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RESPONSIBLE INNOVATION IN AND FOR PEDS

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1. INTRODUCTION

Innovation has to be both problem-solving and social-ecologically responsible. The framework at hand addresses stakeholders directly involved in the development of PEDs and outlines options for critically questioning, reflecting and sharing their experiences with PED development. It, thus, aims to help guide the development of PEDs in a socially and ecologically responsible way. Given the risks, uncertainties and unintended side-effects such as rebound effects[1] that come with ambitious technological innovation, it is essential for PED practitioners to engage with potential social-ecological consequences of their undertaking. Responsible innovation means being aware of the possibility of such (unwanted) side-effects and systematically taking them into account in the development of PEDs. In particular, before replicating or upscaling solutions, potential social and ecological side-effects and risks need to be addressed, as well as uncertainties drawn attention to. Depending on whether projects are set up as real-world experiments or learning environments from the onset, or as regular city development projects, they may reflect on potential side-effects, path-dependencies, lock-ins and other problems to a stronger or lesser degree. However, given the inherently experimental nature of PEDs, it is not only desirable but necessary that learnings are being transferred to newly emerging PEDs in order to avoid the replication of problems at different PED sites.

This framework aims to spread the word about means to incorporate reflective learning, which is essential to responsible innovation in PED development processes, which can overall contribute to a responsible energy transition. It does not provide a rigid scheme of how responsible innovation should be organised in PEDs, but rather serves as a flexible and adaptable guideline to encourage the increased integration of "moments of reflection" in order to foster second-order learning in ongoing urban development processes. Extracting lessons learnt that can inform policy-makers, city planners, PED developers, etc. based on first-hand experiences of implementing ambitious socio-technical solutions in PED contexts is at the core of this framework. This text is based on a more extensive TRANS-PED report (c.f. T4.1. Report on Responsible Innovation in PEDs) on responsible innovation for Positive Energy Districts (PEDs). In the background report, key aspects of responsible innovation are covered in detail and contextualised with PEDs. The RI Framework at hand represents a summary that was informed by practitioners in the TRANS-PED project, and is primarily targeted at the following groups:

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[1]   A rebound effect is described as "the social and behavioural response to the introduction of more energy efficiency technologies and processes by which there is a corresponding increase in energy service demands" Ehrhardt-Martinez and Laitner (2010). On distinguishes between direct and indirect rebound effects. An example for an indirect rebound effect is that due to improved housing insulation or the usage of e-mobility, people may feel inclined to engage in environmentally harmful behaviour, e.g., travel by plane several times a year.

1. **Practitioners:** Social actors who plan and develop PEDs. These are, for example city coordinators, local policy-makers, planners, architects, energy engineers, investors, etc.

2. **Policy-makers:** Social actors involved in setting policy frameworks for PEDs and the public promotion of such processes. These are, for example, decision-makers and administrative units at the national or supranational level (or even at the local level if they are not directly involved in the development of a specific PED), but also research funding bodies and networks for the promotion of climate-neutral cities.

3. **Stakeholders:** Social actors who are affected by PED developments. For example, people who live or work in a PED independently of whether they actively participate in its development or not.

4. **PED intermediaries:** And finally this framework addresses actors whose primary task is to mediate between the above-mentioned social actors. For example, organisations that facilitate participation processes and promote local discourses and learning processes.

Box 1: Target groups of this framework

PED practitioners, policy makers, stakeholders and intermediaries may be interested in making learning and reflection more intentional, regular and method-supported for the following reasons:

1. the **knowledge gained can be useful for the further development of their own PED** (or similar: can be used in a follow-up project at a different site);

2. the **knowledge can be shared with other/future** PEDs (e.g., in discussions, at site-visits, workshops but also in a written format, e.g., on websites, etc.);

3. the **knowledge can inform policy-makers or the general public** and thus contribute to the decarbonisation of the energy system (e.g., lessons learnt as a form of agenda-setting and input for more in-depth investigations).

This framework highlights the connection between responsible innovation and learning, in particular second-order learning. This involves the ability to question decisions made and solutions found in an innovation process in a fundamental way. Responsible innovation can be supported by different approaches, which vary in their degree of rigour and formalisation. The framework zooms into three approaches: responsible research and innovation (RRI), real-world experiments and "moments of reflection". In order for second-order learning for responsible innovation to work, different stakeholders with assigned roles and competences need to interact and capacities need to be built to enable this interaction. We stress that learning ought to be understood as a process in which experiences are gradually becoming condensed into knowledge. Lastly, it is of central importance for the further development of PEDs that results of critical reflection are shared within the wider PED community and that structures and resources by funding bodies, etc. are available to support this endeavour.

2. RESPONSIBLE INNOVATION AND SECOND-ORDER LEARNING

Learning processes are crucial for the development of new energy systems in and for PEDs. Connected, it is important to bear in mind that there are (at least) three types of learning. Learning processes may be related to the effectiveness and efficiency of measures. Here, the main focus is on understanding and improving existing systems (i.e., "doing things better", c.f. Sterling, 2011). This type of learning is referred to in the literature as first-order learning (c.f. Bateson, 1972 in Sterling 2011). Important approaches and methods for this kind of learning are qualitative and quantitative indicators (KPIs), evaluation programmes, technical monitoring, user surveys or other scientific studies. However, learning processes can also relate to issues that go beyond predefined goals and address broader societal implications that cannot simply be changed through optimisation measures, but are directly linked to the chosen solution. Here, the focus is on different pathways and their respective implications (i.e., "doing better things", c.f. Sterling, 2011). In this type of learning, fundamental underlying assumptions are questioned and, if necessary, also changed. This type is referred to in the literature as second-order learning (c.f. Bateson, 1972 in Sterling 2011). Finally, learning may refer to even more far-reaching changes and radically question widely accepted assumptions. In this case, we speak of third-order or epistemic learning. Learning in this case aims at transformative change (i.e., "seeing things differently", c.f. Sterling 2011). The development of a concept like PEDs is based on such fundamental learning processes, which have recognised that climate change is causally linked to the burning of fossil fuels, and hence a profound change of energy sources is required to avert the worst consequences of the climate crisis.

For responsible innovation processes, it is particularly important to enable second-order learning in the PED context. Hence, second-order learning allows for reflection that purposefully targets potential side-effects and potential risks of innovation. Given that, it represents an essential prerequisite for responsible innovation, as it addresses issues that go well beyond the mere functioning of solutions. The following questions shed light on the type of enquiry that is relevant to generating second-order learnings on social-ecological and technological aspects of PED development, and thus avoiding, e.g., the replication of problematic solutions, and to take into consideration risks and unintended side-effects when discussing a technological option in the PED context.

- What unintended side-effects have emerged or could emerge based on similar examples?

- What are the possible longer-term consequences of the implemented energy solution?

- What risks could be potentially connected to the solution without having been observed yet?

- Can this solution be widely disseminated and replicated in its current form, or is further development and/or research on it required?

- Is there a risk that the measures taken lead to rebound effects? And how could they be avoided?

- Which alternative solutions were on the table? Which could/should have been chosen instead?

- Does the currently chosen solution/preferred option avoid unnecessary risks, unsustainable path-dependencies and has engaged with potential rebound effects?

Box 2: Question set to inform second-order learning in PEDs

2.1. APPROACHES TO SUPPORTING RESPONSIBLE INNOVATION

Responsible innovation and second-order learning can be supported through different approaches. Three such approaches are presented in more detail below. (1) Responsible Research and Innovation (RRI), a comprehensive approach primarily developed for European research projects, (2) real-world experiments or experimental designs, which have emerged from the Technology Assessment and Sustainability Transitions discourse, and (3) "moments of reflection", an idea that primarily aims at stimulating selective second-order learning processes, but is more easily implemented and can be used in situations where reflective learning was not intended from the onset.

2.1.1. RESPONSIBLE RESEARCH AND INNOVATION (RRI)

RRI is aimed at promoting research and development processes that involve a high degree of societal responsibility, ideally involving the inclusion of a variety of stakeholders in decision-making, anticipation of risks and reflection on the impacts of solutions (c.f. e.g., Stilgoe et al. 2013). One approach to RRI rooted in EU policy contexts and values and proposed by von Schomberg (2014) foregrounds the importance of "a transparent, interactive process by which societal actors and innovators become mutually responsive to each other with a view to the (ethical) acceptability, sustainability and societal desirability of the innovation process [...] in order to allow a proper embedding of scientific and technological advances in our society" (2014, p. 39). Hence, the aim is for innovations to be shaped in a manner that they serve overarching societal goals. This is to be supported by a set of principles such as anticipation, reflexivity, inclusion and responsiveness, which are to be integrated into research and innovation practices (Stilgoe et al., 2013). In the RRI approach, "[a]n innovation [...] is morally acceptable only if it aims at solving a societal problem, without creating new problems, or exacerbating existing problems" (van den Hoven, 2022, p. 135). Consequently, RRI demands to place societal values – sometimes related to future generations and connected to the so-called "grand challenges" – at the core of research and innovation projects. Hence, RRI both aims at preventing potential (negative) impacts of emergent innovation and research through processes of reflexion (including risks and uncertainty), principle-guided design and the inclusion of transdisciplinary knowledge (including descriptive, speculative, experiental, evidence-based and both tacit and explicit forms of knowledge). Additionally, RRI refers to a bundle of policy targets that are aimed to be addressed through responsible innovation and research practices.

Yet, a major weakness of RRI so far has been the translation of the academic and policy discourse on responsibility in research and innovation into concrete practices, structures and institutions enabling these (de Saille, 2015b). At times, RRI ends up being little more than a formalised box-ticking activity (Technopolis, 2017, p. 44). A few methods have been developed specifically for the implementation of RRI, yet, they have often taken the form of questionnaires as illustrated by the RRI Tools self-reflection tool (RRI Tools). The comparatively high bureaucratic effort connected to RRI tools often renders RRI unattractive for projects that do not contain RRI elements/requirements from the onset, which could also present a hindrance for PEDs to operate under an RRI frame. Over the years, while having contributed to foregrounding the importance of responsibility when researching and innovating, RRI has received criticism for several reasons: the relative uncertainty about the effectiveness of RRI regarding enhanced public involvement; RRI's often techno-economic orientation with attention being drawn to capital-oriented rather than livelihood-oriented innovations; the reduction of innovation to technological innovation, and the uncritical embrace of economic growth as a core societal goal despite ample evidence for its correlation with social-ecological destruction. However, according to de Saille (2022), "[all] that should not stop us from also anticipating the possibilities of an RRI which is no longer an agenda whose legitimacy is derived from a political entity whose mantra is 'innovation for growth'". While bureaucracy can be expected to be attached to practising RRI, it is nevertheless advisable for PEDs to consider conducting a research project under the RRI frame – in particular if there is funding and a fitting research context.

2.1.2. REAL-WORLD EXPERIMENTS

A second way to institutionalise responsibility and learning is to plan PEDs as real-world experiments from the beginning. Due to transformative urban development being a comprehensive and complex task, including multiple perspectives across a variety of actors, experimental settings can allow for a fitting learning environment that meaningfully addresses risks and uncertainties attached to the realisation of a PED. Hence, whether there is a higher likelihood for learning to occur in a PED context may be determined by whether a PED is conceived of and designed as an experiment vs. a regular city development project (c.f. Magnusson & Rohracher, 2022 for a PED process typology). When setting up a PED as an experiment, it can be useful to accompany it with an evaluative scheme for sustainability transition experiments such as the one developed by Luederitz et al. (2017), which due to its "generic, comprehensive, operational and formative" (ibid., p. 61) nature aims to be applicable to a wide range of practical cases. Previously, this scheme has also been adapted to identify gaps and problems in a failed urban development project, and thus generate learnings in regard to social, ecological and technological aspects of PED innovation for future similar endeavours. Most cases studied in the context of TRANS-PED occur as parts of urban development, and are not primarily framed as real-world experiments, or per se as learning environments. This stands in contrast to the case of Hammarby Sjöstad 2.0, which frames itself as a testbed (About Us: Hammarby Sjöstad 2.0.). As a result, core to the project and embedded in its structure, is to learn, test and improve. Notably, the citizens of Hammarby as part of the citizens initiative EletriCity have developed a critical attitude towards initial developments in Hammarby, and have as a result, overcome former lock-ins such as the switch from fossil-powered district heating to heat pumps, and the plan to realise an energy community.

There are numerous ways in which real-world experiments can be set up and structured (c.f. Rose et al., 2022), including urban experimentation, urban living labs (ULLs), niche experiments, bounded socio-technical experiments (BSTE), grassroots experiments, and transition experiments (Sengers et al., 2019). The approaches share that they involve a large variety of stakeholders, and emerge around and/or as a result of a problem (c.f. T4.1. Report on Responsible Innovation in PEDs). However, they may emerge from different governance contexts, e.g., municipalities may launch an experiment to enhance citizen participation in finding solutions to pressing social-ecological challenges (urban experimentation); other times, private actors may initiate an experiment that allows for the testing and improving of an innovation (e.g., niche experiments). Purposes of experiments may differ, even for one type of approach. Yet, what is key to experiments is the possibility of failure, the involvement of a range of actors and thus knowledges, and the documentation of gained insights for improvement of a situation or technology. Thus, there is an inherent openness towards learning, and documenting knowledge that then informs further decision-making.

2.1.3. MOMENTS OF REFLECTION

A more low-key way to engage with responsible innovation is to create settings that allow for reflection, "or at least, to introduce reflexive moments" (Rip, 2016, p. 295). Ideally, responsibility should manifest in "creating time for uneasy questions, vulnerable experiences, and uncertainty" (Steen, 2021, p. 256). One type of such moment could be so-called "bridging events" (Garud & Ahlstrom, 1997), which bring together actors that have different roles and identify with the discussed socio-technical solution to different degrees. All target groups of the framework as mentioned in the introduction have a role to play in such moments of reflection. In order to allow for meaningful exchange between stakeholders, it has been stressed in the literature that "safe discussion arenas" that balance out different levels of information ought to be established (De Bakker et al., 2014) and professionally facilitated and evaluated (Gemen et al., 2015). Further, clarity for the non-expert stakeholders on how their contributions will be used is essential to endow their contributions with meaning beyond legitimacy gains for a project (de Saille, 2015a). A method reminiscent of moments of reflection is the so-called "Emancipatory Boundary Critique" (Pohl, 2020). It consists of a set of questions that "empower[s] non-experts to uncover normative assumptions underlying an expert's solution to a problem", and allows to draw attention to social and ecological concerns (Pohl, 2020). It can, thus, help to uncover invisible underlying motivations, power imbalances and sources of knowledge in decision-making processes as well as means of legitimation.

There are different contexts in which moments of reflection may emerge, yet in general have to be well-timed in order to turn out meaningful: out of necessity (if a problem occurred or a solution needs to be found), moments of external evaluation, e.g., certification (bringing gaps or learnings to the surface), regular meetings (an option perhaps more typical of PEDs that are set up as real-world experiments), before large decisions are being made that potentially have long-term consequences. "Moments of reflection" may also occur coupled with social-ecological assessment methods that bring to the surface insufficiencies such as life-cycle assessments, and socio-economic assessments connected to owner costs vs. user costs, and ecological economic concerns such as first cost analysis vs. life-cost analysis.

Problems with "moments of reflection" may be that a tight project timeline, political or economic interests, or identification with a solution prevent critical engagement with a solution and require a person or structure that ensures reflection does not remain a one-off bureaucratic box ticked, but a process taken seriously and enacted regularly or at least repeatedly. Rather than organising a "series of events", the aim is to institutionalise an ongoing dialogue (Schuijff & Dijkstra, 2020).

This way of bringing reflection into PED development processes is comparatively spontaneous, flexible and effortless, and turned out to be the preferred option to reflect in TRANS-PED, given that none of the project partners applied RRI frameworks, and only one project partner considered themselves a real-world experiment.

SECOND-ORDER LEARNING IN THE TRANS-PED PROJECT

Second-order learning can lead to realisations in PEDs that can influence the further development of a PED, processes within an existing PED and/or its governance, or generate information that can be passed on to other PED development projects and prevent or reduce the possibility of the repetition of socially or ecologically undesirable outcomes. In the following, we will illustrate which insights may emerge from a second-order learning process. The results are primarily based on second-order learning conversations that were facilitated during a project meeting in September 2022 (PED-Lab Austria). Additionally, information was retrieved from the interviews conducted earlier in 2022 with representatives of each of the 5 PEDs that are part of the TRANS-PED project. For the case of Hammarby, additional sources (such as the project website and scientific literature) were added.

In the workshop, a total of ten second-order learning conversations took place, which each lasting for approximately one hour in two rounds. One or two insiders, one critical outsider and one notetaker were part of each conversation. In the second round, the roles were partly changed, and new participants joined the conversations. The topics of the conversations had been previously identified through interviews and during PED-Labs (i.e. site visits of the PEDs). The insiders had prepared inputs for the workshop, and there were clear instructions on how to conduct the conversations, with suggested questions and role definitions. The conversations were documented and analysed. The insights gained from these conversations varied. In some cases only tentative questions were raised, in others well argued lessons could be formulated. Three examples are summarised below.

The example of **Hammarby Sjöstad** (Sweden) shows that neighbourhoods can be redirected towards a PED development even after an unsuccessful first attempt, involving green gentrification and unsatisfactory energy solutions. Key for the success of Hammarby 2.0 has been the creation of a lively PED community based on local citizen engagement, including regular energy meetings, workshops with experts, school education, and multimedia information material.

The example of **Sonnendorf** (Austria) reveals the intertwinement of energy solutions with social, political and economic preconditions. In Sonnendorf, a more sustainable energy solution (a local anergy network) could not be realised due to the lack of a fitting non-profit operating unit (public or private). Instead, each house was equipped with its own geothermal probe.

The example of **Brunnshög** (Sweden) provides an insight into the repercussions of the private ownership of public infrastructure on future-oriented city planning. There, master-planning by technological infrastructure competes there against liveable streets. Given different pipe owners' accessibility needs, streets become wider and reduce options for green space. Ideally, independent mediators could facilitate between the city and the pipe owners, or legal requirements could better protect green spaces.

3. SECOND-ORDER LEARNING IN PEDS: ACTORS, CONSTELLATIONS AND IDENTITY

Each PED-development process inevitably involves a broad variety of stakeholders, which can pose certain challenges regarding communication, visions and interests, yet a diversity of knowledges (tacit, explicit, experiential, evidence-based, speculative, situational, etc.) and/or competences appears to be a precondition to all types of learning. However, it is important to carefully facilitate the exchange in a constructive manner that can give rise to second-order learnings. Given this starting point, we have found that a basic arrangement of roles for second-order learning requires an "insider", i.e., someone who has a large degree of knowledge about a solution and (likely) identifies with it, an "outsider" who critically but constructively engages with a solution, challenges it and broadens the horizons to think about alternative pathways, and finally, a neutral facilitator, who feels responsible for bringing together different parties and to facilitate the exchange, which we may call a „triangle for second-order learning". While constellations might be larger, or more complex, we regard this basic constellation as a functional point of departure, and have tested it as part of our "second-order learning conversations" method (c.f. Box 2). Since "insiders" will have the tendency to defend a chosen solution, "outsiders" represent the starting point for reflective learning by challenging commonly held assumptions, and creating mental space for the discussion of alternatives. There may be a dedicated person, e.g., a so-called "monitor", i.e., a person who closely observes a project, and intervenes at critical points in the project to raise questions or open up discussions about unresolved issues in the project that may also remain unclear to the project manager and participants (van Mierlo et al., 2010). Different actors will bring to the table different competencies (e.g., fine memory, critical thinking skills, analytical approach, holistic perspective, specialised knowledge, tacit knowledge, practical experiences, etc.), and thus contribute to overall capacity-building within a PED development project.
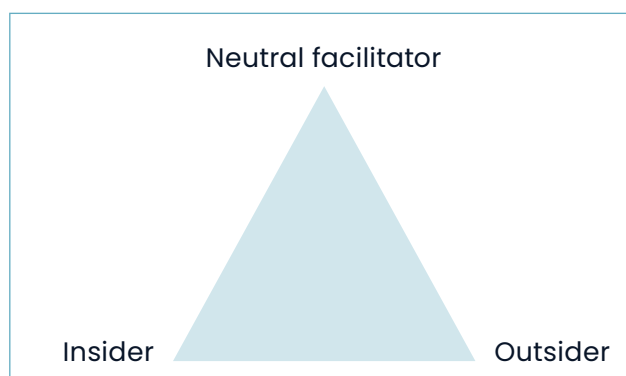

Figure 1: Triangle for Reflective Learning

4. CAPACITY-BUILDING FOR SECOND-ORDER LEARNING

In the literature on education, capacity-building has been interpreted mainly along two lines, one referring to "readiness" for change (Harris, 2011, p. 627), the other referring to learning and associated concepts such as "learning communities" for profound societal shifts (Mitchell & Sackney, 2011). This term, emerging from education science, we borrow to refer to constellations of actors that – when in structured interaction with each other – have the potential to generate second-order learnings. Related concepts are "communities of practice" and "situated learning" (Wenger, 2003). Capacity-building is collaborative in that it relies on "collective responsibility where professionals are working together to improve practice through mutual support, mutual accountability and mutual challenge" (Harris, 2011, p. 627). Capacity refers to the development of skills and resources, but also to the development of structures that allow for second-order learning and dissemination for responsible urban innovation. Power imbalances between the actors involved can hinder or even prevent learning processes. Capacity-building for promoting second-order learning should therefore aim to identify and mitigate such inequalities between different stakeholders. These inequalities may relate to the endowment with resources, including decision-making power and access to information, and may be intensified through inaccessible language and formats in the planning process (c.f. Confluences & Vrije Universiteit Brussel, 2022). While second-order learning may be collectively desired, it may also result in resistance of some participants who might perceive that they are being experimented on. For this, discussion arenas and conflict resultion schemes might be of help to navigate different perspectives and needs that occur during the learning process in a constructive manner. Structures that enable second-order learning may include changes in policy-making such as cross-departmental collaboration in city planning endeavours, or may simply involve regular formats in which citizens can connect and discuss next steps for their PED initative (e.g., such as is the case in Hammarby Sjöstad 2.0.). Yet, in order for this to work, it is of utmost importance that roles and responsibilities connected to second-order learning are clearly assigned within PED developments, i.e., including the endowment with resources of whichever person, group, or structure is responsible for initiating second-order learning processes. These might be so-called "monitors" (c.f. above), intermediaries (c.f. introduction), researchers (c.f. Box 2), or initiatives within PEDs such as ElectriCity in the case of Hammarby Sjöstad 2.0. These may acquire research projects, invite guests (including future PED developers), manage communication, facilitate meetings and coordinate the recording, processing and potentially dissemination of learnings. In the case of Graz Reininghaus, Stadtlabor (an innovation lab for collective sustainable city development) may be considered as the faciliator for second-order learning.

5. SECOND-ORDER LEARNING IS A PROCESS

Both RRI and experimentation have in common the process dimension, i.e., learning is not described as a singular event, but rather as a long-term project that may occur in loops of action-reflection-adaptation (such as described in organisational learning), or involve initial meetings that then result in larger follow-up projects (such as described for collaborative learning) (van Mierlo & Beers, 2020). This is reminiscent of the approach of "experiential learning" (a prominent approach in innovation literature), which is defined as "a continuous process of learning through experience with experience being transformed into knowledge" (Timmermans et al., 2020, p. 417 with a reference to Moon, 2013). Thus, it is crucial not to view singular reflection events, or a one-off "moment of reflection" as a complete means of generating second-order learning, but rather to plan, intervene, spontaneously halt and reflect, document, record, and integrate learnings on social-ecological as well as technological implications of certain energy solutions that can then be bundled into "lessons learnt" that can be passed on to other PED projects.

6. STRUCTURES TO SUPPORT RESPONSIBLE INNOVATION IN PEDS

Responsible innovation within PEDs does not only require structures and processes within PED initiatives, but is particularly dependent on networking, mutual learning and the joint consolidation of knowledge about risks and wider implications. The growing community of PED practitioners in Europe provides an excellent basis to advance the PED concept and to test and evaluate promising socio-technical solutions. Intensive exchange of knowledge, also and in particular about findings from second-order learning processes, offers an important basis for such a development. This allows potential risks and unintended side-effects to be identified at an early stage and positive and negative implications to be better anticipated and assessed.

6.1. RI IN RESEARCH PROGRAMMES AND PROJECTS

RI and second-order learning could be emphasised to a greater extent in the calls for tender for PED research projects. Critical reflection and second-order learning need different expertise, precise identification of roles and additional resources that need to be made available. Since funding bodies have a tendency to prioritise positive results, and thus give preference to self-presentation over self-reflection (Regeer et al., 2016). As a result, failed attempts, arising problems and unfulfilled intentions – as there are plenty expected in energy-related developments – are likely to remain undocumented and unshared. Consequently, it may be advisable for funding bodies to set up research programmes in a manner that a) provides specific funding for reflective activities as part of a research project, as well as for the dissemination of emerged learnings in order to render the uncomfortable work of critical self-reflection an integral part of any research endeavour; and to b) provide resources for the inclusion of critical outsiders in a project, or the creation of a "board for internal reflection". This board could consist of researchers, social movements, future inhabitants and potentially specialists from the private sector, who, however, do not hold any stake or do not have any financial interests in the given project. This would allow for reflective learning to become a core aspect of evaluation by funding bodies, and can help counteract losing valuable knowledge (about gaps, further requirements, failed attempts) that can be passed on to connected projects, and may in return inform the funding body about needs and challenges in a specific research community.

6.2. SECOND-ORDER LEARNING AT CONFERENCES, IN WORKSHOPS AND COALITIONS

Reflective knowledge that has been developed locally needs to be disseminated and made available to the PED community in order to avoid the repetition of mistakes or systemic lock-ins. Ideally, a learning process should not end once a project has been finalised, but structures for the exchange of learnings beyond are central. These structures may include conferences and workshops that focus on risks and unintended side-effects of PED developments. An accessible format that allowed for the engagement with city planning failures was the "Fuck Up Night" organised at the Urban Futures 2022 Conference in Helsingborg. Similar formats could allow for the sharing of learnings in a manner that does not stigmatise (partially) failed attempts at PED creation. Alternatively, alliances, coalitions or other collective projects that foster second-order learning and the dissemination of knowledge could present a promising way forward. These coalitions may also become facilitators of site visits, learning journeys, field trips and other forms of face-to-face exchanges where learnings can be directly transmitted. This will allow groups involved in new PED development to enquire specifically about issues that apply to their specific contexts, and which may involve responses based on tacit knowledge by locals that has not been previously documented.

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6.3. CRITICAL REFLECTION AS A TOPIC IN GOOD-PRACTICE COLLECTIONS AND DATABASES

Another way to intensify the exchange on reflective knowledge is to include relevant categories in PED databases, e.g., the JPI Urban Europe database. In addition to categories such as "success factors" or "barriers", insights from second-order learning processes, for example about concept-related path dependencies or unintended social-ecological consequences should also be included. These databases could also benefit from being extended to include detailed background information on PEDs in an accessible, bundled manner in order to enable PED practitioners to easily identify cases that are similar to theirs. Similarly, contact details of people who are open to sharing knowledge about their PED, in particular if they were involved in planning and/or decision-making, would represent a useful addition to databases.

7. CONCLUSION

This framework is intended to contribute to greater reflection of the experiences with innovation processes in PEDs. In order to achieve their ambitiously set targets, PEDs are inevitably engaging with new technical and societal risks. It is crucial that lessons are learnt and fed back into further PED developments in order to avoid the repetition of failures (such as the implementation of problematic solutions), and continuation of path-dependencies in times of multiple overlapping crises. We have focused on second-order learning because this mode of learning is, in our view, a key foundation for responsible innovation and can be integrated as a methodological element in the various forms of PEDs. PEDs that are designed as real-world experiments or learning environments from the beginning or that have already implemented an RRI concept can use this framework to improve their reflexion processes. PEDs without a dedicated learning concept may aim to integrate deliberate "moments of reflection" into their activities. In order not to leave the responsibility merely with PED practitioners to generate, document and disseminate learnings on social and ecological matters in regard to PED development, it is essential that funding bodies provide the necessary resources to make the engagement with reflective learning integral to funding requirements. Overall, this RI framework has been designed to support and enhance societal learning in and about PEDs, and thus contribute to capacity-building for urgent urban energy transitions, and thus also raise the ambitions of regular urban development.

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More information on Responsible Innovation

For more information on this topic, see the reports on the Trans-PED website.

All about the Trans-PED project

Check out the Trans-PED website for details on the project, the international consortium of partners, as well as the participating PEDs.

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