate My Homework: An Alternative Exploration of Research Methodologies Situating Generative AI as an Academic Co-Researcher

Anna Shimshak[1], Sara Arias[2], Selina Oswald[2], Hannah Puckmayr[2], Anamaria Soče[2]

[1]University of Graz, Austria; [2]Student in 'Virtual Bodies' Course, University of Graz

In November 2022, public access to OpenAI's ChatGPT took the world by storm. It was clear that the impact of ChatGPT, and generative AI more broadly, would be substantial across social and professional sectors. In education, academics, teachers, and journalists voiced concern for the ChatGPT's implications for learning, academic integrity, critical thinking, free speech, and the merit of academic assessments. While ChatGPT has seemingly confirmed some of these fears with its ability to pass medical and law school exams and write term papers, we contend that while there are certainly merits to the concerns, there is potential in conceptualizing of ChatGPT as more than the "downfall of education and critical thinking." We argue that if one cannot 'beat' the use of ChatGPT and generative AI platforms in an educational context, why not make them academic co-researchers?

This paper is co-authored by a Gender Studies class at Universität Graz and presents research undertaken by students as part of a class assignment to use ChatGPT (*or other generative AI platforms) in an investigation of topics related to gender, sexuality and technology. Students were given latitude to explore a topic of their choosing related to the broader course focus with

the stipulation that they use ChatGPT* not to produce a final work output, but rather to approach it as a research partner or research participant.

In “A Cyborg Manifesto,” Haraway (1990) proposes the cyborg as a hybrid creature emancipated from hierarchies, binaries and arbitrary divisions. Haraway’s work has been influential in the development of posthuman feminist theories, which decenter the human, advocating for a ‘more than human’ perspective and engagement that considers the environment, plants, animals, technologies and things equally and equally deserving of empathy. In using ChatGPT and generative AI in their research, students engaged with these theories, exploring how technology related to social bias, hierarchy and empathy. They utilised hybrid methodologies that drew from participatory co-design, speculative design and design fiction, thing ethnography, as well as ethnography and auto-ethnography.

While this assignment revealed significant findings in each of the students’ individual research on generative AIs’ perspective and synthesis of information on gender and sexuality related issues, the course assignment also yielded new modes of conceptualizing more broadly of generative AI’s role within academia, student work, research, social empathy production. Students engaged with ChatGPT* in different ways, from interviewing ChatGPT*, to using text-to-image generators or creating hypothetical users to test demographic differences in ChatGPT*’s responses. Students’ work not only highlighted biases and myopia in ChatGPT*’s responses to gendered topics, but also discovered significant limitations in its deployment of linear language or the platforms’ refusal to discuss topics related to gender and sexuality. While sociological work often engages with research participants to explore complex social dynamics and belief systems, positioning ChatGPT* as a co-researcher allowed students to explore how generative AI and its use of socially produced data sets can be another avenue of exploring sociological dynamics mediated through technological and algorithmic lenses.

Following the completion of their course assignment, students conducted semi-structured interviews with one another, discussing their experiences researching with ChatGPT* as well as their larger critical reflections on generative AI’s usage in academic work. This paper presents the findings from students’ interviews and modes of researching with ChatGPT*. Based on these findings, we have developed a methodological and reference framework for the engagement of ChatGPT* and generative AI platforms as academic co-researchers. This presentation of ChatGPT* confronts anxieties around ChatGPT’s* deleterious role in student work, academic integrity and development of critical thinking.

Intersectional Gender Relations and Socio-technical Transformations in the Energy Sector

Andrea Wolffram

RWTH Aachen University, Germany

Technology and innovation research should not be viewed as a purely technical endeavor, but always in its socio-technical dimensions. In particular, current technological transformations such as those in the areas of digitalization, energy and mobility must be framed as sociotechnical transformations. If the socio-technical side of technological transformation is ignored, it is also difficult to recognize the intersectional gender dimensions in such

transformation processes. Even if researchers are asked to reflect on whether people are affected by the implementation of technological research results in order to integrate the relevance of gender and diversity into the research content, the results are likely to be shortened if research teams do not work together on an interdisciplinary basis. And so the examples provided by research funding organizations to illustrate the relevance of the gender dimension in engineering disciplines often appear very contrived and superficial, especially when they are reduced to supposedly biologically determined gender differences (cf. https://www.dfg.de/de/grundlagen-rahmenbedingungen/entwicklungen-im-wissenschaftssystem/vielfaeltigkeitsdimensionen/ing#255778)

STS research, on the other hand, has shown that technology is always embedded in social contexts (as expressed, for example, by the concept of the seamless web) and that transformations - especially major ones - will not succeed if the social conditions in which the technical transformations are embedded are ignored. With such a perspective on technology and innovation, the relevance of gender/diversity relations in technical research is often very obvious and offers a variety of methodological approaches to social science analysis.

This will be illustrated using the example of the socio-technical transformation field of energy. A pilot study from 2020, in which six qualitative interviews were conducted with homeowners, explored, among other things, the motives in the context of different gender arrangements that justified the installation of supply technology based on renewable energy sources - at a time when massive subsidies and legal requirements hardly provided any incentives to convert building technology to sustainable energy sources. The pilot study has already demonstrated the relevance of intersectional gender relations in terms of acceptance and engagement in the energy transformation: the results point to the relevance of considering different masculinities and the relevance of non-heteronormative lifestyles that challenge stereotypical gender images.

Between pioneering and a paper tiger: the evaluation process of gender mainstreaming in EU project proposals

Katrin Mögele, Paula Gundi

Technical University of Munich, Germany

The EU has emerged as a pioneer in promoting gender equality and gender mainstreaming in research[1], [2], and evolved into an interesting case of evaluation-based funding for STS scholars[3], [4].

Integrating the gender dimension in research has become an inherent part of project proposals and the ensuing evaluation process within EU framework programmes. Gender equality as a ranking criterion has gained in importance and applicants have been asked to elaborate on the gender dimension in research, if relevant (Horizon 2020) or by default (Horizon Europe). Evaluators are supposed to assess this accordingly[5].

The EU’s research policy sets a promising example for achieving gender inclusivity in research and innovation. However, it raises the question of whether the policy translates into tangible outcomes in the research funding cycle. The policy review "Gendered Innovations 2" concludes

that gender integration is less advanced than anticipated, highlighting the need to better educate evaluators[6].

This leads us to the question how the peer-review of proposed research and innovation projects includes the gender dimension.

Applying a grounded theory approach, we analysed 71 evaluation reports (ESRs) of collaborative project proposals in pillar II of the Horizon 2020 programme that referred to gender. Four ESRs mentioned sex in the context of medical research, always directly associated with gender.

Based on our preliminary analysis, we categorise the evaluation of gender into three main groups: commended, mentioned, criticised. We observe variations in terms of content and depth in each category. Although the evaluation is primarily intended to focus on gender in research within the excellence chapter, we have noticed several references to gender aspects in the other evaluation criteria and the gender balance within the consortium, particularly in the implementation criterion. Evaluators revealed their concerns on gender issues such as women leadership or equal opportunities. The assessment of the gender dimension ranges from evaluative terms such as (in)sufficient to the score descriptor "(minor) shortcoming". It is inconclusive to identify point deduction due to the lack of integrating gender. Nevertheless, we have identified ESRs that commend the integration of gender in the research design and scientific impact, or criticise its absence. In some cases, the lack of implementation steps is reviewed inadequate. There are some indications that the review process of gender aspects depends on the research field the proposals address.

This preliminary analysis requires further refinement to address the research question, which will complement the work of STS scholars on integrating gender in grant writing[7], [8], [9], and the future implementation of Horizon Europe.

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[8] Sjöö, K. & Kaltenbrunner, W. (2023). Gender mainstreaming research funding: a study of effects on STEM research proposals. Science and Public Policy: 304 - 317

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Stream E: Mobility and Logistics: A Socio-Technical System on the Way to Sustainability

E.1: Transforming organisational mobility towards more sustainability

Session Chair: Kay Cepera, TU Dortmund, Germany

Session Chair: Marlon Philipp, TU Dortmund, Germany

Session Chair: Ariane Wenger, ETH Zurich, Switzerland

Business air travel: Influencing factors and an outlook on reduction and substitution potentials

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Air travel is one of the most emission-intensive activities per capita. In times of urgent need to reduce emissions and to achieve a mobility transition which is essential for this goal (Geels, 2012), it is therefore worth exploring potentials to reduce or substitute air travel whenever possible. At the same time, reducing carbon-intensive behaviors is a particular challenge due to the prevalence of carbon lock-in at the technological, institutional and behavioral levels (Seto et al., 2016). In contrast to the area of leisure air travel and tourism (cf. Gössling et al., 2023) or academic air travel (cf. Wenger et al., 2023), the scientific literature on business air travel is sparse, especially when it comes to quantitative travel data. A recent exception is the study by Müller & Wittmer (2023), which looked at the choice between air travel and video conferencing among business travelers and found that the COVID-19 pandemic had a significant impact on the need for business travel and that video conferencing can replace business air travel in some cases, but not all (also shown by Walsh et al., 2021). We aim to complement this limited field of research by focusing on what factors influence air travel in knowledge-intensive companies, both from an organizational and individual perspective (RQ1), and what opportunities and barriers exist for the reduction or substitution of business air travel based on these factors (RQ2). To answer these questions, we apply a mixed-methods approach and combine semi-structured expert interviews with business representatives (n = 13, fall 2022) with a quantitative survey of business travelers (n = 101, spring 2023) with a focus on knowledge-intensive companies in Austria. The interviews show that institutional, organizational and individual factors play a role in business air travel. At an organizational level, costs and time resources, the limits and use of digital tools and meetings, and applicable

travel policies and guidelines determine the scope of business air travel. At an individual level, travel preferences and the perceived freedom of action of travelers can influence their decisions. This is also reflected in the survey results, which clearly show the interplay of organizational structure and travel guidelines with personal preferences and actual travel behavior. The predominantly male business travelers took an average of 4 business trips in 2022 and 8 business trips per year from 2017 to 2019, indicating a continuous decline after the COVID-19 pandemic. Preliminary conclusions point to the complex interplay of institutional, organizational and individual factors and the need to clearly differentiate and formalize in which situations in-person presence in conjunction with air travel is mandatory and in which either other forms of physical travel or a virtual substitute can and should be used.

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Greener or Faster: Unraveling the Impact of Travel Time Presentation on Rail and Air Travel Decision-Making

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Global air traffic is a significant contributor to the environmental footprint of transportation, accounting for approximately 2.5% of global CO2 emissions (Lee et al., 2020). In particular, business travel has become an essential part of today's globalized business world. However, the environmental impact of such trips has become a growing concern, leading companies such as consulting firm EY to declare plans to reduce emissions caused by business travel by 35% (EY, 2021). Such reduction could be achieved by encouraging a modal change from air travel towards rail travel among employees, as traveling by train is considered an environmentally friendly mode of transportation and offers a viable alternative to air travel for short-haul routes (Dobruszkes, 2011). Research on rail and air competition suggests that travel time is an essential determinant of the mode choice of business travelers (Behrens & Pels, 2012). On the one hand, many analyses consider time (duration) as a cost associated with traveling because it is perceived as unproductive (Mackie et al., 2001). However, with the advancement of information technology, in many sectors travel time can be used for work purposes as well. Despite this, there is a lack of evidence-based research on the effective use of travel time by business travelers, especially with regard to different modes and travel durations (Wardman & Lyons, 2016).

In a series of studies, a combination of surveys and randomized controlled online experiments, we investigate how travel time and productive work time affect travel-related decisions of business travelers. More specifically, we leverage travel planning applications to investigate the impact of different representations of travel time and the amount of productive work time on business travelers' mode choice. In our first study, we plan to conduct a survey with a representative sample to investigate to what extent business travelers consider travel time productivity as a decision criterion when choosing their mode of transport. Additionally, we will investigate how business travelers assess travel time productivity for air and rail travel when presented with different trip durations in travel planning applications.

The survey aims to provide a better understanding of the value of travel time productivity. Ultimately, the information gathered will serve as a basis for further research into how travel time-based behavioral interventions in travel planning apps can encourage business travelers to choose environmentally friendly modes of transportation. Our study thus contributes to the conference session “Transforming organizational mobility towards more sustainability” by first addressing how travel time productivity affects the choice of transportation mode by business travelers. It will also shed light on technology-based behavioral strategies to achieve more sustainability in the transportation sector, thus addressing one of the session aims.

Telework and individual living space

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So far, teleworking has been promoted as a policy to reduce the environmental impacts of commuting (Ohnmacht et al., 2020; Ravalet & Rérat, 2019; Wöhner, 2022). In the future, it will be increasingly important to pursue a sustainable lifestyle. With these points in mind, it is also necessary to analyse the impacts of teleworking on the living space.

From a sustainability perspective, the impacts of teleworking on the living space should be considered. The average living space per person in Switzerland is 46 square meters (Bundesamt für Statistik [BFS], 2022). The baseline survey of the Suurstoffi Living Lab in Risch-Rotkreuz, Switzerland, shows that 65% of the interviewed residents are able to work at home, with 70% having their own room set up for this purpose (Ohnmacht et al., 2023). In view of the more intensive use of the apartment, there is a risk that the need for living space will increase. It is, therefore, important to consider the impacts of teleworking on housing. From a sustainability perspective, teleworking should not lead to an increase in living space per person. Else, the saved resources by eliminating the commute would presumably be compensated.

This relationship between teleworking and living space per person should be analyzed. The first step is to investigate how telework affects living space (e.g. number of rooms, satisfaction with housing, living environment). Smaller dwellings or shared spaces in houses, for example, reduce resource consumption (Creutzig et al., 2022; Hertwich et al., 2019). On the other hand, the more intensive use of the dwelling might lead to an increase in the consumed surface.

The study uses a data set that was collected as part of a research project on the optimization of floor plans of rental apartments and also contains information on teleworking in particular. The survey (N=981) will be analysed specifically in relation to teleworking and will answer the question of how teleworking affects living space.

This paper addresses the question of the impacts of teleworking on housing and the consumption of living space from a sustainability perspective. The paper will end by setting practical and scientific implications in dealing with teleworking against the background of housing needs.

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(Un) recognizing of transport needs in a changing socio-technical system: the case of electric scooters in Poznan.

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Over the years, many solutions have been implemented to achieve the goals of affordability, inclusiveness, efficiency and reduced pollution in urban transport systems. The shared electric scooter was one of such solutions and its introduction into transportation systems was accompanied by promises of achieving goals mentioned above and reducing car dependence in urban areas. However, these claims have been challenged and questioned in academic studies and public debates.

We combined the theory of socio-technical transitions (STS) with the energy justice framework to analyze dynamic networks between residents, e-scooters as a technology, policies, circumstances around its gradual implementation and other components related to the controversies which emerged during the transition leading to new disputes and conflicts over access, regocnition, civic participation and knowledge. Our study aimed to investigate ways in which the introduction and establishment of e-scooters in Poznan's transport networks transformed the residents' perception and the articulation of ideas, interests and needs for just transport on individual and collective basis. We conducted a mixed-methods study combining a survey in the metropolitan area (N=900 with additional sampling among EM users and open recruitment) with in-depth interviews with Poznań citizens aged 15-60 (N=30) collected as part of the ITEM project (Inclusive Transition to Electric Mobility), an international research project investigating the process of transition to electric mobility from social justice perspective.

The survey revealed significant differences in the ability and willingness to use a scooter, and different assessments of the implications of this process for urban mobility in Poznań. It also investigated how people of different ages, genders, income etc. related to statements about just transport. The qualitative part of the study highlighted how the e-scooters shaped the existing socio-technical mobility regime, transformed social practices, uncovered existing problems (e.g. curb height, lack of cycle paths) or made new disputes emerge (e.g. between road traffic participants, residents, policy-makers, private firms). Regardless of whether they use e-scooters or not, interviewees complained about the lack of dialogue and participation in setting the rules for the transition and the experience of limited agency in the decision-making process related to local and national policies. The introduction of scooters was often seen as a non-negotiable technological solution that disrupted the existing urban mobility patterns. Furthermore, ways in which the vehicle was tied to existing spatiotemporal arrangements were seen as oppressive to certain groups such as pedestrians, people with limited digital and physical skills, older adults and with lower financial capacity. Despite criticisms, there were many for whom it was a tool for emancipation, regaining agency and reducing transport exclusion. According to these testimonies, e-scooters helped solve problems such as bad public transport access on the city's outskirts or the preceeding abolishment of shared city bikes system.

We conclude with implications for the study of socio-technical transitions through the lens of social justice and conflict theories. One of main finds in our study is the social mobilization that emerged during and because of the transition. E-scooters as a ‘flashpoint’ in the network prompted previously passive actors to reflect and take a stance (e.g. articulate their desires, ideas, demands), brought into the spotlight competing claims or actions between categories of actors, reconfigured the perception and public discourse about inclusive, effective transport which in turn, informed following policy changes and the spatiotemporal reality of everyday life in Poznań.

The role of incentive mechanisms in changing mobility behaviour

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The public debate on mobility transitions often centres mostly on technical solutions (cf. Manderscheid 2020, p. 38). However, it is important to consider not only the technical aspects but also social aspects to gain a holistic understanding of transport mode choice and identify opportunities for individual and societal change. We argue that incentive mechanisms, also known as nudges (Thaler and Sunstein 2009), can play a crucial role in complementing technical, infrastructural, or legal measures.

This presentation identifies theoretical approaches to explain mobility behaviour. It examines where incentive mechanisms can be applied and how they should be designed. An overview of existing concepts is provided before presenting and discussing a theory-based concept for a suitable combination of incentives to foster a change of mobility behaviour.

Circular changes of location are often embedded in everyday routines such as the journey to work or education, which means that the choice of transport mode is generally not reconsidered on a daily basis but is carried out as a matter of course. This can be described as the automatic-spontaneous mode. For a new consideration of the choice of transport mode to take place, there must therefore be a change in the framework conditions so that a decision is then made in the rational-calculating mode (cf. Kroneberg 2007; Esser 1990). In this context, the choice of transport mode primarily depends on the subjective expected utility of individual users.

Hence, we find that a combination of transport factors, individual attitudes, and contextual factors is most effective in explaining the constitution of the subjective expected utility leading up to mobility behaviour (cf. Weyer and Hoffmann 2023; Widmer et al. 2019; Schneider 2013). In this context, transport factors refer to the availability of certain means of transport and their respective journey times. Individual attitudes describe individuals' preferences and attributions regarding certain means of transport and their needs. Contextual factors can include a person's living environment, family status, or economic situation.

Regarding incentives, we conclude that it is advisable not to use incentives across the board, but to first typify the recipients. This typification can be based on the aforementioned factors influencing mobility behaviour, so that the recipients of the incentives can be divided into specific mobility types. In this way, individually adapted incentives can be used that relate to personal mobility behaviour.

For the proposed incentive concept, the app-based display of individualised route recommendations and feedback seems particularly useful (cf. Weyer 2022). These route recommendations could include sustainable alternatives if they are similarly time efficient. Additionally, individualised refuelling and parking recommendations could be provided if the necessary data is available. This solution can be realised without high hardware requirements, ensuring large-scale and flexible implementation. Additionally, this solution can be modularly combined with other incentive mechanisms such as rankings, high scores.

E.2: Analysing Multi-System Interactions in the Transition to Sustainable Mobility system

Session Chair: Soma Rahmani, IAS-STS, Graz University of Technology, Austria

TIS Subsystems: The case of hydrogen-powered aviation

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Achieving climate neutrality in the global aviation sector is not only hampered by a multitude of complex techno-economic challenges, but also by various challenges that are conceivable from a transition studies perspective. These challenges are related to certain particularities of the sector, including large uncertainties concerning problem directionality, exceptionally high entry barriers in a market that is dominated by a small number of multinational companies, as well as the global nature of the sector, regarding regulation, demand and manufacturing, which requires a particularly strong collaborative effort on a global level. The transition to hydrogen-propulsion – one of the most discussed solutions for climate neutral aviation – accentuates these challenges, due to the more disruptive nature of the technology, and is therefore of special interest to the field of transition studies. Accordingly, we set out to study the transition to hydrogen-propulsion technology in the global aviation sector, with the objective to learn about the challenges faced by the aviation sector in its transition to hydrogen technology and the peculiarities of this transition compared to other sustainability transitions. Following an explorative research approach, we conducted a comprehensive set of qualitative expert interviews with representatives from a wide variety of stakeholders, to identify the relevant structures and dynamics surrounding hydrogen aviation. The deep and detailed information gathered through these interviews is extensively analyzed with a qualitative content analysis, resulting in novel insights, which are of high relevance to the hydrogen transition in aviation but equally contribute to a deeper understanding of sustainability transitions in general. Using a technological innovation system (TIS) framework, we find a global TIS driven by two distinct subsystems: one strongly affiliated to regime actors and one shaped by emergent actors. More than the type of actors involved, the two subsystems also differ in their practices of bringing about innovation, which can be associated with the ‘breakthrough’ and ‘bricolage’ innovation modes described by Garud and Karnøe (2003). In our case, the regime actor subsystem follows a ‘breakthrough’ innovation mode, aiming at achieving technology breakthroughs through largely isolated high-tech R&D-activities. On the other hand, the emergent actor subsystem follows a ‘bricolage’ innovation mode, using resourcefulness and improvisation to achieve small but continuous technology improvements, in a system characterized by strong collaboration between various actors. Furthermore, we find that the two subsystems exert a dissimilar contribution to the fulfillment of the hydrogen aviation TIS functions and thus have a pivotal relevance to the comprehension of the overall TIS functioning. Based on these findings, we discuss implications for the hydrogen transition of aviation and the conceptualization of sustainability transitions. Regarding hydrogen aviation, we argue that a stronger inclusion of emergent actors, e.g. through collaboration efforts of established actors, could improve TIS

functioning and yield valuable learning effects. A more conceptual discussion focuses on how the two subsystems could additionally differ in their geographical specificity and stickiness and the resulting implications for the hydrogen transition in aviation. Since TIS subsystems might also exist and decisively shape TIS functioning in other sectors beyond aviation, future research should be carried out on TIS subsystems, their interactions, their contribution to the respective TIS functions, as well as distinguishing different innovation modes performed by subsystems.

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Exploring the socio-technical dynamics that affect the diffusion of Electric Car in Graz

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The imperative to globally decarbonize personal mobility has led to a significant surge in the adoption of electromobility, specifically electric cars, contributing substantially to increased market share worldwide. This research focuses on Graz, Austria, conducting a comprehensive examination of the city's current position within the sustainability transition phases of electric cars. The study explores the socio-technical dynamics influencing the adoption and diffusion of EVs in Graz, emphasizing the interconnectedness of these dimensions and the need for a holistic understanding of the socio-technical system.

A triangulation approach is employed, incorporating in-depth interviews with both E-car and non-E-car owners in Graz, along with insights from key stakeholders actively engaged in E-car development. This multifaceted perspective enables a nuanced exploration of the socio-technical dynamics grounded in the dimensions of technology, institutions, and actors within the socio-technical system.

The findings reveal the evolution of E-cars in Graz, progressing beyond experimental and early deployment phases to establish themselves as more than niche innovations. However, the anticipated rapid diffusion and upscaling of E-cars face obstacles rooted in factors such as costs, range limitations, charging infrastructures, social attitudes (informal institutes), and related policies and strategies (formal institutes).

In conclusion, the research provides insights into the current state of the E-car sustainability transition in Graz. The analysis offers evidence-based recommendations for policymakers, industry stakeholders, and urban planners to address barriers and leverage opportunities for the widespread integration of electric vehicles. Acknowledging the multifaceted nature of socio-technical dynamics, this study contributes to a comprehensive understanding of the challenges and opportunities associated with E-car adoption in urban contexts. It establishes a foundation for informed decision-making in the pursuit of sustainable and widespread electromobility, promoting a holistic approach to navigating the complexities of E-car adoption in urban settings.

Everything everywhere all at once: governing simultaneous transitions in India’s transport sector

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In roughly the last two decades, new policy objectives such as achieving net-zero, developing industrial competence in emerging green technologies, and reducing fuel import dependence have been added to India’s transport sector policy mix. over already existing objectives like meeting growing fuel demand and air quality improvement. Thus, India's transport sector is undergoing simultaneous sociotechnical transitions. To realize these multiple objectives, several alternative fuels and powertrains (AF&P) such as ethanol, bio-CNG, EVs, green hydrogen, and methanol are being aggressively promoted by the government. However, weaving multiple policy goals in a single long-term coherent vision can create tensions between technological trajectories and pose governance challenges (especially in the short- to medium-term).

This study takes a brief stock of the variegated AF&P landscape of India and through wide stakeholder interviews identifies three significant governance challenges - 1. inter-sectoral co-ordination, 2. balancing policy neutrality and specificity, and 3. articulating the role of gas in the transition. The traditional governance paradigms were formulated and developed for contexts where problems are clear and structured and policy process is a linear exercise. However, this paradigm falls short in a situation which involves long-term objectives, uncertainties, and potential value conflicts.

The governance challenges engendered by such situations are inherently political. Therefore, addressing them would need a governance paradigm suited for long-term policy making, underpinned by consultation and reflexivity.

It is argued that addressing these would require shifting from the governance paradigm based on linear management of clearly structured problems towards a more reflexive approach. A significant aspect of this governance paradigm is to understand the interlinkages between technology, values, and policy objectives. Energy technologies are underpinned by different values like affordability, sustainability, industrial competence, feasibility, and efficiency. Understanding the connection between technology, values, and policy objectives would shed light on the conflicts and complementarities between different visions. Considering the political nature of consultation, identifying these conflicts and complementarities is not likely to eliminate former completely but it can help provide points of deliberation for developing a shared transition vision through wide stakeholder consultation. During the course of long-term transition, social, political, and economic contexts change. Also, as technologies develop, the complementarities and trade-offs between them are also likely to change. All this would cause a concurrent shift in the dynamics between technology, values, and objectives. Thus, in a rapidly evolving state, any shared vision arrived at has to be periodically revisited and recalibrated. This would require incorporating reflexivity in the governance. In essence, this would require embracing the multi-dimensionality of problem framings and keeping the policy processes and goals open ended. Based on the principles of reflexive governance and transition management, a reiterative governance framework is proposed.

Circular economy and strategic oversight in policymaking: Evidence from regional Electric Vehicle policies in India

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Sustainability transitions have gained prominence in global policy agendas, particularly in the context of electric mobility, prompting a closer examination of policy strategies and instruments. This article focuses on policy strategies, with a central emphasis on circular economy (CE) niches, to facilitate the transition to electric mobility. As a concept, CE offers a potential roadmap for achieving sustainability transition objectives, especially in developing countries, where the challenge of decarbonising industries while maintaining growth is pronounced.

This study investigates how India's regional electric vehicle (EV) policies align with local contexts, particularly in less industrialised states that lack automobile manufacturing clusters. CE, defined through niches such as scrapping, retrofitting, reuse, and recycling, is examined as a policy strategy that can be integrated with industrial policies.

An interpretive policy analysis approach is used to explore the unique framing of problems and solutions embraced by states, shedding light on the interplay between national and regional factors in EV policy development. The research reveals three primary aspects related to policy strategy at the regional level: the influence of national vision and policies, consideration of local context, and institutional structure and capacities for policy experimentation. The lack of concrete initiatives in niches like recycling, retrofitting, scrapping, and secondary usages, despite their importance, highlights the risk-averse nature of regional policymaking. The analysis demonstrates that sectoral industrial policies remain unidimensional regardless of states' local context, leading to missed opportunities for circularity in material recovery, recycling, and reusability. The challenge lies in clarifying standards, technology, and market creation, requiring the active involvement of agencies at both the national and state levels.

Furthermore, the study underscores the need for greater coordination among states to ensure competitiveness and lay the foundation for a sustainable transportation system beyond just EV development. Policymakers can harness the nascent electric vehicle sector to implement circularity principles, promoting the creation of CE niches and new regimes. In conclusion, this research highlights the secondary and passive nature of CE links in regional EV policies in India despite their potential as a significant market and industry. It suggests revaluating policy strategies to promote circularity and hasten sustainability transitions at regional and national levels, emphasising the importance of multi-level governance and coordination to achieve a sustainable transition to electric mobility.

Stream F: Sustainable Food Systems

F.1: David against Goliath: Diversity to foster resilient agri-food systems

Session Chair: Katharina Biely, Wageningen University and Research, The Netherlands

Reshaping food systems: assessing sustainable development in an Austrian FoodCoop through participatory action research

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Introduction: Prevailing unsustainable consumption patterns do not only negatively impact the environment, but also decrease health and well-being (Dhandra, 2019; Duguleaña & Croitoru, 2021; Quelch & Jocz, 2007). However, community-based grassroot initiatives try to reshape the prevailing unsustainable food system and tackle these challenges. Alternative food networks, like FoodCoops and community-supported agriculture, foster sustainable consumption through short supply chains and close consumer-producer ties, enhancing social embeddedness (Jarosz, 2008; Maye, 2013; Renting et al., 2003; Seyfang & Longhurst, 2013). While there has been a surge in interest in consumer networks in recent years (Albinsson et al., 2021), their definitive contribution to sustainable development remains uncertain (Forssell and Lankoski, 2015).

Research aim: The aim of this project is to evaluate a selected Austrian food network regarding the achievement of defined criteria of sustainable development, whereby sustainable development is understood as a holistic, comprehensive concept.

Methods: One Austrian FoodCoop was selected as case. Special focus is placed on the active involvement of the members of these networks (both consumers and producers). Thanks to their experience, they have valuable expert knowledge and can therefore contribute a lot to the planned research. To ensure commitment and open communication, attention was not only paid to ongoing communication with the people involved but the researcher also actively participated and helped in events (meetings, festivals, ...) of the networks. This method is also called participatory action research, in which the focus is not on the study of individuals but on the study of group dynamics, contexts and culture (McTaggart, 1991; Selener, 1992). This allows even deeper insights to be gained and insider knowledge to be used that would otherwise remain hidden if the researchers looked from the outside and only minimally involved stakeholders.

The primary objective of action research is to generate practical knowledge that individuals can readily apply in their daily lives, especially for enhancing the overall well-being—economic, political, psychological, and spiritual—of individuals and communities (Reason & Bradbury, 2001). This concept challenges the idea of an objective, value-neutral approach to knowledge creation and favors a politically engaged, socially participatory and democratic practice. It values people's experiences, advocates democratic processes for positive social change, and combines theory and practice to promote learning and action (Brydon-Miller et al., 2003).

Participatory action research has gained prominence in interdisciplinary research and especially in the research field of community empowerment in agriculture and food networks (Landwehr et al., 2021; Moreira & Fuster Morell, 2020; Piccoli et al., 2023 and many more). In this case study, various research methods are combined to get a comprehensive picture. Methods include informal interviews, observations, document analysis and questionnaires.

Findings: This is an ongoing study. At the time of the conference, indicators for sustainable development that have been designed and selected together with the relevant stakeholders, their operationalization and (preliminary) results can be presented.

Practical and scientific implications: Foodcoops can leverage this generated knowledge to attract and enroll new members, enhance identified sustainable development criteria, and reinforce engagement and motivation among existing members through pertinent sustainable development information. Non-members can utilize this information when considering network participation. Policymakers can use these outcomes to endorse consumer networks, bridging grassroots initiatives and governmental structures, potentially justifying funding. Additionally, researchers can utilize these findings to standardize the evaluation and documentation of sustainable development within consumer networks for future studies.

Promoting diversity among consumers to strengthen sustainable agriculture: CSAs accessibility to a broader target group through pricing strategies

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Introduction: Food production is responsible for around 30% of total greenhouse gas emissions (Shukla et al., 2019). Yet it is not only climate-damaging greenhouse gases, but also the deterioration of air and water quality, water availability, soil health, the loss of biodiversity and the homogenization of landscapes that are among the harmful environmental effects of our diet (Springmann et al., 2018). Moreover, the prevailing food and nutrition systems have led to social inequalities, exploiting rural areas, concentrating market power, and endangering small-scale farming structures (Kelly-Reif & Wing, 2016; Seferidi et al., 2020; Lin et al., 2011).

Community-supported agriculture (CSA) offers a promising alternative, fostering local farming, sustainability, and healthier consumption patterns (Volz et al., 2016). Despite its potential, CSA has faced criticism for its exclusivity, primarily benefiting those with extensive knowledge of vegetables and adequate financial means (Egli et al., 2023; Sitaker et al., 2020). As CSAs are currently more relevant for this selected target group, they are falling short of potential. Therefore efforts have been made to address this issue through cost-offset CSA (CO-CSA) models, aiming to make CSA accessible to low-income households (Jilcott Pitts et al., 2022, Sitaker et al., 2020). Various strategies, such as member donations, grants, food stamp systems, fundraising, and workshares, have been proposed to mitigate the financial burden on disadvantaged groups (Jilcott Pitts et al., 2022). However, whereas member donations from more wealthy members seem to be the most common, practical and accepted approach from the point of view of farmers and existing members (Jilcott Pitts, 2021), we are not aware of any research examining the point of view of (potential) recipients of subsidized CSA shares.

Research aim: Previous studies have put a spotlight on farmers and CSA-members, researching their motives and opinions in mostly qualitative surveys (Jilcott Pitts, 2021; Sitaker et al., 2020), leaving doubt that the target group (families with smaller household income) would be interested in contributing in a CO-CSA. The aim of this study is to investigate this very issue. Further we question at what price a CO-CSA would be relevant and which form of subsidizing would be the most attractive for the target group.

Method: To answer the research questions mentioned, we conducted a quantitative cross-sectional study using an online questionnaire, exploring pricing, subsidy preferences, and participation barriers. The target group were people, living in Austria, who belong to the lowest two income tax classes.

Findings: The preliminary results from 93 respondents of this ongoing study show, that almost a third of respondents (32.3%) had already heard of the CSA System before. 86% prefer weekly in comparison to yearly payments and show a willingness to pay an average of 22.77 euros for weekly harvest shares. Public funding emerges as the most attractive subsidy option, significantly differing from member donations or income-adjusted pricing. The findings emphasize involving the target group in funding planning, enhancing CO-CSA accessibility and adoption among economically disadvantaged populations in Austria. As this is an ongoing study, further results will become available. These include socio-demographic variables and their influence on the results as well as any hurdles in the decision for or against a harvest share.

Conclusions: In conclusion, this research contributes to understanding CSA's potential in food systems in Austria regarding low-income households. The results emphasize the importance of public policy interventions tailoring funding strategies to the target group's preferences, particularly favoring public subsidies. By providing insights into the needs and preferences of economically disadvantaged populations, the study aims to encourage CSA adoption, fostering societal and environmental benefits, and contributing to the quest for more diversity at the end of and along the supply chain.

Science, policy, and politics of transition to Nature-positive agri-food systems in India: Whose knowledge counts?

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Agriculture policy debates are often occupied by claims of scientific knowledge, data-based evidence, and expertise. The transitions from conventional agriculture to agroecology-based Nature-positive agricultural systems have attracted debates on the intricacies of politics of knowledge around scientific evidence, technological optimism, and power relations. While evidence-based policymaking is crucial for agricultural development, it is also pertinent for the democratisation of science to engage with plural knowledge systems and acknowledge the informal innovations that fill the gaps in mainstream interventions. However, the deeply rooted power relations prevailing in the Global South hinder or slow down the science-society interactions, democratisation of scientific research and innovation and scope for co-production of knowledge Trapped in the lock-ins of productivism and technological optimism, scientific research and innovation systems largely undermine any alternative approaches in agriculture on the claims of 'lack of scientific evidence'. In science-based policy-making, the question of what knowledge needs to be counted is as much important as the question of what is counted as evidence and whose knowledge counts. This paper looks into the intricacies of science, policy, and politics of knowledge around the adoption of natural farming, an agroecology-based nature-positive agriculture system, in India.

Nature-positive agri-food systems that focus on regenerative actions aiming at safe and nutritious food production while restoring balance with nature within planetary boundaries. Natural farming is an agroecology-based diversified farming system that rely on soil biology instead of soil chemistry and integrates crop production with livestock and functional biodiversity. It is a farmer-centric approach that offers increased net income to the farmers by reducing the cost of production while working with nature.

Originally promoted by an independent initiative by an agriculturalist named Subhash Palekar in the mid-1990s, natural farming has gradually gained much popularity amongst the farmers and various state governments of India, especially the southern states. Recently, the central government of India has made efforts to mainstream it nationwide and has incorporated natural farming into the curriculum for agricultural sciences. Over this period, it has undergone several stages whereby the technological characteristics of natural farming, originally introduced as Zero-Budget Natural Farming (ZBNF), have been defined and shaped by various actors (including NGOs, scientists, and farmers) involved in the process. However, India's major academic body of agricultural scientists undermine natural farming, claiming that it is an "unproven technology" that does not abide by any scientific methods or is backed by any scientific evidence. These claims discredit the evidence base of natural farming, including peer-reviewed scientific articles and ignore the grassroots and local agricultural knowledge and co-production of technoscientific innovations associated with natural farming. The prevailing questions this paper explores include: whose knowledge counts when it comes to evidence-based policy-making for natural farming? among different scientific evidence, which evidence weighs over the other? Is it about scientific knowledge Vs local knowledge? And most importantly, what is counted as evidence when there is a multiplicity of evidence of scientific

and informal characteristics? This paper contributes to bringing nature-positive agriculture from the Global South into the STS research agenda by analysing the discourse based on secondary literature and thematic analysis.

Assets, Commodities and Sustainability: Knowledge politics and the perils of assetization in food transition in Greece

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In this paper we argue 1. That assetization of food products is an emerging approach in food policies in Greece since 1997; 2. Assetization has been emerged as part of the research politics in securing the entrepreneurial activities of research labs and the role of research communities and scientists in the making of the agrifood system; 3. Assetization is introduced as a way to redefine, reinvent agrifood products and in the same time to create new niche markets. Yet the emphasis in the making of niche innovation and relevant markets can result in concealing the quest of sustainability since sustainability is not a clearly stated matter of concern. By using recent approach from the STS scientific field and by focusing on the role of science in assetization processes we study the way research labs are transformed to knowledge infrastructures with aspirations for participating in the country's development and the making of the agrifood transitions. In the paper we study cases from three different scientific labs and different agrifood products like the Ω3 fatty acid eggs and chickens and the olive oil with high concentration in polyphenols. The concept of "assetization" has been introduced by Birch and Muniesa (2020) in an attempt to identify the dynamic role of science in enhancing the value or even give value to products, processes and things. Science, and technology can attribute values where they did not exist before. Through the process of identifying the genetic profile of agrifood products they respond to pressures in relation to the identity and authenticity of the product. Furthermore, by identifying methodologies in boosting the antioxidant function of specific agrifood products and converting the in functional food. Processes of accetization are represented as ways of securing the fulfilment of the responsibility that research lab can have towards regional and national economy. The paper explores the way that knowledge politics shape new transition pathways in food production by partially medicalizing food, creating repertoires of regional development and industrial growth. The paper is based on research and extensive interviews with researchers and scientists from specific labs. Furthermore, we are using published materials, reports and articles while we are comparing activities and approaches of three different labs from the Universities of Athens, Thessaloniki and Thessaly.

Course Correction of the Historical Wrongs: Embracing "Diversity" and "Locality" in the Climate Change Paradigm

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Most South Asian countries have performed poorly on the World Hunger Index and other human development indicators in the last decade. Climate change, depleting water tables, and uncertain weather conditions have further accentuated the issues in the twenty-first century. Revitalising Rainfed Agriculture Network (Henceforth RRA), a consortium of non-government organisations, experts and volunteers, focuses on the problems related to food and sustainability in India's different rain-dependent regions. This paper focuses on the strategies for identifying the climate-resilient corps in the different rainwater-dependent areas of India. The network employed a bottom-up approach with the pilot-scale projects. It started mapping the soil types and crop patterns resilient to climate perturbations. Madua (finger millets), jawar (sorghum), bajra (pearl millets), toor (pigeon pea), kulthi (horse gram) and mooth (mal beans) were a few "local" climate-resilient and non-water-intensive crop options that require community interventions and government support.

In the middle of the twentieth century, the Indian subcontinent faced the worst food crisis. In the late 1950s, two-thirds of its population was in poverty. In the late 1960s, the Indian government launched large-scale public policy interventions in food, agriculture and milk, known as the "Green Revolution" and "White Revolution" respectively. These interventions were vital and significant in taking millions out of poverty. These massive interventions created a food-agriculture system that promoted monoculture and focused on one or two major crops in the season. Wheat and rice are the two prominent crops that dominate the procurement and distribution markets in the Indian food-agriculture system.

Diversifying the procurement sites and creating a market for madua, jawar, bajra, and kulthi was one of the first challenges identified in the pilot-scale studies. The government of India, the central government, is the biggest buyer and distributor in the country that promotes rice and wheat through public distribution systems. Therefore, one of the recommendations of the study was to develop regional procurement and distribution channels through state governments and district clusters. Beyond government interventions, the network uses public communication and community organisation channels to promote a robust market for millets and lentils. It was a considerable task to undo the scientific communication of the "Green Revolution" era. The paper would further invoke the food and nutritional security debate to emphasise that the role of diversity promoted by millets and lintels is not limited to the climate-resilient food options but credible nutritional resources to cope with massive malnutrition in the region.

Decolonisation in low-carbon transitions: Politics of protein transitions from an Indian perspective

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Transition to an alternative protein diet is considered as a 'silver bullet' or 'techno-fix' to address many sustainability challenges in today's world. This transition is in response to contention that animal-based foods give rise to significant challenges concerning the global food supply, climate change, animal welfare, and diet-induced public health crises. However, a substantial portion of these challenges emerges in response to the issues inherent in the prevalent industrialized animal farming practices predominantly found in the Global North. The global push for the widespread adoption of solutions developed in response to the challenges originating from the Global North underscores the imperative need for the decolonization of sustainability research.

Much of the interventions for environmental sustainability is still trapped in the 'colonial baggage' that gives supremacy to the Western knowledge paradigms (Amo-Agyemang, 2021; Chilisa, 2017). Modern science, that is supposed to be neutral and free from any biases, often fail to take the local contexts into consideration in identifying the problems and formulation of solutions, especially when it is about the countries of the Global South. Such academic imperialism is well evident in the sustainability discourses around climate change and transition to low-carbon societies (Chilisa, 2017; Ulloa, 2017). These colonialist and imperialist notions in the scientific practice practically try to ignore the local practices while narrowing down the diversity of practices and knowledge systems (Chambers, 1997; Chilisa, 2017; Ulloa, 2017). Moreover, many of the large-scale solutions to climate change issues drawn up by the Global North are intrinsically embedded in colonial hegemony (Zografos, 2022) and it exacerbates injustice and inequalities in different geographic and local contexts. One such arena is the much discussed climate crisis.

The global discussions on actions to address climate crisis is influenced by how carbon emissions are calculated and interpreted. There are debates on whether it should be based on per-capita emissions, per-country emissions, or as the recent study that shows historic emissions from a region (Hickel, 2020; Paul, 2020). The Global North, irrespective of its combined historic contribution of 92 % of Carbon Di Oxide emissions (Hickel, 2020), still demand the developing countries to stagnate their industrial growth (Kanitkar, 2020). As Greenpeace UK states, "climate emergency is a legacy of colonialism" (Gayle, 2022). It is in this context the demands for decolonisation of decarbonisation becomes highly significant.

In India, livestock and fisheries sectors play a significant portion of livelihood and economy. More importantly, India is one of the largest milk-producing countries in the world and dairy products are an integral part of the cultural fabric of the country. India also plays a big role in fisheries and aquaculture. On the other hand, the global demand for a switch to alternative protein sources is also increasingly being embraced in India.

The study focuses on who will get benefited and who will be left out in the protein transition in India. These research questions can serve as a starting point for exploring the imperative of decolonizing sustainability research in the context of alternative protein sources in India, with

a focus on respecting local contexts, values, and perspectives. The study is based on qualitative thematic analysis of relevant literature and focuses on livestock keeping in India. The study observes that the debates revolve around the peripheral issues without digging deeper into the structural issues of the problem that is associated with such product transition. This is because of the tendency of environmental discourses to focus on technological innovation instead of looking at the structural issues such as colonialism (Erickson, 2020).

What is enough? Sufficiency in small-scale dairy farming as a key strategy for resilience and transformation against the status quo

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In Europe trends of homogenization of crops and farming practices and the amalgamation of power in agriculture over the past 50 years raise the question of what the role of small scale farmers is in presnt and future food systems. Small scale farmers are responsible for upholding some of Europe's most iconic landscapes: high altitude meadows and pastures. Here nature and culture have Co-evolved together over millennia, as so-called Biocultural landscapes. Domesticated animals graze these mountains, maintaining open flowering meadows and pastures in a system of Alpine transhumanance, where livestock and people migrate vertically between a permanent valley dwelling and mid and high altititude temporary pastures, which has been practiced since the Bronze Ages. These landscapes are precious but changing. Farmers are the stewards of these landscapes, their practices matter. And while subsidies are absolutely necessary to support the continuation of alpine farming, how they are implemented can also cause disillusionment among farmers, another cause of abandoning this way of life. It is in this context that in 2022, I set out to research the resilience of small-scale alpine dairy producers. Resilience is the process of the ever-changing capacity to respond to change, through interacting dynamics of persisting, adapting and transforming (Haider and Cleaver 2023). I decided to focus on Austria, which for central and northern Europe has a high proporption of small scale dairy farms.

In this paper, I would like to extend the concept of social-ecological resilience into critical STS studies with a particular focus on the concept of "What is enough? (technology/production) in food systems. For this I draw on an in-depth collaborative ethnographic study from a small-scale dairy farm in Salzburgerland with farmer Präa Sepp. In particular, I am interested in how this family farm resists against the status quo of ever-increasing production and while the neighbours in the valley move to milk robots one by one, this farmer persists with a simple bucket milker technology, because "it's enough." The entire logic of the farm is built around this core concept of sufficiency, including the rare practice of milking only once a day. In response to a surprise snowstorm at the summer pasture one August, Präa Sepp made the switch to once a day milking. This adaptive practice enabled a persistence of quality of life at the summer pastures, while taking a transformative stance against the status quo, enabling also a diversification of other on-farm activities. Through in-deoth on-farm practices like these, we show how Präa Sepp has many capacities that enable his resilience as a small scale farmer: capacity to respond to crisis with creativity, deciding what is 'enough', maintaining autonomy over resources and time. WIth this foundational understanding of resilience as

response-ability to uncertainty, we explore the conditions and processes under which subsidies either empower or disempower farming resilience.

In this paper for the proposed session, I explore what this means against 'Goliath': the EU Green New Deal, and specifically reactions to the biodiversity area subsidy. A green transition is absolutely necessary, but it must implemented in a way that brings farmers along or at the forefront of that transition rather than protesting against it. Through this in-depth exploration I hope to uncover ways in which subsidies could be enacted that are more enabling for resilience, rather than degrading it.

Assessing resilience of Indian farming systems to climate risks: a socio-ecological systems approach

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At a time when achieving worldwide food and nutritional security is a major developmental goal, managing the imminent threat of climate change to the global agri-food systems is an arduous challenge. Food systems across the world already experience multiple disruptions from extreme weather events, pest attacks, economic shocks, and depleting natural resources. The added threat of climate change will likely exacerbate these disruptions and the magnitude of its impact will be determined by context-specific vulnerabilities and resilience of agri-food systems. As a result, the poorest, most marginalized rural communities will evidently be the most compromised populations in face of uncertain and unprecedented climate change.

A predominantly agrarian country with around 54.6% of the workforce almost completely dependent on agriculture for its livelihood, India is home to many such communities. It has 46.1 % of the total arable land under agriculture, with 52% being rain-fed (dependent on the monsoons), making it extremely vulnerable to climate change. Without appropriate adaptation, the impacts of climate change could depress agricultural yields by 25% in the long term and reduce annual agricultural incomes by 15-18% on average.

Considering the complexity of challenges faced by agrarian economies like India, employing a piecemeal approach to address these pressing threats in an isolated manner is sub-optimal. Rather, dealing with these 'wicked problems' requires a more systemic approach. To that end, our paper identifies conditions that can build resilience in farming systems to climate change risks and other environmental and socioeconomic changes. With the acceptance that the questions of climate change, food insecurity, etc. are intertwined and systemic in nature, there has been a paradigm shift in how we study various social and ecological processes. In this context, the concept of **resilience** has emerged during the past few decades as a major strategic reorientation that has guided scholarship, policies, and programs globally.

Resilience of socio-ecological systems has become relevant for farming systems research to study the multilayered processes that determine the well-being of rural households in the face of change. Within the perspective of socio-ecological systems, **diversity is** crucial to building resilience and effective ecosystem functioning. For farming systems, diversity can range from having ecological diversity and diversity of economic opportunities to diverse range of policies

and institutions etc. Essentially, farming systems that depend only on one or a narrow range of resources, networks are less able to cope with change. This resilience approach to studying farming systems can provide invaluable insights for adaptive management and governance in heterogeneous agricultural landscapes.

Hence, through our paper, we propose a framework based on resilience thinking to evaluate two agroecological experiments in India. We employ a systems approach to compare the resilience of the Andhra Pradesh ZBNF farming and the Organic Farming System of the Timbaktu Collective with Conventional input-intensive farming. Even though they have been widely researched individually, there haven't been many attempts to study these systems in a comparative context, especially with respect to resilience. Assessing the resilience of different farming systems by studying their structures and functional characteristics will give insights into what kind of institutions, knowledge systems, and social networks can build or undermine their resilience to climate change. We will be focusing on diversity as a key attribute.

By studying the dynamic interactions and relationships between the different system components, we can identify key leverage points where interventions can be made for the most optimal resilience outcomes. The present study is based on preliminary data collected during a pilot field visit for doctoral research. The data collection involved semi-structured interviews with key stakeholders and experts in each system under study.

Following slipping soils – A sociological study of transformative agricultural actor-networks and soil erosion

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For more than 30 years, the agricultural systems all over Europa have been confronted with a paradigm shift: from ensuring food security towards handling a set of multidimensional challenges and visions in the name of sustainability. Various efforts, from round tables to regulations, were set up to balance conflicting interests and find ways to transform agricultural land use. However, widespread dissatisfaction, protest movements and polarisation throughout actor groups seem to accelerate. Additionally, ecological threats turn from faint risks into current and tangible damages, as can be seen by severe soil erosion after extreme weather events.

The case of soil erosion shows, how various future perceptions and conflicting efforts of agricultural land use are confronted with material limitations: if soil, hitherto a reliable part(ner) in agricultural actor-networks, 'is not playing along' with the usual arrangements anymore, well-established ways of thinking and acting might be questioned and arrangements of actors need to be re-negotiated. Visions of sustainable land use materialise, materiality in turn confines future prospects and implicates often irreversible changes. Some STS and Anthropocene Studies do take natural objects as participating actors into account. Nevertheless, sociological empirical research on soil and human-soil-networks is still marginal.

The qualitative empirical research design draws on the theoretical perspective and heuristics of the actor-network-theory in order to take account of the heterogeneity and plurality of the actors involved. Following both human and non-human entities and their interrelations, I seek to discover how local agricultural actor-networks shift, how actors negotiate land use practices, appear as legitimate speakers to represent others and establish certain attitudes regarding sustainable food systems, transformative land use practices and soil protection.

F.2: Integrated policy strategies for urban foodscapes

Session Chair: Sandra Karner, IFZ, Austria

Session Chair: David Steinwender, IFZ, Austria

Integrating strategies for sustainable, healthy and resilient food systems in Budapest and Lisbon. Lessons learned and steps forward.

Vanda Pózner[1], Éva Bánsági[1], Katalin Varsányi[1], Carolina Capitão[2], Rodrigo Feteira-Santos[2], Osvaldo Santos[2], Rosário Oliveira[2], Bálint Balázs[1]

[1]ESSRG, Hungary; [2]University of Lisbon, Portugal

This work relies on the experiences gathered from urban food planning policy design in two European city regions, Lisbon and Budapest, considering urban and peri-urban food production landscapes as the basis for systemic approaches. Data analysis comprised four complementary approaches: 1, a desk research phase (narrative literature review and historical analysis of food policies in these cities); 2, qualitative interviewing with city administration representatives; 3, district-level food environment mapping activities, with representative stakeholders from two neighbourhoods with a considerable proportion of vulnerable societal groups; and 4, two workshops extending to a visioning, system understanding and a strategic planning phase. Results suggest different ways and drives to integrate local food policy measures into current planning policies. Although food policies and planning are best done through integrated approaches holistically addressing multiple purposes and potentially conflicting urban planning agendas and strategies, they are a rarity for many reasons. Nevertheless, it will be pointed out how currently available urban planning practices can enable a food planning policy and strategy that integrates social, economic, cultural, climate, and biodiversity-related policies. Current good practice for innovative urban planning policy measures will be discussed using the FoodCLIC Project's assessment framework (https://foodclic.eu/), proposing an integrated approach to transform urban food systems and environments in the European food transition framework.

Participatory development of transformation approaches for biodiversity-enhancing dairy production systems as part of sustainable food systems in two German model regions

Dietlinde Annette Quack

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Biodiversity-enhancing and economically viable dairy production systems contribute to sustainable food systems as a whole: extensive grassland management is associated with lower livestock numbers and a correspondingly lower environmental impact, as well as lower milk yields. The latter is in line with the lower milk and meat consumption proposed as part of the Planetary Health Diet. To achieve this, a transformation of today's systems is necessary.

For various stakeholders, the future vision of dairy production systems in Germany already includes that they provide a service for the preservation and promotion of biodiversity. In the two model regions analyzed, the Freiburg and Ravensburg organic model regions, milk production is rather extensive resp. intensive. There is no preliminary work yet on the necessary transformation of dairy production systems in these regions. The food policy council of the Freiburg region dedicates a short paragraph in a preliminary concept for the food strategy to the importance of cattle and dairy farming, particularly in the Black Forest. However, the food policy council, as a representative of the regional food stakeholders, has not yet developed a vision or position on this.

Against this background, the work presented here focused on two objectives:

The development of visions of future biodiversity-enhancing and economically viable dairy production systems in the two model regions with regional stakeholders

The identification of technical measures and policy options with regional stakeholders that support the desired transformation in the two model regions.

An initial desktop research was followed by 30 qualitative interviews with predominantly regional actors followed. Two workshops with regional actors were held in each of the model regions. The workshops were based on the back casting method, whereby visons of the future were developed in a participatory manner in the first workshop. In the second workshop, technical measures and policy options were identified by the participants with the help of a transformation model.

The long-term outcome in the developed visions was identified as “Species-rich habitats have been preserved and their number has increased, i.e., the typical landscape has been preserved.” Beyond this long-term outcome, the visualized visions were rather complex. Nevertheless, it was possible to group the identified intermediate outcomes as follows:

Policy is coherent – especially agriculture and nature conservation policy

Market economy is social and future-orientated

Management of land & adaptation to climate change is appropriate

Appreciation! Farmers are appreciated for their contributions; the same applies to products that contribute to biodiversity

Biodiversity measures are easy to implement

Pasture farming & wild animals (wolf, beaver) can exist alongside each other

Diversity exists at all levels (e.g. farms, greenland management)

In the subsequent process, technical and policy measures were identified and assigned to the different design options in the model – picking up on social trends; promoting and testing innovations; networking change agents; promoting exnovation; utilising the classic policy mix – as well as to the realizing levels - the person/organization; region; federal state; national/EU.

The visions developed in the two regions differ more in nuances than in principle. It is interesting to note that the images of the future go well beyond the conservation of biodiversity and the implementation and facilitation of biodiversity measures; these actually only take up a small part of the visions. The different framework conditions take centre stage. This is also reflected in the technical measures and policy options identified: all design options play a role in the transformation, as do all levels of realization. They are interconnected. It is important that the desired transformation is supported by a broad bundle of measures that cover the various design options and address the different levels.

Exploring the access to green in Graz (Austria)

David Steinwender, Linda Fitzka

IFZ, Austria

Densely built-up areas in urban areas often lack sufficient green space. There is a lot of conflict with other land uses, such as buildings and traffic areas. Green space is not only important for recreational purposes and as a social space, but also fulfills important ecological functions and is of great importance in view of the increasing heat and heavy rainfall events in the course of climate change.

This aspect is even more significant when green space is unevenly distributed in relation to the composition of the population. People from socio-economically better-off backgrounds tend to live in more green areas and either have sufficient private green space and/or good access to larger public green spaces. The quality and facilities of green spaces can also vary.

In addition to the availability of public green spaces, there are other factors for assessing the accessibility of green spaces for different groups of people: the way to the green space and areas in green spaces (reachability and barrier-free access), the facilities for different needs, options for appropriation and safety aspects.

Access2Green – a study of the Forum Urban Gardening supported by the IFZ – attempts to assess the accessibility of green spaces in Graz. The focus of the data collection and assessment of green spaces in Graz is on gaining additional knowledge to the existing urban planning foundations and estimating the potential for edible greenery.

In addition to these quantitative analysis, qualitative surveys in the form of stakeholder interviews are carried out in order to better understand social barriers to access to (edible) green spaces.

Interim results of this research will be presented at the STS conference.

BeSt Graz: Towards an biodiverse edible city strategy

David Steinwender, Sandra Karner

IFZ, Austria

In the face of multiple crises, e.g. expressed by the planetary boundaries[1] in ecological terms or extended by social dimensions in the doughnut economy[2], the food system is also facing a need for transformation. Climate change, the loss of biodiversity, nitrogen and water consumption on the one hand, but also the availability and affordability of "healthy" food, meal cultures, consumption trends and marketing channels on the other are just some of the areas affected. Solutions are aimed at different (sub-)systems, geographical scales, institutions and actors. One of these approaches concerns the shortening of food miles and the prosumer trend through the possibilities of growing food within the city. Social gardening practices have experienced a new renaissance in the last 20 years.

The term "edible city" covers various initiatives, projects/activities, networks, concepts and strategies and is used by different actors (civil society actors/activists, municipal administration, entrepreneurs) with different basic ideas/motivations to establish various food offerings (fruit trees/orchards, raised beds, community gardens, vertical gardens, urban agriculture) in private but above all public spaces. Also the enjoyment of food (culinary delights) is associated with it. In some cities, the "edible city" or facets of it are part of official development strategies. The concept allows ecological, social, cultural and economic aspects of the need for transformation to be considered together.

In the city of Graz, the idea of the edible city has been used to describe certain activities in regard to gardening and the administration’s activities on planting public fruit trees in parks. The city council started developing different municipal strategies, e.g. on food, agriculture and biodiversity. These developments were taken up in a case study of the Horizon Europe project PLANET4B to investigate whether they can be incorporated into an integrated municipal edible urban policy strategy to partially overcome the sectoral division, e.g. in the areas of urban development and green space planning, health, gender and integration and education in the city.

So far, interviews with different municipal stakeholders and some experts have been conducted, capturing the interest in and relevance of the edible city concept and integrated approaches towards policies. The results of this research phase will be presented in the session.

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2Raworth, K. (2017). *Doughnut economics: seven ways to think like a 21st-century economist*. Chelsea Green Publishing.

Stream H: Teaching STS

H.1: The many faces of Futures Literacy

Session Chair: Christian Dayé, Graz University of Technology, Austria

Session Chair: Carmen Sippl, Pädagogische Hochschule Niederösterreich, Austria

The Many Faces of Futures Literacy: A Comprehensive Literature Analysis and Future Research Directions

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MCI The Entrepreneurial School, Austria

Futures Literacy (FL), acknowledged by UNESCO as an essential 21st-century capability (UNESCO, 2021), empowers individuals to deal with novelty, complexity, and imagination, if we want to ensure a successful future for ourselves and our world. Despite its importance, FL faces challenges in research and practice, prompting questions about its conceptual validity and breadth of application. This study ventures into analyzing existing FL literature, aiming to clarify this vital skill set and expand its academic and practical reach. Building on identified research gaps, future directions for further research are outlined

Our research also focuses on a comprehensive systematic literature analysis based on a bibliometric literature analysis and an in-depth content analysis. The analysis aimed to map FL's conceptual roots, literature streams, research networks, and interdisciplinary potential. Our research undertook a comprehensive bibliometric analysis of 3465 journal articles, identified from Web of Science (WoS) and SCOPUS, spanning 1958-2023. To explore the structure and dynamics of the scientific field, we analyzed science mapping, clustering, and network metrics as well as selected performance analysis metrics. With the help of qualitative content analysis, particular attention was paid to 87 publications that deal directly with the topic of "future(s) literacy" in the authors' keywords, titles, and abstracts and were published between 2006 and 2022. The qualitative literature analysis focused on publication types, research aims and questions, research design and methods, underlying theories, contributions, limitations, and outlook.

The study revealed a highly fragmented FL research field, characterized by distinct networks of authors and institutions and a lack of interdisciplinary research. While FL is already established in some areas, such as education, there is a lack of recognition of the concept's relevance in other contexts that offer common theoretical assumptions, such as innovation or entrepreneurship. The majority of the literature is exploratory and conceptual, focusing primarily on qualitative and mixed-methods approaches. While many publications draw on anticipation and transformative learning theories, a clear theoretical foundation for FL is missing. A significant gap is the absence of a robust theoretical framework underpinning FL, underscoring the need for empirical work and methodological development to advance beyond the field's conceptual stage.

In addressing the research gaps, the study suggests a concise future research agenda. A few examples are already mentioned here: There is a critical need for more quantitative research and theory development in FL studies, alongside the development of operationalization and measurement methods. These efforts will contribute to a deeper understanding of FL and its effective implementation across various domains. Moreover, the study recommends integrating FL into educational programs and strategic planning of institutions. This integration can promote critical and future-oriented thinking, preparing students and organizations to navigate future challenges. To enrich FL research, fostering interdisciplinary collaborations and diverse academic exchanges is crucial to bringing innovative perspectives, methodologies, and applications, enhancing FL's research scope and impact.

In summary, this study provides a profound overview of FL, highlighting its importance and developmental trajectory in academic research. By identifying key research gaps and proposing future directions, it sets a roadmap for advancing FL's conceptual clarity and practical application, ensuring its significant role in shaping an adaptable and forward-thinking global society.

UNESCO. (2021). *Futures Literacy: An essential competency for the 21st century.* UNESCO. https://en.unesco.org/futuresliteracy/about

Emerging and Uncertain Worlds: Insights into Teaching Futures Thinking

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In the context of the global polycrisis (Lawrence et al., 2022), futures thinking is expected to play an important role in creating radically alternative futures (Inayatullah, 2008). In this sense, futures thinking is a speculative approach, which in Ross' words "works with the future" and "uses uncertainty creatively in the present" (Ross, 2022: p.13). Here, generating emerging and uncertain worlds becomes pivotal. This is a challenging activity to carry out, though. It can be conceived as undisciplinary (Pink, 2022), as it requires distancing from specific disciplines that treat future in an unproblematic way or overemphasise the role of technology. Also, imagining futures is often affected by several cognitive biases. For example, hindsight bias, planning fallacy, overconfidence effect (cf. Colin et al. 2022). Another source of challenges is given by the fact that, even in activities supposed to encourage the participants to come up with genuine alternative futures, often they create visions of the future that are inevitably reproducing dominant imaginaries and narratives (Stein et al., 2023).

Our presentation focuses on the promise and perils of engaging a group of university students in futures thinking. That is, the main question our study concerns the uncertainties that the design and the implementation of the pilot of a master's course dedicated to futures thinking generated in the two teachers of the course, who are also the authors of the study.

Through engaging each other in reflections-on-action and students' feedback, the two teachers articulated their uncertainties in relation to: the flipped classroom format of the online course; the conceptual apparatus that was used to introduce futures thinking, and how students reacted to the different tasks designed for the course.

The preliminary results of teachers' reflections and students' feedback highlighted students faced several challenges reflecting teachers' uncertainties. Students tended to see the future in terms of dominant imaginaries magnifying the agentic role of technology through linear narratives of progress. It is challenging for the students to be engaged in reversing their assumptions, introduced in the course as a tool for freeing their minds from present constraints. Imaginative work is difficult to encourage, as it may generate uncertainties, which, in turn, leads to prioritizing the evaluation of alternatives rather than their generation.

The experience of the course highlighted the importance of interpreting futures thinking as strongly dependent on freeing one's mind from the dominant narratives of the present and exploring what could be otherwise. The deployment of assumption reversals and the generation of alternative futures from short stories may constitute a solid apparatus to engage students in futures thinking.

From the pedagogical viewpoint, a solid founding of a participatory and non-hierarchical ambiance encouraging exploration appeared as a necessary pre-condition for imaginative work, which counteracts the idea that the teacher's task is preparing people for a future that the educator has already imagined (Poli, 2021).

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Re-conceptualizing Futures Literacy against Methodological Individualism

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Scientists and climate activists address the necessity and difficulty of taking action in the face of an uncertain future. Different paths of sustainable development may exist, but at the same time, it is unclear which paths could be most successful. Nonetheless, it is crucial to act to tackle the global climate crisis and to lay the foundations for different futures. How is the polysemous concept of Futures Literacy useful in this regard?

Our contribution is a theoretical reflection on Futures Literacy. This concept is mainly understood as "anticipatory competency" (UNESCO 2017, p. 10). We argue that this conceptualization implies the problem of methodological individualism: Individuals should acquire the competency to create the future, but if the responsibility for solving the climate crisis is primarily an individual issue, this often leads to resignation. We identify solidary relationships as an effective antitoxin against the problem of individualism, and we ask which pedagogical practices could lead to agency instead of resignation. A decolonial approach is fruitful because it allows different imaginaries for the future and helps criticize individualism as a hegemonic feature of Western modernity. This perspective allows us to re-conceptualize Futures Literacy and to suggest pedagogical implications in the following three ways:

First, it is important to realize that efforts to create a different future cannot be postponed: The future starts here and now. In different pedagogical settings, it would be possible to work with learners on their ideas for a better future and their "real utopias" (Wright 2020). The question "What kind of world do I want to live in?" could be discussed in an educational setting. It would then be necessary to explore possible ways of action to create a better world, not only on an individual level but also on a collective level.

Second, Futures Literacy can be understood as finding ways of relating in solidarity. This means looking for allies who can be different from oneself but with whom some ideas about a better future are shared. A common goal provides the necessary motivation for action and helps to avoid resignation (Wright 2020). In an educational context, a possibility is to invite activists for projects or discussion groups. Their stories help learners to develop political subjectivities and to understand ways of collective action, solidarity, and problem-solving.

Third, from our point of view, Futures Literacy is characterized by a specific persistence: socio-ecological crises demand constant engagement and activism. It is an ongoing process of creating solidarity and imagining a better world for all human and non-human beings.

Futures Literacy, then, deals with matters of concern (Latour 2021). It opens up new ways of "living and dying in response-ability on a damaged earth" (Haraway 2016, p. 2).

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Building SHE futures. An ecofeminist perspective on futures literacy

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Futures literacy is a capability to help us better understand and react to the role of the future in the presence. Crucially, it is not just one future that exists, but many different ones that are all shaped by our imaginations. At the same time, the fields of futures literacy and future studies in general have so far predominately been shaped by men and male futures visions. This can be exemplified through what Ivana Milojević (2018) calls business as usual (BAU) and hyper-expansionist (HE) futures which involve Western technological optimism as well as societal collapse scenarios. Both can also be seen in popular media, such as film and its tendency to dystopian futures of ecological breakdown and the role of men in possibly solving them. What is more, these futures are often considered the most 'realistic' ones, maintaining present-day power structures and hierarchies, not only between men and women, but also between humans and nature. This is why this paper proposes to deepen an ecofeminist perspective on futures literacy, building on the work of Milojević (2018). In this way, the paper critically questions how realistic these BAU and HE futures really are and who decides their feasibility.

Ecofeminism is both a theoretical and activist movement which examines how gender inequality intersects with the environmental crisis. This includes the structural devaluation of women and nature through hierarchical and dualist thinking, which places men at a position of domination. In patriarchal societies where men were and are still prescribed the role of 'culture agents' who created civilization, techno-maniacal futures are broadly seen as realistic and far-reaching. As long as visions of the future and our ability to anticipate are based on one-dimensional gender identities, there is a risk that our ideas of possible futures will remain constrained.

Serving as an alternative cognitive framework, ecofeminism advocates for social and political change focusing on the protection of planet earth, ecology, and well-being of ourselves. It envisions more inclusive futures with a strong commitment to the environment based on the principle of equality among all living beings. In other words, BAU futures with catastrophic visions should be replaced by sane, human, and ecological (SHE) futures, as proposed by James Roberston (1983). Envisioning SHE futures becomes crucial within the realm of futures literacy to overcome dominance and dualisms, hence proposing a society based on balance, care, and cooperation. This perspective would not only expand the scope of futures literacy but also emancipate it from a one-dimensional, male-dominated, and techno-optimistic outlook on the future.

Both authors work for an institute where they engage in anticipation, foresight, and futures literacy along other topics. Further, both authors have engaged with ecofeminism in their

respective studies. Methodologically, this paper draws on interdisciplinary literature work, hoping to broaden futures literacy with an ecofeminist perspective.

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Modelling and Futures Literacy with Fiction

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Despite its growing influence in educational debates, Futures Literacy is notoriously vague and therefore in need of subject-specific clarification and conceptual development. The presentation takes as its starting point the Call for Abstract's estimation that 'fuzzy and polysemous concepts can be a fruitful resource in the search for knowledge' indeed. But it seeks to specify its pedagogical contours and educational value in the context of literary and cultural learning processes in which sustained engagements with literary fiction are a central objective. It presents key findings from a qualitative meta-study on popular fictions of climate-changed futures, on the one hand, and educational suggestions for literacy development on the other. Having identified opportunities and obstacles for futures literacy acquisition, the presentation then reflects on these findings in light of an interdisciplinary approach to model theory and the notion of cultural climate models and asks,

1. Can literary texts be seen as models in their own right?

2. What does this idea imply for literacy research?

3. And how can a better understanding of the entanglement of scientific, technological and cultural logics in an interdisciplinary approach to cultural climate models be used to advance future-making strategies and techniques in young learners and readers of fiction?

The presentation draws on previous research on Futures Literacy and Sustainability (Bartosch et al. 2023) and educational innovation in literature-based climate change literacy (Hoydis et al. 2023). In both contexts, we have developed an intervention within the rapidly expanding field of research in the environmental humanities on climate change and environmental literacy. In the face of dominant, science-centred literacy debates, which largely ignore the unique resources of the humanities, we have tried to reclaim the notion literacy from a perceptive that highlights the function of literary reading which goes beyond cognition (seeing the function of literature primarily as a form of information transfer) and affect (evoking empathy, triggering behavioural change).

These findings will be advanced in the context of the conference panel's focus with Futures Literacy and more general concerns in STS by outlining the entanglement of literacy development with broader societal commitments to risk prediction and management, demands for systems thinking, and research on the importance of dealing with complexity in a futures thinking mindset that acknowledges uncertainty and contingency. To connect these many dots, it presents ongoing work in the international project 'Just Futures: An Interdisciplinary

Approach to Cultural Climate Models' which brings together literary studies, linguistics, STS, and literature pedagogy to investigate how different texts move between seemingly neutral climate facts and normative social values. The project's approach is framed by interdisciplinary model theory, which conceives of models as representations of reality that reduce complexity and serve specific purposes. As the presentation argues, it is necessary to integrate qualitative and hermeneutic cultural modelling of climate futures, especially the extreme cases of climate catastrophe that many fictions engage with, into scientific analyses of future scenarios in order to fruitfully intertwine predictive, normative, and explorative components of climate futures modelling in different contexts and media.

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Is Futures Literacy the Future? Critical Questions from Foresight Practitioners

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Coming from a community of practice with over 25 years of experience with foresight in several Central and Eastern European countries, as well as at the European Union level, we aim to engage in the discourse surrounding the emerging concept of Futures Literacy (FL). Drawing on our extensive experience in implementing or advising foresight projects for various international and national organisations, such as the European Commission, JRC, ECDC, the OECD, ministries, and parliaments, we seek to explore the nuances of Futures Literacy from a foresight practice perspective. Our interdisciplinary foresight group, comprising researchers specialising in evolutionary economics, political science, STS, and environmental studies, has delved into understanding the UNESCO-outlined FL approach and relating it to our foresight practice. Our intention is to spark discussion and sense-making rather than providing an in-depth scientific contribution.

Methodologically, we have critically examined the basic definition of FL as a capability, proposed by Miller (2018), identifying commonalities and differences based on our practical experience. We have collected arguments both supporting and questioning the idea of consolidating all future practices under the umbrella of FL, to present them for debate.

While we share FL's fundamental perspective of recognising foresight and FL as a human ability to act with anticipation, we distinguish foresight practice in three main aspects. First, foresight is a participatory practice rather than a theory, a discipline, or a concept, although it applies scientific methods and draws on results of scientific research. Second, we emphasise

foresight's role as a governance instrument designed to support decision-making processes (European Commission 2002). This obliges foresight practice to adhere to certain values and standards, requiring participation and representation of stakeholders and experts relevant to specific future-oriented issues in the process. Third, foresight processes are explicitly linked to decision-making by informing, advising, and facilitating (policy) actors' networks (Havas et al. 2010).

Given these distinctions, we pose thought-provoking questions to stimulate reflection on the FL concept and its many faces:

Individual FL and Systemic Future-Making: To what extent, if at all is fostering individual FL sufficient to address societal challenges like the green and digital transformation? In what ways does individual FL contribute to systemic foresight approaches, which apply STEEPV frameworks and focus on anticipatory capabilities of networks and organisations? What could be the shortcomings of relying on FL, especially when it is limited to individual capacity building?

Openness and Uncertainty: In foresight, it is of particular importance to recognise the openness and uncertainty of the future, i.e., the possibility of multiple futures. In contrast, approaches heavily based on past data and trend extrapolation are aimed at forecasting a single future. What is the approach of FL to quantitative methods and trend analysis in comparison to creative, participative, and qualitative methods?

Expertise in Translation Work: How does FL as a concept relate to decision-making, especially when it comes to the work of 'translation'? In foresight, expertise in translating scenarios, visions, or future paths into policy or strategy recommendations is crucial for the successful integration of foresight results into policy processes.

Overcoming the Deficit Model of the Public: What if we move beyond the deficit model of the public (Wynne 1994) and acknowledge that everyone is futures literate and doesn't need to be educated on it first? Wouldn't this emphasise that not everyone holds a (social) position to influence policy processes and raise the question of how we can address power relations when designing FL and foresight activities?

In fostering these discussions, our goal is to contribute to the ongoing exploration and refinement of the Futures Literacy concept, recognising the diversity and complexity of anticipatory practices in shaping our collective future.

Navigating Future Skills: The FOUNDING LAB Experience in Shaping the University of the Future

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The challenges of the Anthropocene require interdisciplinary approaches based on creativity and co-creation. The FOUNDING LAB is a collaborative prototype with which the newly funded IT:U - Interdisciplinary Transformation University located in Linz (also known as IDSA – Institute of Digital Sciences Austria) and Ars Electronica want to identify and develop new methods and formats for shaping a pioneering university. Boundaries between disciplines and between art and science are to be overcome and all dimensions of digitization are to be considered. This paper delves into the FOUNDING LAB Fall Term program, evaluating the program design to cultivate crucial future skills, like Interdisciplinarity, Collaboration, Critical Thinking, Problem Solving, Anticipatory and Systems Thinking, Self-Management, Technology Use – and as its core: Futures Literacy or even Fluency.

After a dynamic Summer School and Forum where 75 students and 21 fellows envisioned the new university, the IT:U's inaugural Fall Term began with 25 students and 21 fellows testing the feasibility of their visions. Led by Ars Electronica's Futurelab and Festival-Prix-Exhibitions Department, the team curated and guided the term, fostering a trans-cultural and critical environment. It centred on exploring collective action and creating a unique curriculum test-bed, focusing on interdisciplinary project work, digital transformation, Art & Science Research, international collaboration, and societal discourse. Divided into six thematic blocks, the term addressed core aspects of digital transformation. Fellows from around the world provided diverse perspectives, creating an international dialogue beyond single fields. The chapters were a learning buffet, drawing from Fellows' experiences and academic concepts. The Art Thinking approach from Ars Electronica Futurelab fostered critical reflection. Over four months, students worked on individual projects supported by an experienced facilitation team. Deep Dive Talks by experts and an active feedback process enhanced learning. Breaking geographical and disciplinary boundaries, embracing diverse skill sets, and collectively approaching problems were crucial for successful interdisciplinary processes.

As one of the key research domains of the Ars Electronica Futurelab’s Art Science Research strategy, Futures Fluency explores how to expand the concept beyond mere literacy, fostering fluency and ultimately virtuosity. The research centres on developing and implementing Future Thinking processes like Art Thinking and Future Narratives. These methodologies aim to cultivate philosophical value systems, giving rise to collaborative Future Prototypes across corporate, cultural, and educational sectors. With thei strategy as base and eligned with UNESCO's competencies for sustainable development and the World Economic Forum's recommendations for future job skills, the FOUNDING LAB program employed learner-centred, action-oriented, and transformative learning approaches. Preliminary feedback indicates positive outcomes, particularly in the development of empathy and active listening, a key future workforce competency highlighted by the WEF. The program alos prioritized interdisciplinary and transcultural collaboration, incorporating project-based and research-based learning. As a testament to the impact of the approach, the at the moment still ongoing

Fall Term program (Ending End of January 2024) employs a comprehensive feedback and evaluation process, enabling students to self-assess their development regarding future skills.

In addition to the skills framework, the paper explores students' visions for the University of the Future, emphasizing the need for an environment that fosters collaboration, embraces gradual learning, and integrates diverse perspectives. The ongoing Fall Term, set to conclude on January 25th, 2024, will showcase the results of interdisciplinary collaboration in a public event.

The FOUNDING LAB experience, marked by its diverse and collaborative nature, provides a valuable case study for designing futures-oriented, futures-literate and futures-fluent university curricula. By balancing the potentials and limitations of collective action and creating learning environments that prioritize questioning over knowledge transfer, the program sets a precedent for the University of the Future.

Enhancing Futures Literacy through Gaming? Experiences from Role-playing Games on Socio-Technical Change in University Courses

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"A course with the future as its subject-matter could never be a text-book course." This quotation from one of the founders of futures studies, Ossip K. Flechtheim (1966 [1945], p. 67), rings true to today's practitioners, despite its rather high age of almost eighty years. Also in line with many of today's practitioners, Flechtheim was convinced that thinking about the future was indeed something that can be learned, or at least improved through education and training, should thus be taught at colleges and other educational institutions.

Yet, this position leads to further questions, both with regard to didactical method and to epistemic power (cf. Sippl, Brandhofer, and Rauscher 2023). If not through text-book courses, how then can thinking about the future be taught? And is it even justified to conceive of futures thinking as something that the individual does not possess, but as something that must be taught—thus establishing a level of intellectual gatekeeping that (re-) produces existing power inequalities?

The presentation reflects on these problems based on a series of role-playing games used in a course on futures studies at our university. Called the Mammoth Game (Dayé, Prunč, and Hofmann-Wellenhof 2023), the game focuses on a socio-technical innovation and has students represent different groups of stakeholders, ranging from the companies involved to various political and civil society actors. It thus simulates how controversies around this innovation project may evolve. Apart from describing the game, we also report data from evaluation studies to discuss the impact of the game on the students' Futures Literacy.

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H.2: Teaching STS, beyond STS: a workshop reflecting on teaching in the STEM fields

Session Chair: Mascha Gugganig, Ludwig-Maximilians-Universität München, Germany

Science & technology studies is an interdisciplinary and versatile field that can be found in the form of degrees, programs and departments across the social sciences, humanities and STEM fields. Indeed, the mission and efforts of early STS departments and programs in the US included teaching science and engineering students ethics and a concern for social responsibility that related to novel technologies (Winner 2021). Ever since, STS departments and programs have been established in social sciences, humanities and STEM fields (with varying degrees across countries and based on their higher education policies). Within the latter, in life science departments, engineering or medical schools, buzzwords, such as Science Communication, Responsible Research and Innovation or Ethics signal the need for more critical social scientific training for its students. While STS scholars have (rightly) critiqued these concepts in their respective empirical case studies, what it means to teach in settings where such buzzwords have become institutional policies has received far less attention.

The teaching of STS and related critical social science and humanities approaches bring with them possibilities and challenges, and a scholarly gathering like STS Graz offers a conducive space to reflect on the teaching of STS beyond STS. The proposed workshop aims to address this often overlooked aspect of our work, and invites lecturers working in ‘applied’ educational sites to share and learn from each others’ experiences. What are best practices of teaching engineering/medical/biology students STS theories, concepts, or methods? What expectations should and can we have from students that primarily receive a technical/scientific training to integrate STS perspectives? How should we deal with university’s established teaching programs that tend to relegate social responsibility, ethics, or the politico-economic dimensions of technoscience as secondary concerns of education? What are different issues that arise when teaching in an engineering, biology, or medical context, to name a few? What are conceptual tools and teaching strategies at the intersection of STS and applied scientific/technical work, and how could this work expand our field? The workshop thus aims for an open, participatory engagement to reflect on, and share with others our daily teaching experiences in the STEM fields.

Stream I: Contemporary Societal Challenges

I.1: Science and society in global crises

Session Chair: Erich Griessler, Institute for Advanced Studies Vienna (IHS), Austria

Session Chair: Johannes Starkbaum, Institute for Advanced Studies Vienna (IHS), Austria

Integrating Ethics and Society Through Innovation Ecosystems? Towards Transformative Innovation Ecosystems

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As several global and grand challenges confront our transforming world, science and innovation are often framed as integral parts of successful counteraction (Ludwig et al 2022, Välikangas 2022). Concepts such as “model-regions” (ZRR 2021:10), “brainbelts” (Van Agtmael and Bakker 2016) or “regional innovation ecosystems” (Pidorycheva et al. 2020) describe efforts to advance (regional) transformation through and for innovation. These concepts resonate with calls for a ‘systemic turn’ in Responsible (Research and) Innovation and engagement research (Aris and Willems 2023, Braun and Könninger 2018, Stahl 2022). Responding to these calls, Smolka and Böschen (2023) have introduced the concept of *responsible innovation ecosystem governance*, which they conceptualize as system-level capacity of diverse actors to reflect on socio-ethical horizons in different streams of an innovation ecosystem. However, empirical research on the practicality of such a ‘systemic’ approach remains scarce. In this presentation, we provide empirical insights into, and critical reflection on, achievements and challenges in practicing responsible innovation governance in the emerging innovation ecosystem of NeuroSys. NeuroSys is a multidisciplinary research and innovation cluster, in which scientists, industry actors and regional stakeholders collaborate to develop and commercialize brain-inspired computing hardware and software that promise to improve the energy-efficiency and performance of artificial intelligence (AI) applications. Critical issues include the environmental costs of computing (Becker 2023, BCG et al. 2023, Jones 2018), social injustices in global hardware value chains (Crawford 2021), risks of discrimination, privacy inflictions, and surveillance posed by AI (Stahl, Schroeder and Rodrigues 2023), and adverse and distributive effects of innovation on society, which can result in societal resistance (Jasanoff 2016, Volti 2017).

In a team of embedded social scientists and ethicists, we therefore seek to integrate ethics and societal considerations in high-tech research and innovation, drawing on Vision Assessment (Lösch, Heil and Schneider 2019), multi-stakeholder scenario workshops and dialogues (Fischer and Mehnert 2021), and Reflexive Monitoring in Action (van Mierlo et al. 2010). We find that a significant challenge for a responsibility-focused innovation ecosystem is to simultaneously achieve “sociotechnical viability” (Walrave et al. 2018) beyond the sociotechnical niche and what we call *sociotechnical desirability* in light of multiple, interdependent unfolding transformation processes. To better understand these challenges

and ways of addressing them, we introduce the concept of *transformative innovation ecosystems*. It can be defined as an alignment structure, through which actors within the ecosystem gain the ability to account for and reflexively shape ongoing transformation processes to realize a *synchronized value proposition*, which aligns technical and commercial with ethical, societal and ecological ambitions. Finally, we describe complementary system-level capacities required for the synchronized value proposition to materialize. Through guiding and promoting this capacity-building, the concept contributes to integrating ethics and societal considerations into research and innovation in a transforming world.

Disjointed reality: scientific research and science journalism in Qatar

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Drawing on a recently completed Qatar National Research Fund (QNRF)-funded study, this paper sketches the development of scientific research infrastructure and the current state of science journalism in Qatar. Even though Qatar has invested rigorously in scientific research for the past decade and a half, there has been a very small production of local science news in the country. A content analysis of 483 Arabic and English-language news stories about scientific discoveries in Qatar shows that they do not often make it to the news page (except, to some extent, medical discoveries). Wherever they do, the vast majority (94% of stories) are about foreign science achievements, being mostly copied or translated verbatim from foreign media sources (76%), with very little localization (85%). In-depth interviews with 15 local science journalists and editors as well as a Delphi panel with six scientists explains this content pattern. In general, there is no science journalism culture in Qatar, with both reporters and editors not seeing science as a newsworthy category and investing very little money and time in producing original science news or training their people to do so. Some even see science communication as the job of the government rather than of the media. Our participating scientists confirm this, noting a lack of two-way communication between scientists and journalists in Qatar. In that context, foreign science news provides a quick fix, and many published science news are about scientific studies and stories done outside of Qatar. In other words, Qatari print newspapers rely heavily on outside sources. This paper will explain the causes, short- and long-term implications of this dependency for the development of Qatar and the Global South, and potential solutions.

Adorno's Negative Dialectics and Climate Change

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A fashionable response to climate change has been the concept of circularity, whereby systems are designed to reuse their own energy and materials. While this approach has certain advantages, this approach is anthropocentric and can yield limited results. My paper first positions circularity as a sociohistorical artefact that is rooted in the Enlightenment and universality. Postcolonial Studies has demonstrated that the Global South has a very different experience of Enlightenment and universality and therefore circularity. Therefore, circularity, while a small step in reducing our consumerism, can serve as an alibi in the continued mutilation of the planet.

The next section of my paper is a postcolonial reading of Theodor Adorno's negative dialectics especially his critique that an idealized humanism diminishes and excludes animality. A negatively dialectical postcoloniality is one that finds heterogeneity *in* our animality. Cat Bohannon, in her book *Eve* demonstrates how animality is central to our evolution as modern humans. For example, the early Eve or "exemplar genus" of mammalian milk—*Morganucodon*— can be traced to a weasel like animal who existed 205 million years ago. The paper concludes by theorizing that although climate change is anthropogenic, a postcolonial project needs to acknowledge that our humanism is a product of our animalism that requires a different understanding of human history and progress.

Towards a Transformation Assessment – a proposal for observing and shaping sociotechnical transformations

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In the face of global challenges (such as climate change, increasing poverty worldwide), politics, science, and civil society are initiating transformation programs of varying focus and scope. The transformation projects associated with these programs require a far-reaching reorganization of the structures and processes of society. In response to the programmatic imperatives of transformation, concrete transformative activities (e.g., real-world labs) are being initiated. Each is intended to make its contribution to the urgent transformation. However, transformation processes on any scale require a restructuring of the fundamental socio-technical constellations in society and have a potential impact on all social subsystems. Technology-based societies expect new technological innovations to solve their problems. The resulting socio-technical changes are massive and pervasive, and they also affect those actors who are not directly involved in the transformation activities. This drastically changes the relationship to concurrent and desired technological developments. Because relevant transformative developments are conceived, initiated, and shaped without reflexively contextualizing the necessary and related social structural and processual changes, transformation programs as responses to crises, such as the energy or digital transitions, create dramatic breaks with the actual state of social coexistence. Although their

conceptualization is relevant for the success and impact of any transformative activity, these interrelations and interdependencies in the promise and practice of transformation have received little conceptual attention.

Technology assessment (TA) (Grunwald 2019) is involved in transformation projects at all levels as an observer, (co-)researcher, and also as an actor, as a fundamentally problem-oriented, but also solution-oriented science and advice practice. Like other approaches in “Science and Technology Studies” STS (for example, Konrad et al. 2016), the expertise of TA lies in its interdisciplinary and integrative spectrum of theory, methods, and processes for the critical examination, evaluation, communication, and co-design of (evolving) transformative activities. TA's specific normative foundations (democratic, sustainable, socially just and inclusive, issue-oriented) are indispensable for its inherent interdisciplinarity and transdisciplinary cooperation (with the public, politics, society). TA as STS does not focus on individual technical innovations and their impacts but on socio-technical processes in their interaction with broader societal changes. Specifically, TA is motivated by existing societal (not primarily scientific) problems and the creation of enabling structures that generate solutions to provide scientifically robust knowledge for negotiation and advice in political and societal decision-making processes. For this reason, TA's analytical and normative view of transformation is not limited to local transformation projects. Instead, it contextualizes them within larger societal contexts and processes. It critically examines the opportunities for and effects of change in the social subsystems involved, the visionary promises that guide the process, and the connectivity and operability of transformation projects. This contextualized view and practice of TA (e.g.; Böschen et al. 2021) opens up possibilities for more reflexive transformative action.

In our presentation, we will outline a theoretical and methodological concept for "transformation assessment" by and in TA. It is intended to provide orientation for transformation projects and to make their possibilities and consequences visible, assessable and reflective. It integrates (a) the analysis of transformations from a systems-theoretical perspective (e.g. Büscher 2018), which takes into account couplings in current interactions and interdependencies in structures and processes of change, (b) from an immersive anthropological and cultural-scientific perspective (e.g., Ufer/Hausstein 2021), which focuses on conjunctures in historical processes, and from the perspective of vision assessment (Lösch et al. 2023; Schneider et al. 2023), which examines and modulates socio-technical visions as socio-epistemic practices that refer to future spaces of possibility. In this respect, "transformation assessment" could serve as a theoretical and methodological aid for both non-TA and TA transformation projects.

Socio-technical visions for degrowth futures. Insights from ecological economics and degrowth

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Ecological economists, and more recently degrowth thinkers, have made substantial contribution to the understanding of the causes of today's economic and social crises; and to the limits of the 'reform' approaches to sustainability transition (e.g. green growth). They draw attention to the necessity of deep transformation of the current institutions, socio-economic structures and power relations. This body of literature has been characterised by a mostly sceptical attitude towards technology. According to ecological economists, sustainability is not a 'technical' problem; it cannot be addressed solely through technological innovations. Instead of searching for 'technological fixes' we should rather direct our attention towards changing the institutional system, reconsidering values, and taking into account planetary boundaries. Among degrowth thinkers, the intellectual heritage of Georgescu-Roegen, Ellul, Gorz, Illich etc. also projected a sceptical stance towards modern technologies. While degrowth scholars have particularly strong visions about what kind of eco-social system they want for transcending the current mainstream, the role of technology in such a transition is still a bone of contention and somewhat under-researched.

In the present theoretical paper, we attempt to build on the insights of ecological economics and degrowth thinking (on the top of STS) in order to address the potential of technologies to bring about 'deep transformation'. Our research question asks how is the transformative potential of technologies connected to the socio-technical visions of actors (and the process of vision-building)? What kind of technologies could contribute to the building of degrowth futures?

Current technological systems typically embed relations and values, which are in contrast with the degrowth vision (the vision of a just and democratic deep transformation). Since we cannot start with a clean slate, it is not sufficient to simply come up with 'convivial', 'appropriate' etc. technologies. We have to 'fix technology' (transform and recreate our current systems) in order to build degrowth futures. We must both address the questions what kind of technology can support this transition and how can we transform our innovation systems to facilitate the change.

We demonstrate how visions are already good starting points on deciding the kind of technological developments we support and vice versa, the kind of technological developments we have already also have strong underlying societal visions. However, these visions continue to remain implicit. It is a fundamental necessity for degrowth to demand for any innovation to make such visions explicit and make use of the – dominantly participatory – processes that, through deliberative means, clarify such visions. As degrowth rejects the idea of technological determinism, it is pivotal to know what kind of questions we need to ask regarding any technological innovation. This study attempts cataloguing the fundamental questions that we need to ask ourselves when creating technologies in a degrowth transition. By the means of these questions, we can unearth the underlying visions and turn them from

unconscious influence into conscious decisions that are properly reflected upon. Only these deliberative processes can lead to the acceptance, rejection or alteration of certain technological solutions.

"This is the real face of Covid-19 pandemic!". How Refused Knowledge Communities contested science during the health crisis.

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The Covid-19 pandemic has been deemed a global health crisis, not only due to the extensive economic and societal damage but also because of the uncertainty regarding solutions and explanations that has accompanied this challenging period for the most affected societies. For this reason, Covid-19 pandemic promoted a generalised process of knowledge production and storytelling by a variety of actors devoted both to find a way for contrasting the spread of the virus and to understand what was happening. Refused Knowledge Communities (RKCs) that are communities that support knowledge that are refused or denied by official science and institutions, have gained a prominent place in the public scene by contesting the mainstream explanation of Covid-19 delivered by public institutions and official science. The general aim of RKCs was devoted to unveiling the "real face of Covid-19 pandemic" by providing alternative explanations to those released by Italian government to cope with the problematic situation created by the virus. The emergence of an alternative and contested view of Covid-19 led to a public controversy where a great effort was done by mainstream media and public health institutions to ask people to "follow the science" instead of what was framed as "conspiracy" or "fake news".In this context, the contribution will analyse the results of a digital ethnography implemented during the first months (from January to July 2020) of the Covid-19 outbreak in Italy with the aim of understanding the role of RKCs in the rise of the pandemic controversy. The digital ethnography focused on following human and non-human actors who played a relevant role in catalysing dissent and in shaping public concerns raised by the virus spreading. Those actors have been: 1) pandemic objects such as vaccines, masks, and other previously unknown objects that become part of the public discourse and are displayed by institutions as tools to deal with Covid-19; 2) RKCs experts as a meaningful resource to deliver essential knowledge to cope with the uncertainty; and 3) impostors, i.e. the official experts promoting a version of the health emergency contested by RKCs. What we have noticed is that those actors contributed in different but complementary ways - some as "brokers", some others as "boundary objects" – in favouring new alliances among different RKCs. Those actors played the most prominent role in favouring the emergence of refused knowledge based-social worlds that are still active today in contesting mainstream science and institutions and in some cases appear to have been reinforced by the current pandemic.Analysing how RKCs re-assembled their alliances by trying to disentangle the pandemic, offered a fruitful perspective for better understanding how refused knowledge has been employed in sense-making processes by RKCs and how their claims became a matter of public concern during the Covid-19 pandemic.

Culture, climate change, and water conservation: Water ecosystems and culture-based adaptation practice in Global South/Bangladesh

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The research focuses on climate change, water conservation, and community development in Bangladesh. Bangladesh is one of the most climate-vulnerable countries in the world and water challenges, especially in the coastal areas are severe and significant. The aim is to determine the socio-ecological effects of water-related climate change in coastal communities in Bangladesh, with a specific focus on the potential of traditional knowledge (TK) and local, culture-based adaptation strategies to enhance resilience to water challenges in some of the poorest and most biodiverse regions on the planet. Until now, most climate change water adaptation practices are based on grey infrastructure (e.g. dams). Their functionality and effectiveness in storage, purification, and supply of water are not at the intended level and create obstacles to a natural flow. TK-based solutions, on the other hand, are culturally appropriate, focus on biodiversity and ecosystem restoration, and are easy to maintain as well as low cost. There is growing interest in nature-based and TK-based solutions at different scales. However, ecosystems are vulnerable to climate change and as TK is often based on historical knowledge of ecosystems, the question arises to what extent it can be helpful during radical change. Crucially, the research asks how the potential of traditional knowledge can be harnessed to strengthen resilience. Using a mixed method approach grounded in ethnographic methodologies, the project will help to guide greater community-level adaptation and biodiversity and ecosystem conservation and influence future policy and planning in this field.

Discourse Formats for Responsible Research and Innovation in Quantum Technologies

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Technological progress always opens up a range of possibilities characterised by both opportunities and risks. Beyond the obvious dual-use potential, the latter include a number of indirect, potentially negative consequences. For example, while digital technologies undoubtedly increase access to information, they also contribute to challenges such as the spread of fake news and the exacerbation of socio-economic disparities, leading to the digital divide. There is therefore a need to carefully examine the trajectory of technological development and thoughtfully address these potential pitfalls. In this context, the application of Responsible Research and Innovation (RRI) has emerged as a valuable approach in STS and technology assessment. RRI goes beyond the mere consideration of ethical implications; it also promotes active engagement, dialogue and collaboration among all stakeholders to ensure a balanced and sustainable technological landscape.

One current, potentially particularly disruptive technology is quantum technology (QT). The individual technologies covered by this term have the potential not only to improve the accuracy of our measurements for medical or geological applications (quantum metrology), but also to change the way we communicate (quantum communication) or solve previously unsolvable

problems in materials science or medical technology (quantum computing). Alongside these more positive applications, however, there is also a dual-use potential (quantum radar, hacking of current encryption) and an emerging quantum divide. Here we see, among other things, the development leadership of QT in the hands of larger, regionally concentrated technology companies and a few start-ups, as well as the discourse leadership of a few highly qualified researchers from individual disciplines. However, as we are also at an interesting point of development of recognisable technological lines of development without full maturity of the QT (Collingridge Dilemma), powerful solutions in terms of RRI to overcome the quantum divide are conceivable. In particular, access to the technology and participation in its development have proved to be of central importance, which we will describe by means of two specific examples of solutions.

A particularly fundamental and obvious solution is the training of interested parties. Here, however, we go beyond the usual avenues of the educational landscape and describe training opportunities for those interested in technology 'without a PhD', which are provided in the form of various grassroots organisations. Through a series of interviews, we identified an extremely diverse organisational landscape that enables people from previously neglected groups around the world to access QT, regardless of the institutional landscape. For example, free educational opportunities ensure that everyone can understand QT, access to (simulated) quantum computers provides low-threshold access to programme developments, and the international approach often involved enables networking across national borders. This broadens the base of participants for the development lines of QT and adds perspectives and concrete formats to the discourse on QT.

Another solution, which goes beyond the above-mentioned target group, is the interaction between art and science. In a two-way process, people also from outside physics and science, who have not been formally reached, are included through different event and discourse formats, which we organise and scientifically accompany. On the one hand, the various forms of expression and exhibition of art allow access to QT and thus an assessment of its development through learning and understanding the basic principles. On the other hand, creative exchange formats also enable participation in its further development, which can include feedback to researchers, influence on public and political discourse, and future collaboration in the development of QT.

In this way, both pathways allow for the co-creation of QT by including previously neglected groups of people and their views on social change, which we would like to present and discuss with interested parties.

Scientific (dis)information and ingenuous trust in science: Engagement and reception of scientific (dis)information in Italian high schools

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The proposed intervention focuses on the high school classroom as a social group in order to investigate its role in mediating access, reception, and circulation of scientific (dis)information. It is based on a two-year-long mixed-method research on twelve high school classrooms selected from six schools proposing different curricula (humanistic, scientific or professionalizing). In each of them, we conducted qualitative interviews with students, teachers and parents; focus groups with students and parents; two rounds of qualitative media diaries; virtual ethnography and commented social media reel scrolling sessions; and data donation.

Especially when compared with the family, the classroom as a social group has by and large emerged as a weak mediator for the access and reception of scientific (dis)information: a role that is almost entirely fulfilled by the guidance provided by teachers within their educational programs. Beyond that, scientific information is rarely shared or discussed among classmates, except for information delivered through infotainment formats on social media, or strictly related to common concerns for everyday life (in particular regarding health and nutrition). By far more relevant are smaller groups of friends, within and across the classroom, who share the same interests or passions, like astrophysics.

Notwithstanding this role of the classroom, our observations suggested how students share the same criteria to distinguish between scientific information and disinformation – generally based on stylistic features of the message and on the refusal of scientific populist or conspirative frames – and, above all, a similar, and somehow ingenuously unrealistic, idea of science, based on an unerring capacity of the scientific method to ascertain definitive truths, grating unanimous consensus in the scientific community.

This ingenuous trust in science can represent a vulnerability when probed by personal or social crises (like a family member's disease or the pandemic). As a part of the project, we have developed an experimental formative module to promote a more realistic understanding of science, based on the main acquisitions of the Social Studies of Science, taking care, however, not to undermine its trustworthiness.

21st Century Bourgeois Agrifood Utopias and Emerging Socio-Technical Imaginaries: Insights from "Agriculture 4.0" Discourses and Policies in Türkiye

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One noteworthy trend in agrifood relations over the past few years has been the increasing interest in the application of digital technologies and tools throughout the agrifood system. This encompasses activities ranging from data collection and decision-making to production and distribution processes. This growing trend is reflected in various labels such as "smart agriculture", "smart farming", "digital agriculture", and "precision agriculture". The preferred term in this paper is "Agriculture 4.0", as it encourages a broader perspective on agrifood digitalization. Rather than viewing it solely as a set of "smart" techniques adopted in agriculture, "Agriculture 4.0" is considered part of an emerging "socio-technical imaginary" that seeks to reimagine the entire agrifood system.

This paper examines the fundamental features of this emerging socio-technical imaginary within the context of Türkiye. It situates the conceptions and policies of Agriculture 4.0 within the trajectories of capitalist agrifood relations, focusing on three key actors: (1) the "Smart Agriculture Platform" of the Ministry of Agriculture and Forestry, (2) the Turkish Industrialists' and Businessmen' Association (TÜSİAD), a highly influential corporate entity in Türkiye, and (3) TABİT Smart Agriculture Technologies Inc., a social enterprise specifically addressing small producers in terms of digitalization processes.

The analysis draws on examining key texts, including reports, policy documents, and webpages from these actors, alongside the emerging literature on agrifood digitalization in Türkiye. The guiding questions throughout this exploration include: (1) How is this socio-technical imaginary of Agriculture 4.0 constructed, by whom, and for what purposes? (2) To what extent does the vision of Agriculture 4.0 represent a continuity or discontinuity regarding the discourses and practices of capitalist development/agricultural modernization in Türkiye?

The analysis reveals three interconnected assertions about Agriculture 4.0: (1) presenting it as revolutionary, (2) portraying it as inevitable, and thus (3) characterizing it as incontestable—a process beyond objection. This aligns with the broader discourse on agrifood digitalization, framing it as a solution to escalating agrifood-related challenges like hunger, ecological degradation, demographic transitions, and sustainability.

Contrary to such claims, the argument posits that Agriculture 4.0 is merely a renewed effort of capital as a socio-ecological relation to reshape the world in its image. Leveraging critical analyses of agrifood digitalization, this paper suggests conceptualizing Agriculture 4.0 as a 21st-century bourgeois agrifood utopia – neither revolutionary nor inevitable. Instead, it constitutes a discontinuity only within the continuity of the contradictory tendencies of the capitalist food regime.

Researchers' Disciplinary Perspectives on Science-Society Relations: Insights from an Online Survey on Knowledge Transfer

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As we face multiple crises as a society, the demand to contribute to the resolution of these crises has become a prominent imperative in academia, complementing the traditional focus on research and teaching. Researchers are increasingly called upon to legitimize their scientific work by demonstrating its societal impact. One way for scientists to respond to these demands is to actively engage in knowledge transfer activities, such as patenting an invention or consulting NGOs.

The significance of knowledge transfer in science policy and research evaluation has grown, and it has become a topic of research. Previous studies have primarily concentrated on investigating knowledge transfer under a narrow definition within specific fields (e.g., technology transfer within engineering), hindering the ability to draw comprehensive cross-disciplinary comparisons. As a result, the empirical basis supporting the science and society discourse represents only selective parts of the science system, and debates remain partial and superficial.

The high level of diversity of the scientific landscape should not be neglected. Research fields may consist of many disciplines, each with their own peculiarities, such as research practices or distinct ways of knowledge production. These disciplinary characteristics affect how well scientists in each discipline can make their societal impact visible. For example, some disciplines' research output tends to be a specific product which would be in line with the narrow definition of knowledge transfer and is thus directly recognized as useful. In contrast, other disciplines produce process knowledge and may struggle more to legitimize their scientific work.

We argue that an assessment of the status quo of knowledge transfer with a fine-grained comparative approach is essential for an understanding of the barriers and potentials of science's contribution to society. For this reason, we conducted an extensive online survey in fall 2023, encompassing over 3,000 researchers across all disciplines and status groups. Knowledge transfer was defined as a broad concept that encompasses any interaction between academic and non-academic actors with the goal of exchanging, applying or creating knowledge. We sought to capture a comprehensive snapshot of the current state of knowledge transfer in Germany and provide a robust empirical basis to deepen our understanding of science-society relations, taking scientists' views and perceptions on knowledge transfer as a starting point. Consequently, the survey items probe into scientists' understanding of knowledge transfer, but also the associated knowledge transfer practices. Detailed questions about respondents' disciplinary characteristics and research practices allow an exploration of potential connections between disciplinary affiliation and perspectives about the relationship between science and society. Additionally, the questionnaire captured scientists' views surrounding the debate on science skepticism and how they as scientists perceive societal demands regarding research in general. Based on our data, we will present first results of our analysis of the status, challenges, and opportunities associated with knowledge transfer in the German academic landscape from a discipline-comparing perspective.

By examining knowledge transfer from the perspective of scientists, we contribute to a more comprehensive understanding of the complex interplay between the inherent logics of the science system and the potential of science to contribute to resolving societal problems. Moreover, we highlight the importance of comparative science studies in the analysis of science-society relations.

DNA data storage: public engagement through qualitative online survey

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DNA data storage represents an expanding technology with the potential to provide a sustainable and efficient solution for archiving vast amounts of digital data. Despite its development, the public perception of this emerging technology remains largely unexplored. Understanding public attitudes towards new technologies is crucial not only for ensuring responsible development but also for fostering widespread understanding and acceptance. This study aims to address this gap by investigating public attitudes towards DNA data storage through an exploratory qualitative online survey involving 54 respondents.

The findings reveal a significant level of intrigue and fascination among respondents regarding the concept of storing data in biological cells, often described as futuristic. However, alongside this enthusiasm, participants also voiced concerns regarding ethical considerations, data control, potential misuse, safety, and accessibility issues. Additionally, many respondents expressed a sense of inadequacy in their understanding of this technology.

Importantly, the study highlights the nuanced and mixed perspectives within individual responses, underscoring the complex interplay between optimism for technological advancement and apprehensions about unforeseen consequences. The critical need for early public engagement is emphasized in tandem with the development of novel technologies. Furthermore, further qualitative research to deepen our understanding of public attitudes towards emerging technologies is encouraged.