INTRODUCTION

Technology assessment in 'imperialist ruins'?: Towards solidarity, conviviality and care

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Abstract • Do we need to reconsider technology assessment (TA) scholarship, practice and institutions when values such as human-ecological sufficiency, intra- and intergenerational justice, solidarity, conviviality and care are deeply acknowledged? In line with the previous two Special topics of TATuP this year, this section addresses this challenging question head-on. In this introductory piece, we outline some of the distinct challenges facing TA in the 21st century and discuss options, but also emerging issues regarding heterodox, yet timely approaches to TA. In terms of conceptual approaches, we draw on Andrea Vetter's recent work on 'convivial technology', as well as earlier alternative conceptions of technology. Our ambition is to foster a dialogue within and beyond the TA community about what contemporary societies might need or even expect from TA, including concrete adjustments that some might call for while others might warn against.

Technikfolgenabschätzung in 'Ruinen des Imperialismus'?: Das Ringen um Solidarität, Konvivialität und Fürsorge

Zusammenfassung • *Müssen wir Technikfolgenabschätzung (TA), ihre Praktiken und ihre Institutionen überdenken, wenn Werte wie human-ökologische Suffizienz, intra- und intergenerationelle Gerechtigkeit, Solidarität, Konvivialität und Fürsorge ins Zentrum rücken? In Anlehnung an die beiden vorangegangenen Spezialthemen von TATuP in diesem Jahr widmet sich dieser Artikel dieser herausfordernden Frage. In unserem einleitenden Beitrag skizzieren wir einige der besonderen Heraus-forderungen, denen sich TA im 21. Jahrhundert gegenübersieht, und diskutieren Optionen, aber auch neue offene Fragen im Zusammenhang mit heterodoxen, zeitgemäßen Ansätzen. Konzeptionell stützen wir uns auf Vetters (2024) Arbeit zu „konvivialer Technik" sowie auf weitere alternative Technikkonzepte.*

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From ubiquitous digital technologies to the vision of controlling the geosphere through technology: Attention to technology-based extraction, exploitation, and exclusion has gained traction in technology assessment. Not least, the most recent Special topics of this journal are testament to this shift in focus, with this year's first issue of TATuP focusing on the importance of care in sustainability transformations (Hackfort et al. 2025) and featuring an article on decolonizing technology assessment (TA) (Arora and Van Dyck 2025), and the second Special topic searching for strategies that transcend short-termism in the governance of socio-technical change (Sardo et al. 2025).

Important impulses for this recent turn and its underlying criticism of established practices have come from decolonial and postcolonial theory, political economy, social ecology, degrowth and post-growth paradigms, new materialism, eco-feminism, and infrastructure studies. Past experiences have showcased that every high-tech innovation – however noble the associated goals may have been and however good the performance in one impact dimension – has further added to our material and/or energy footprint, to social frictions and geopolitical conflicts. Traditionally, technology assessment has focused on intended and unintended effects, aiming to identify, prevent or at least manage and mitigate negative consequences while fostering societal benefits. The ambition has been to render socio-technical innovations as socially robust as possible and to avoid crossing red lines.

However, having reached or exceeded our global economy's 'limits to growth' (Meadows et al. 1972) or 'carrying capacity' (Höhler 2006) in an increasingly 'full world' (Daly 2005), in an age in which the human impact on the Earth's geology, ecosystems, biodiversity, and climate becomes irreversible and decisive for the future of humanity, demands and expectations pertaining to technology governance change. The new epoch, whether referred to as the Anthropocene (Crutzen and Stoermer 2000), Capitalocene (Moore 2016), or Chtulucene (Haraway

An alternative perspective on the long-term overall impact of socio-technical innovation in the face of limited resources and on its geo-political management requires a comprehensive TA approach that includes all dimensions relevant to the affected communities and considers local and trans-local, material and immaterial causal chains and limits. It also reformulates an old question, namely whether and, if so, how socio-technical innovations can be intrinsically sustainable, or whether innovation unavoidably and "fundamentally remains a tool of

Can we imagine socio-technical innovation that is 'deeply sustainable'?

2016), raises critical questions about values such as global justice, human rights, and anthropocentrism, thereby challenging the seemingly self-evident nature of socio-technical innovations as improvements to social conditions per se. Tsing (2015), in a highly acclaimed book on "the possibility of life in capitalist ruins", also advocates for radically new perspectives, focusing not only on past paradigmatic successes, but also on socio-material destruction and decay we should confront ourselves within in an attempt at collaborative survival.

For a field like TA, new core questions come to the fore: Do socio-technical innovations contribute effectively enough to a future worth living for all? Can we imagine socio-technical innovation that is 'deeply sustainable' and thus radically aligned with planetary boundaries, human dignity and global justice? Is an at least net zero balance in all relevant dimensions, from the social, political, and cultural to the economic and ecological sphere, feasible on local, regional, and global scales across all time horizons and generations? Or will it always be the case that 'one person's gain is another's loss', that a benefit in one dimension comes with harm in another? And if so, by which democratic instruments can this – often transnational or transgenerational – asymmetry be addressed?

Current experiences are disconcerting in many respects. The development and use of electric vehicles may be motivated by the good goal of advancing the energy transition in the Global North, but still disregard global human-ecological limits and values in terms of raw materials required for their production, resulting in the exploitation of humans and ecosystems in the Global South and geopolitical dependencies and conflicts, or, in Pansera's (2025, p. 2) more radical wording: "[T]oday's corporations ravage the Global South for 'critical minerals,' leaving behind toxic wastelands to fuel the illusion of 'clean' energy". The production of renewable energy leads to land use conflicts in peripheral rural regions, particularly in the Global South. Generative artificial intelligence, although seemingly immaterial and artificial, has serious ecological and social downsides, e.g., in terms of energy and water consumption or the working conditions of so-called 'clickworkers' (Muldoon et al. 2024). Such examples illustrate material, immaterial, and geopolitical dimensions of socio-technical innovation in a 'glocal' world society.

control, displacement, and accumulation [. . .] diffused through circuits of global capital, digital infrastructure, and militarized surveillance" in a world order "where extraction and erasure are repackaged as efficiency and security" (Pansera 2025, p. 2). Raising this question, leads us simultaneously both ways: towards past concepts and approaches as well towards reformulations and interventions in light of current knowledge, challenges and capacities.

Past and present conceptions of technology beyond extraction, exploitation and exclusion

Andrea Vetter has recently undertaken such a two-fold task: In her work on 'convivial technology' (Vetter 2018; 2023) she builds on a well-seasoned concept, namely Ivan Illich's 'tools for conviviality' (Illich 1973). Illich had engaged intensively in the question of how to find a way to accept limits and to recognize boundaries while at the same time creating a productive and humane man-made environment. He envisaged a convivial society, in which "modern technologies serve politically interrelated individuals rather than managers" (Illich 1973, p. 11). Vetter (2018; 2023) further develops Illich's approach into a conception of deeply sustainable technology and an approach for assessing how a technology fares in this respect. In her 'matrix of conviviality' she focusses on the material dimension, the production cycle, the uses and the relevant infrastructures of technical artefacts as well as on several quality dimensions: relatedness ('What does it bring about between people?'), access (by whom and how), adaptability (independence and compatibility), bio-interaction (as 'interaction with living organisms') and appropriateness ('relation between input and output considering the context') (Vetter 2018, p. 1780). Zoellick and Bisht (2018) also build on earlier work such as Illich's when focussing on degrowth. They suggest slightly different quality dimensions, namely ecological impact, accessibility, autonomy, decentralizability and innovation.

But Illich's 'convivial tools' are by far not the only concept that has addressed technologies for/in a good life or 'deeply sustainable technology' in the past. Schumacher focused on 'intermediate technology', which he also labelled as 'self-help technol-

ogy', 'democratic' or 'people's technology', and conceived to be "much simpler and freer than the super-technology of the rich", i.e., "a technology to which everybody can gain admittance and which is not reserved to those already rich and powerful" (Schumacher 1973, pp. 145–146). It was later relabelled as 'appropriate technology', lending its name to a social movement. Schumacher's concept also figures as just one of many conceptions of 'low technology' (a more recent example being the concept of 'calm technology' introduced by Weiser and Brown 1995). The concept of 'soft technology' was put forward by Lovins (1977). The vision of a cooperative rather than confrontational relationship between nature and technology also informed Ernst Bloch's concept of 'Allianztechnologien' (Bloch 1986) as well as the concept of 'ecotechnology' (Bookchin 1977). The latter spread quickly in the 1980s and is present in various fields today (Schwarz 2022).

Concepts of the new millennium build on such earlier conceptions, while also adapting them to new contexts, constellations, challenges and ambitions. Bihouix (2014) proposes a low-tech approach not for developing countries, like Schumacher originally did when discussing intermediate technology, but for European production and innovation systems so as to be better equipped to align with planetary limits. Watson (2020), a landscape architect by training, counters the perception that indigenous innovation existed isolated from technology and captures this perspective under the label Lo-TEK (TEK for Traditional Ecological Knowledge, see also Martin et al. 2010). Bialski (2024) builds on the concept of 'intermediate technology' or 'middle tech' and proposes a 'tech culture of good enough', thus re-calibrating the expectations we have regarding socio-technical innovation. Other approaches, such as 'frugal innovation', 'inclusive innovation' or responsible innovation' focus more broadly on innovation (if, still, with a strong focus on technology).

Arora and Van Dyck (2025, p. 19) in their tentative suggestions for decolonizing TA call for "practising solidarity with decolonial movements that directly challenge deeply entrenched colonial relations" and for confronting all colonial relations. They thus refer to six modes of relating that Arora and Stirling (2023) outlined as constitutive of colonial modernity: assumptions of comprehensive superiority, appropriations of cultural privileges, assertion of military supremacy, enforcements of gendered domination, extension of controlling imaginations, and expansion of toxic extraction. Pansera (2025) calls for nothing less than a "fundamental reorientation of what counts as innovation and who gets to define its purposes", for "dismantling the conceptual and material architectures that bind innovation to violence", "rejecting the fiction that ethical guidelines can sanitize technologies born from occupation" and "building alternative practices rooted in Indigenous data sovereignty, demilitarized research agendas, and transnational solidarity with communities resisting techno-colonialism" (Pansera 2025, p. 4).

It is important to note for the task at hand that practically all these past and present conceptions of 'deeply sustainable technology' come not only with a disruptive impetus concerning our conceptions and expectations of technology; they also come with a diagnosis and critique of the past and present societies we live in; of late foremost what is being subsumed as the 'Global North', the 'industrialized West', 'colonial modernity' (Arora and Stirling 2023) or 'imperial modes of living' (Brand and Wissen 2021) and with alternative visions for a future along paradigms of solidarity, conviviality, radical justice and care. They draw inspiration from philosophies of multiple cultural contexts, from Asian Buddhism to Latin American conceptions of *buen vivir*. Thus, the additional question arises whether 'deep sustainability' can be an attribute of concrete technologies at all (Sharma et al. 2025), or whether the realization of such an objective is not primarily about much further reaching aspects like infrastructures, institutions, socio-political arrangements, modes of living and/or visions for life.

Contributions in this TATuP Special topic

Against this background, our call for papers for this Special topic aimed high. We invited contributions that scrutinized the feasibility of deeply sustainable technology informed by heterodox conceptions of technology and provided empirical examples; and we also asked for contributions that discussed what kind of technology or which kind of object (from technological artefact to modes of living to socio-political systems) TA should focus on in a search for 'deeply sustainable' socio-technical innovation. The turnout of submitted illustrates that the questions we raised made sense to scholars working on very diverse empirical cases.

In their empirically informed discussion of convivial care technologies, Nora Weinberger, Bettina-Johanna Krings and Dana Mahr draw on an ethics of abundance as articulated by prominent care scholars such as Puig de la Bellacasa. They focus on alternative assessment criteria such as relational richness, meaningful participation, contextual sensitivity, improvement of relational agency, inclusion, and ecological and social justice. Crucially, they advocate a 'comprehensive cultural and ethical shift' away from viewing humans as 'deficient beings' in need of technological solutions, towards accepting 'frailty, illness, and ageing as human conditions that can inspire collaboration and care', and valuing 'relational, ecological, and communal flourishing over relentless technological optimization'. To this end, they suggest smaller-scale research and development collaborations involving communities and individual users. They also see such real-world experimentation as the best site for TA.

Dorian Cavé and Rainer Rehak discuss the possibility of decolonial digital information and communication technologies. Their argument is informed by documentary research and includes a review of published case studies on the adoption of information and communications technologies (ICT) by change-oriented social collectives in rural Mexico and Europe on their own terms. Like Weinberger et al., they focus on alternative assessment criteria such as collective self-determination, human ecological impacts, extractivism, and colonialism. They advoc-

ate a paradigm shift away from 'imaginings of control influenced by coloniality in modern culture', which only benefit major commercial players and justify further resource extraction. To this end, they suggest small-scale, frugal, community-built, -controlled and -owned infrastructures. They also highlight unsolved problems within the documented cases, such as the failure to emancipate disadvantaged social groups, the failure to address broader colonial patterns, and the reliance on mainstream ICT that is intertwined with existing power structures and ideologies.

with governance approaches that lack binding mechanisms in these respects. However, they also identify some weak signals in this regard that could be leveraged to initiate deeper change. They therefore encourage TA scholars to incorporate sufficiency and justice considerations into CE frameworks, expanding their scope 'beyond impact prediction to shaping the normative orientation of innovation systems' to 'help steer the CE discourse away from incrementalism and toward genuinely transformative outcomes'.

This overall turnout also shows us that we are at the start of an exciting journey.

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Fiona McDermott also addresses ICTs, albeit from a different perspective. She discusses the application of key value indicators (KVI) to 6G mobile communication technology. With her focus on KVIs as linked to sustainable development goals, she scrutinizes options for value-led socio-technical ecosystems. Based on a literature analysis, she outlines several central challenges of such an approach, including its top-down and context insensitive nature, patterns of overpromising that result from a one-sided and incomplete group of lead actors in this context and an ignorance of possible rebound effects and lock-ins, and a lack of ex-post assessment after implementation. Against this backdrop, she calls for more bottom-up, interdisciplinary and participatory processes of valuation that consider value added, value displaced, resultant trade-offs, cultural pushbacks and societal acceptance.

A focus on sustainability goals is also central to the empirical case presented by Jorrit P. Smit, Nikola Biliskov and Marula Tsagkari. They provide a heterodox evaluation of electrochemical technologies as an alternative to fossil fuels and a means of decarbonization, drawing on Zoellick and Bisht's criteria (2018). Based on an exploratory analysis of recent publications in this field of innovation, they assess orthodox electrochemistry, discuss degrowth options and propose a 'heterodox agenda for convivial electrochemistry'. This agenda includes respect for socio-ecological constraints, democratized application, degrowth life-cycles and open innovation. They conclude that the sector's central structures must align with principles of degrowth, sufficiency and conviviality if the potential to support decarbonization is to be realized.

Like McDermott and Smit and colleagues, Ivan Kibet, Thomas Döring and Jürgen Wieser examine value-led innovation policy, specifically the implementation of circular economy (CE) strategies in the plastics sector. Their discussion is based on an analysis of the sustainability reports of twelve firms. It is informed by a deep sustainability paradigm, which implies structural change, ethical reorientation and a redefinition of socio-technical goals so as to achieve sufficiency and justice. They find that narratives of efficiency and innovation dominate, while sufficiency and justice motifs are largely absent, which aligns

Philipp Nicolas Lutz presents the case of EU regional development funding, which aims to create smart urban spaces for growth through a 'twin transition'. His critical discussion is informed by a degrowth scholarship. As McDermott's contribution, this text critically assesses the central role of techno-optimistic perspectives. Furthermore, Lutz also calls for consideration of the geopolitical ramifications of extractivism that is characteristic of this field of action. He advocates a convivial technology paradigm as a guiding principle and a public-commons partnership as an organizational means to implement it.

This overall turnout also shows us that we are at the start of an exciting journey. Each submission provides one piece of a complicated and endless puzzle, one manoeuvre in what may eventually be recognized and established as an intricate craft within our innovation systems; and one point of reference for technology assessment in what may eventually develop into a new understanding of our practices. We also see some fundamental challenges arising for TA practice and the conception of TA scholarship. Is TA mostly about technology in the conventional sense or is it rather about society at large? If TA begins to evaluate national and supranational policies by introducing alternative paradigms and normative frameworks, what democratic authority does it derive its legitimacy from?

Conclusion: What kind of technology assessment 'in imperialist ruins'?

The search for 'perfect case studies' and 'ideal interview partners' for this issue's interview section was a learning process in itself. We noticed that empirical cases tend to focus on one or a few, but almost never all, facets of what a convivial future could be made of, such as the ecological, justice or geopolitical aspects. There are no such things as 'ideal' or 'perfect' in this context. When it comes to showcasing TA, one might expect success stories and promising proofs of concept that can be transferred and 'upscaled', but that would be misleading here.

Tsing (2015, p. 37) seems to react to similar expectations when proposing "to listen to and tell a rush of stories" as a method or even as a science, but noting that, then, "we have a problem with scale. A rush of stories cannot be neatly summed up. [. . .] Arts of noticing are considered archaic because they are unable to 'scale up' in this way". They might also be considered as useless by political decision makers expecting 'hard evidence'. Laurent and Violle (2025, p. 423) likewise identify "tensions related to both the scalability objective and the kind of territory where experiments are conducted and where they are expected to be upscaled." Rendering these local experiments denser instead of bigger, they call 'deep-scaling', "best described as the ability to go deeper

calls for a TA that addresses the 'big questions', "such as, e.g., the role of the growth paradigm and expectations of technological progress" (Grunwald 2018, p. 1862). However, as with social movements and expert activism, *the position of TA towards socio-political critique is unclear and requires further elaboration.* For example, how can TA established as an advisory unit at a parliament, process such critique in a functional way? Is there room for a multiplicity of different TAs? Or should TA take a, e.g. hermeneutic, back seat instead? In this respect, it might help to open up TA's black box of 'technology' and 'innovation' once again, including its fetish with high-tech (see also the interview with Mario Pansera in this issue).

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into a given territory by multiplying the numbers of economic actors, the possibilities of use, and the connections between producers, transporters, and users" (Laurent and Violle 2025, p. 437). There is at least one proposal we can get out of this for TA: *Maybe we should not be looking only for up-scalable evidence, but also for (networks of) deep-scale stories; maybe we should elaborate ways of how to render troubled stories about struggles for conviviality meaningful for policy and society at large.*

Another option for scaling up impact without simultaneously scaling up a problematic capitalist innovation rationale lies in eco-social movements and their contagiously convivial character. For instance, care is not something we would consider scalable, but rather a socio-political motif that is currently spreading; do-it-yourself (DIY) is also a movement, and a very important one at that. Both are strongly featured in the contributions to this Special topic. However, the relationship between institutionalized TA and socio-political movements and activism is, at best, ambivalent. While DIY communities are analyzed and expert-activists are interviewed, the participation of civil society is organized in a way that implicitly upholds a distance or even an asymmetry of power and agency. Admittedly, TA's engagement in 'real-world laboratories' ('Reallabore' in the German speaking contexts) establishes a tentative direct connection to a DIY paradigm. *Further scrutiny and elaboration of this relationship would be helpful for the sake of TA's contribution to convivial futures.* Arora and Van Dyck (2025) even advocate for 'radical care' as a form of solidarity with decolonial movements, to avoid the risk of 'remaining a civilizing instrument of colonial modernity'.

The critical socio-political diagnosis of Arora and Van Dyck (2025) resonates with Grunwald's (2018) acknowledgement that the system as a whole may not be environmentally compatible. "In that case", Grunwald concludes, "TA would only contribute towards stabilizing a system that as such is not worthwhile to be stabilized", "thus delay[ing] or even prevent[ing] altogether the fundamentally necessary correction of the system". He therefore

Last but not least, how can Eurocentric TA learn from other approaches and knowledge systems, such as traditional ecological knowledge? An emerging practice, network and discussion of global TA is certainly making important first steps in this respect (see conference report in this issue). However, a long road lies ahead when it comes to *processing pluriversal ontologies, normative standards and socio-political expectations and addressing established power asymmetries and mechanisms of injustice and othering.*

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