SIAMESE Working Paper 1

Transformative Experiments: Getting the phenomenon right

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Introduction: What is an experiment?

In common parlance, an experiment is a (daring) trial – a process whose outcome is uncertain due to a multitude of unpredictable parameters (Merriam-Webster Online Dictionary, 2022). The experiment is typically associated with science, where it is considered the most original of all empirical methods (Kelterborn, 1994). It represents a systematic test setup in which the interaction of a (highly restricted) number of variables is provoked and knowledge is gained from the observation of the subsequent reaction (ibid.). Beyond this strictly scientific interpretation, however, **experimental approaches also have a long tradition in social science** (e.g., experiments in behavioral economics) and in transdisciplinary practice (e.g., experimental policy development) (Huitema et al., 2018).

In recent years, experiments and labs[1] have received a lot of attention in transition studies and **transdisciplinary transformative research**. Here, the experiment constitutes a central research method. In the tradition of action research, researchers and other social actors jointly dedicate themselves to the object of investigation in order to fathom it (J. Wittmayer & Hölscher, 2017). This includes both **real-world experiments**, in which new things are tested in real social environments (e.g., temporary roadblocks for measures of co-creating livable public space), and **controlled experiments**, which are implemented in limited experimental environments (e.g., investigating the effects of different energy pricing models on the behavior of selected private households) (see, among others, Wanner et al., 2018, Schäpke et al., 2017). Hence, the experiment is aimed at *"[...] providing proofs of principle. The knowledge and experiences gained through experiments could subsequently become widely applied and relevant for general societal development through various up-scaling mechanisms."*

This is what discerns real-life experiments from scientific experiments: *"[T]hey should be understood as trial and testing processes of novel institutional arrangements to govern urban systems."* (Fastenrath & Coenen, 2021, p. 140) Such experimental approaches are an expression of a *"politics of experimentation"* (Bulkeley et al., 2016, p. 14) that is gaining in importance. In urban planning in particular, they have reached the status of hopefuls for transformative change and are thus experiencing an enormous upswing (Huitema et al., 2018; Schneidewind & Scheck, 2013). We thus refer to experiments as a mode of sustainability governance that has abandoned *"the modernist dream of total control [... in favor of a ...] more provisional, adaptive understanding of the city [as] an emergent and heterogeneous assemblage."* (Evans et al., 2016a, p. 429) While this forms a useful

[1] The terms *experiment* and *lab* are often used interchangeably. While the literature offers different approaches to differentiate or integrate the two terms, we follow McCrory et al. (2020), who define experiments as a specific method *within* labs. However, as Bulkeley et al. (2019) state, labs can range from protected arenas set up in the course of transformative research endeavors as well as real-world urban development processes. In SIAMESE, we focus experiments, although some processes and initiatives transcend the boundaries between the two.

working definition, it does not relieve us of briefly outlining those concepts and characteristics associated with experimentation that we consider essential for our research in SIAMESE. We'll thus summarize five major experiment-concepts below that we take into account in our own study:

- **Real-world experiments** is an umbrella term used in different social science contexts to signify the difference to experiments in the natural and engineering sciences (Schneidewind & Scheck, 2013). However, the term has experienced a particular revival in the context of sustainability research and an increasing political debate about Grand Challenges such as climate change. In its simplest, real-world experiments use the city as an experimental space or lab to develop and test solutions for societal problems *in situ* (Evans et al., 2016b; Schneidewind & Scheck, 2013).
- The term **climate change experiment** is first introduced by Castan Broto and Bulkeley (2013) to describe a visibly experimental mode of urban climate change governance in cities. Arguing from a politics and governance perspective, climate change experiments are presented by the authors as interventions that try out new ideas and methods in the context of future uncertainties. They serve to understand how interventions work in practice and in new contexts, where they are thought of as innovative (ibid.).
- **Bounded socio-technical experiments** (BSTE) is a concept stemming from the transition studies discourse. Such experiments aim to test alternative socio-technical solutions in small protected and bounded niches, e.g., testing novel e-mobility solutions in a peripheral region, to learn if and how they could be scaled to support system change (Sengers et al., 2019; Seyfang & Haxeltine, 2012).
- **Transition experiments** have a similar conceptual background, although they are not confined to protected niches, but aimed at sustainability transitions at the city-regional and (smaller) community scale, .e.g., the realization of a citizen-financed solar power plant. Hence, they are critical for societal transformations (Forrest & Wiek, 2015).
- Finally, grassroots innovations or **grassroots experiments** are community-led initiatives that put bottom-up solutions for sustainable development into practice. Herewith, they differ from the above types of experiments in that they are civil society driven and sometimes activist forms of experimentation (Sengers et al., 2019; Seyfang & Haxeltine, 2012).

Characteristics of experimentation

Experiments are **place-based** (Eneqvist & Karvonen, 2021), meaning they are being conceptualized in reaction to Grand Challenges and their local societal implications, respectively societal challenges specific to that place. Moreover, experimentation is a **practice-oriented** form of governance intervention, meaning they are not just being devised to *react to* but also to *interact with* place-based challenges by taking action and implementing potential solutions in real-life (Sengers et al., 2019). This is closely related to the **co-creative** nature of experiments (Wirth et al., 2019), i.e., the inclusion of a broad and fluctuating variety of stake-, knowledge-, share- and interest-holders (Schmitter, 2002) into the common design and trial of potential solutions. The **novelty** of the intervention, i.e., trying out something that hasn't been tried out (at least) in that locale or to tackle that specific challenge is also a valuable criterion (Wanner et al., 2021). Another one is the intervention's **radicality** in terms of its deviation from and challenge or provocation of established modes of governance, rules and regulations, frames, narratives and imaginaries, existing networks and power geometries, or modes of resource distribution and access to resources (Sengers et al., 2019; Torrens & Wirth, 2021).

Regarding the process of experimentation, its **iterative**, non-linear and thus seemingly "chaotic" character, i.e., the constantly changing nature of participation, modes of interaction, or goals to be achieved is a key attribute (Torrens et al., 2021; Wanner et al., 2021). Hence, experiments are also referred to as a way of "reflection in action" (Torrens & Wirth, 2021). This is directly related to the **uncertainty** of outcomes. The acceptance of **failure** and learning by failing are significant scenarios when conceptualizing experiments (Fuenfschilling et al., 2019) as opposed to formalized modes of planning. Part of the reason for why failure is an option is the **open-ended** character of experiments in terms of their envisioned outcome, impact and longevity (Raven et al., 2019) – again, as opposed to established forms of planning that are typically envisioning end-states with sustained lifespans. That said, many experiments are **a priori limited** in terms of time and scope (Wirth et al., 2019), often leaving observers with the "What if" question after these initiatives have ended ever so abruptly.

Learning thus can't be overemphasized as a key outcome and a major reason for why the implementation of such risky endeavors is considered valuable at all (Wanner et al., 2021). Sengers et al. (2019) make an important differentiation in that regard by distinguishing 3 types of learning from experiments: (1) deepening, i.e., learning from the study of the conditions of experiments, (2) broadening, i.e., learning from the study of related experiments, and (3) scaling up, i.e., learning about regime change and broader developments, where experiments played a role.

From experimentation to transformation

The insufficient breadth and directionality of innovation policy in dealing with today's "Grand Challenges" (Wanzenböck et al., 2020; Weber & Rohracher, 2012) has spurred its recent reframing into "transformative change" (Kattel & Mazzucato, 2018; Schot & Steinmueller, 2018). "Transformation" refers to putting established unsustainable configurations into question and changing them via targeted action. The purposeful, sometimes drastic change from an undesired status quo to a new and desired state is a key stance in that regard (Hölscher et al., 2018).

Urban experimentation is in line with the orientation of a transformative innovation policy approach that values challenge-driven and non-technological innovations with a normative stance towards transformative change (Fagerberg, 2018; Haddad et al., 2022). Tackling wicked problems by trialing, piloting and testing potential technological and non-technological solutions (Sengers et al., 2019), drastically altering the existing system by overcoming rigid, incremental policy approaches towards sustainability transformations (Fuenfschilling, 2019), and producing transformative knowledge for amplifiable solutions and the de-institutionalization of unsustainable configurations (Wanner et al., 2021) are thus some of the important key traits of experimentation as we understand it.

For the above reasons, experiments have taken a key position in the urban governance and innovation process as promising tools and potential drivers of social-ecological transformation. The often-cited "experimental turn" in sustainability and social sciences (Schäpke et al., 2017; Schneidewind & Scheck, 2013) and the "experimentalist turn" in governance research (Morgan, 2018) are testament to the notion that experiments can provide **solutions to a wide range of societal problems**: *"Cities around the world are embracing experiments as a means to achieve their sustainability goals. Various stakeholders engage in experiments to demonstrate that improved urban futures are possible through laboratories, testbeds, platforms, and innovation districts."* (Eneqvist & Karvonen, 2021, p. 183)

That said, not every experiment holds the same transformative potential. In SIAMESE, we specifically look at transformative experiments, that is, interventions that **address more than one urban or regional development issue by connecting adaptation and/or mitigation objectives with other societal goals** such as the SDGs, and impacting for example quality of life, welfare, health, or social justice together with climate issues. We put an emphasis on experiments that aim at and are ultimately successful in realizing **social innovation**, i.e., a reconfiguration of resources, practices, and interactions. Social innovation is still under-researched and undervalued in discourses on experimentation and transformative change (Suitner, Krisch, & Aigner, 2022). It is essential, however, for safeguarding societal transformation, just transitions, and acceptance (J. M. Wittmayer et al., 2020). Hence, it is key for avoiding transformative failures (Weber & Rohracher, 2012).

However, small-scale experiments won't intrinsically transform systems. We are thus equally interested in the modes that allow elevating place-based, bounded transformative knowledge to the level where it triggers second order structural and cultural change (Loorbach & Rotmans, 2010) and the adaptation of the political activity space for climate governance towards more transformative action. This is what we define as the four steps of transformation via experimentation that also shape our research concept (cf. Fig.1):

(1) Experimentation as such: Identification of place-based social challenges, local climate risks or the local vulnerabilities caused by unsustainable systems and development of experimental interventions to address these challenges *("recognize")*
(2) Social innovation: Implementation of initiatives that test drastically diverging socio-technical or societal solutions by changing resources, practices and interactions *("realize")*
(3) 2nd order change: Cause deep structural and cultural impact through experimentation *("reconfigure")*
(4) Political activity space: Amplify or generalize knowledge for the transformation of the institutionalized climate governance regime *("reframe")*

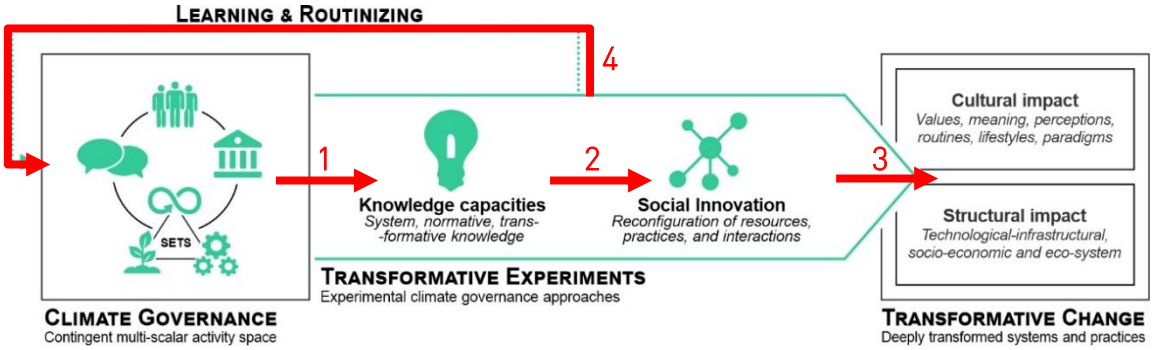

Fig.1: The SIAMESE research concept and the 4 levels of transformation in and beyond experimentation (authors' elaboration)

Experimentation & Social Innovation

Cities across the globe have adopted a "politics of experimentation" to approach the consequences of climate change. This is intended not only to anticipate locally specific climate risks and vulnerabilities, but also to overcome a lack of financial resources and institutional capabilities (Anguelovski & Carmin, 2011). In addition to technical innovation, social innovation is increasingly considered an essential component of successful climate governance (Fazey et al., 2018; Schartinger, 2019). Therefore, studying the role of social innovation in climate experiments seems reasonable and relevant.

According to Moulaert et al. (2015), social innovation can be defined as **a new way of working together aimed to address societal needs or goals better than previous social configurations did** by establishing, renewing, or changing social practices and interactions. Consequently, experiments can be interpreted as innovative ideas and implementation processes emerging from specific structural and sociopolitical contexts (Bulkeley et al., 2016). The socially innovative character of climate-oriented experiments in urban and regional development, then, consists of (cf. Zapf, 1989; Murray et al., 2010; Hochgerner, 2013):

i. the development of an original idea that addresses local social needs,
ii. the (experimental) implementation of this idea in a co-creative knowledge production process, and
iii. the consolidation of this knowledge in the form of changed social practices and interactions.

SIAMESE hence defines climate experiments *as* particular forms of social innovation that are characterized by a re-interpretation of existing knowledge production and learning processes or a novel form of social participation in technical innovation and policy-making processes, thereby having a potentially transformative effect. This definition is similar to that of Bulkeley et al. (2016; 2019), who define climate change experiments as governance innovations or innovations in/through governance. Thus, particular attention is paid to the **knowledge production, learning, and social change processes** that occur before, during, and after the completion of experimental interventions.

TERRITORIAL DIMENSION *or* EXPERIMENTATION INPUTS	ORGANIZATIONAL DIMENSION *or* EXPERIMENTATION PROCESS	TRANSFORMATIVE DIMENSION *or* EXPERIMENTATION OUTPUT
SETS: The Social-ecological-technological systems that together determine the exposure to local climate risks and social, economic, and ecological consequences *to be expected from these structural conditions (McPhearson, 2020)* **Climate Governance Regime**: The multi-scalar configuration of actors and networks, policies and institutions, discourses and imaginaries that determine the territorial political path in terms of planning and development *(Anguelovski et al., 2014; Fastenrath & Coenen, 2021; Loorbach et al., 2015; Pelling et al., 2015)*	**Agenda**, i.e., problematization and legitimization of the experiment, and objectives and conception of its role in the policy context *(McCrory et al., 2020)* **Structure** of interactions, communication, and decision-making *(Anguelovski et al., 2014)* **Actors** taking reflexive decision within their opportunities and based on knowledge of SETS and climate governance regime *(Grillitsch & Sotarauta, 2020; Suitner, Haider, & Philipp, 2022)*	**New** system-, normative-, and transformative **knowledge** *(Bergmüller & Schwarz, 2016; Schäpke et al., 2017; Urmetzer et al., 2020)* **New practices** for hard/soft projects, strategies and concepts, products and rules *(Anguelovski et al., 2014)* **Societal change**, i.e., a change of social practices with structural and/or cultural impact on SETS *(Grin et al., 2010)* **Transformative** impact on climate governance regime (Suitner, 2021)

Fig.2: Three analytical dimensions of SI in experimentation (adapted from Suitner, 2022: 61)

Transformative experiments - both bottom-up and top-down - should always be seen as part of a comprehensive urban climate governance process. Their emergence and success depend substantially on the multi-dimensional and multi-scalar political-institutional and structural conditions of local governance (e.g., the configuration of an urban planning regime, the values and traditions of a local planning culture, the actors involved in urban development, and the economic, social, and spatial conditions forming the frame to these developments). Their examination is therefore necessary to scrutinize what facilitates or inhibits the emergence of socially innovative experiments with transformative impact. SIAMESE, in this regard, borrows from various studies to distinguish three analytical dimensions of experimentation (cf. Fig.2):

i. The **territorial dimension** (or input layer) aimed at understanding the role of geography and governance context for the emergence of experiments,

ii. the **practical-organizational dimension** (or process layer) aimed at scrutinizing the character and process of specific experiments, and
iii. the **transformative dimension** (or output layer) aimed at unveiling the transformative impact of experiments in terms of changed cultures, practices, and interactions and the amplification of that knowledge for transformative climate governance.

A tripartite definition of socially innovative climate experiments for SIAMESE

Based on the above elaborations, we differentiate three approaches to experimentation for adaptation and mitigation where social innovation potentially plays a crucial role:

(1) Experiments in transformative research test technological, nature-based or societal solutions for sustainability problems. These types of experiments are typically implemented by research institutions in specifically arranged urban living labs or real social settings. The transdisciplinary idea of knowledge production through co-creation with public, private and civic actors, however, is always at the center of attention. (McCrory et al., 2020; Schäpke et al., 2017; Steen & van Bueren, 2017; Wanner et al., 2018)

(2) Governance experiments put new institutional configurations into practice ad hoc by "skipping" established policy cycles. This approach is the direct result of an "experimentalist turn" in governance (Morgan, 2018) that aims to drastically change political instruments and mechanisms in the short term to effectively steer transformative change. However, governance experiments are also temporary and reversible during the trial period. Examples are socio-technical experiments, climate change experiments or transition experiments (Anguelovski & Carmin, 2011; Tassey, 2014).

(3) Grassroots innovations are a mode of bottom-up or activist experimentation with alternative societal practices and ways of living. Their objective is to change practices, interactions and power structures, and to support autonomy and societal change. Grassroots innovations are typically community-led social innovations that test solutions for sustainable development, referencing networks of activists and organizations (Seyfang & Smith, 2007). Solutions address a specific local context, and the interests and values of the communities involved. Thus, they create knowledge on what works in specific localities and what matters to local people (Wirth et al., 2019).

To conclude, in SIAMESE, we turn away from the dichotomization that sees scientific and governance experiments on the one hand and social innovations arising from bottom-up initiatives on the other. Rather, we assume that social innovation and consequent impactful political-institutional and societal change can emerge from all three types of experiments. Therefore, we take an empirical look at all three.

References

Anguelovski, I., & Carmin, J. (2011). Something borrowed, everything new: innovation and institutionalization in urban climate governance. *Current Opinion in Environmental Sustainability*, *3*(3), 169–175. https://doi.org/10.1016/j.cosust.2010.12.017

Anguelovski, I., Chu, E., & Carmin, J. (2014). Variations in approaches to urban climate adaptation: Experiences and experimentation from the global South. *Global Environmental Change*, *27*, 156–167. https://doi.org/10.1016/j.gloenvcha.2014.05.010

Bergmüller, C., & Schwarz, H. W. (2016). Zielsetzung: Große Transformation. Darstellung und Diskussion des WBGU-Ansatzes. *ZEP : Zeitschrift für internationale Bildungsforschung und Entwicklungspädagogik*, *39*(1), 9–12. https://doi.org/10.25656/01:15444

Broto, V. C [Vanesa Castán], & Bulkeley, H. (2013). Maintaining Climate Change Experiments: Urban Political Ecology and the Everyday Reconfiguration of Urban Infrastructure. *International Journal of Urban and Regional Research*, *37*(6), 1934–1948. https://doi.org/10.1111/1468-2427.12050

Bulkeley, H., Coenen, L., Frantzeskaki, N., Hartmann, C., Kronsell, A., Mai, L., Marvin, S., McCormick, K., van Steenbergen, F., & Voytenko Palgan, Y. (2016). Urban living labs: governing urban sustainability transitions. *Current Opinion in Environmental Sustainability*, *22*, 13–17. https://doi.org/10.1016/j.cosust.2017.02.003

Bulkeley, H., Marvin, S., Palgan, Y. V., McCormick, K., Breitfuss-Loidl, M., Mai, L., Wirth, T. von, & Frantzeskaki, N. (2019). Urban living laboratories: Conducting the experimental city? *European Urban and Regional Studies*, *26*(4), 317–335. https://doi.org/10.1177/0969776418787222

Eneqvist, E., & Karvonen, A. (2021). Experimental Governance and Urban Planning Futures: Five Strategic Functions for Municipalities in Local Innovation. *Urban Planning*, *6*(1), 183–194. https://doi.org/10.17645/up.v6i1.3396

Evans, J., Karvonen, A., & Raven, R. (Eds.). (2016a). *Routledge research in sustainable urbanism*. *The experimental city*. Routledge Taylor & Francis Group.

Evans, J., Karvonen, A., & Raven, R. (2016b). The experimental city: New modes and prospects of urban transformation. In J. Evans, A. Karvonen, & R. Raven (Eds.), *Routledge research in sustainable urbanism. The experimental city* (pp. 1–12). Routledge Taylor & Francis Group.

Fagerberg, J. (2018). *Innovation, economic development and policy: Selected essays*. *Edward Elgar E-Book Archive*. Edward Elgar Pub., Inc. https://www.elgaronline.com/view/9781788110259.xml https://doi.org/10.4337/9781788110266

Fastenrath, S., & Coenen, L. (2021). Future-proof cities through governance experiments? Insights from the Resilient Melbourne Strategy (RMS). *Regional Studies*, *55*(1), 138–149. https://doi.org/10.1080/00343404.2020.1744551

Fazey, I., Schäpke, N., Caniglia, G., Patterson, J., Hultman, J., van Mierlo, B., Säwe, F., Wiek, A., Wittmayer, J., Aldunce, P., Al Waer, H., Battacharya, N., Bradbury, H., Carmen, E., Colvin, J., Cvitanovic, C., D'Souza, M., Gopel, M., Goldstein, B., . . . Wyborn, C. (2018). Ten essentials for action-oriented and second order energy transitions, transformations and climate change research. *Energy Research & Social Science*, *40*, 54–70. https://doi.org/10.1016/j.erss.2017.11.026

Forrest, N., & Wiek, A. (2015). Success factors and strategies for sustainability transitions of small-scale communities – Evidence from a cross-case analysis. *Environmental Innovation and Societal Transitions*, *17*, 22–40. https://doi.org/10.1016/j.eist.2015.05.005

Fuenfschilling, L. (2019). An institutional perspective on sustainability transitions. In F. Boons & A. McMeekin (Eds.), *Handbook of sustainable innovation* (pp. 219–236). Edward Elgar Pub., Inc. https://www.researchgate.net/publication/335827086_An_institutional_perspective_on_sustainability_transitions

Fuenfschilling, L., Frantzeskaki, N., & Coenen, L. (2019). Urban experimentation & sustainability transitions. *European Planning Studies*, *27*(2), 219–228. https://doi.org/10.1080/09654313.2018.1532977

Grillitsch, M., & Sotarauta, M. (2020). Trinity of change agency, regional development paths and opportunity spaces. *Progress in Human Geography*, *44*(4), 704–723. https://doi.org/10.1177/0309132519853870

Grin, J., Rotmans, J., & Schot, J. W. (2010). *Transitions to sustainable development: New directions in the study of long term transformative change. Routledge studies in sustainability transitions*. Routledge.

Haddad, C. R., Nakić, V., Bergek, A., & Hellsmark, H. (2022). Transformative innovation policy: A systematic review. *Environmental Innovation and Societal Transitions*, *43*, 14–40. https://doi.org/10.1016/j.eist.2022.03.002

Hochgerner, J. (2013). Social Innovations and the Advancement of the General Concept of Innovation. In C. Parra Rodriguez & C. Ruiz Vinals (Eds.), *Routledge/Lisbon civic forum studies in innovation: Vol. 1. Social innovation: New forms of organisation in knowledge-based societies* (pp. 12–28). Routledge.

Hölscher, K., Wittmayer, J. M., & Loorbach, D. (2018). Transition versus transformation: What's the difference? *Environmental Innovation and Societal Transitions*, *27*, 1–3. https://doi.org/10.1016/j.eist.2017.10.007

Huitema, D., Jordan, A., Munaretto, S., & Hildén, M. (2018). Policy experimentation: Core concepts, political dynamics, governance and impacts. *Policy Sciences*, *51*(2), 143–159. https://doi.org/10.1007/s11077-018-9321-9

Kattel, R., & Mazzucato, M. (2018). Mission-oriented innovation policy and dynamic capabilities in the public sector. *Industrial and Corporate Change*, *27*(5), 787–801. https://doi.org/10.1093/icc/dty032

Kelterborn, P. (1994). Was ist ein wissenschaftliches Experiment? *Anzeiger Der Arbeitsgemeinschaft Für Experimentelle Archäologie*, *1*, 7–9.

Loorbach, D., Frantzeskaki, N., & Lijnis Huffenreuter, R. (2015). Transition Management: Taking Stock from Governance Experimentation. *Journal of Corporate Citizenship*, *2015*(58), 48–66. https://doi.org/10.9774/GLEAF.4700.2015.ju.00008

Loorbach, D., & Rotmans, J. (2010). *Towards a better understanding of transitions and their governance, A systemic and reflexive approach, as Part II*. https://www.researchgate.net/publication/281364837_Towards_a_better_understanding_of_transitions_and_their_governance_A_systemic_and_reflexive_approach_as_Part_II

McCrory, G., Schäpke, N., Holmén, J., & Holmberg, J. (2020). Sustainability-oriented labs in real-world contexts: An exploratory review. *Journal of Cleaner Production*, *277*, 123202. https://doi.org/10.1016/j.jclepro.2020.123202

McPhearson, T. (2020). Transforming Cities and Science for Climate Change Resilience in the Anthropocene. In K. Hölscher & N. Frantzeskaki (Eds.), *Transformative Climate Governance: A Capacities Perspective to Systematise, Evaluate and Guide Climate Action* (pp. 99–111). Springer International Publishing. https://doi.org/10.1007/978-3-030-49040-9_3

Merriam-Webster Online Dictionary. (2022). *Experiment*. https://www.merriam-webster.com/dictionary/experiment

Morgan, K. (2018). Experimental Governance and Territorial Development. https://orca.cardiff.ac.uk/125697/1/Morgan(2018)ExperimentalGovernanceAndTerritorialDevelopment_OECD_FINAL%20report.pdf

Moulaert, F., MacCallum, D., Mehmood, A., & Hamdouch, A. (Eds.). (2015). *The international handbook on social innovation: Collective action, social learning and transdisciplinary research* (Pbk ed. repr). Edward Elgar.

Murray, R., Caulier-Grice, J., & Mulgan, G. (2010). *The Open Book of Social Innovation: Ways to Design, Develop and Grow Social Innovations* (Vol. 24). National Endowment for Science, Technology and the Arts (NESTA). https://www.researchgate.net/publication/272566551_The_Open_Book_of_Social_Innovation_Ways_to_Design_Develop_and_Grow_Social_Innovations

Pelling, M., O'Brien, K., & Matyas, D. (2015). Adaptation and transformation. *Climatic Change*, *133*(1), 113–127. https://doi.org/10.1007/s10584-014-1303-0

Raven, Rob, Sengers, Frans, Spaeth, Philipp, Xie, Linjun, Cheshmehzangi, Ali, de Jong, & Martin (2019). Urban experimentation and institutional arrangements. *European Planning Studies*, 1–24. https://doi.org/10.1080/09654313.2017.1393047

Schäpke, N., Stelzer, F., Bergmann, M., Singer-Brodowski, M., Wanner, M., Caniglia, G., & Lang, D. J. (2017). *Reallabore im Kontext transformativer Forschung: Ansatzpunkte zur Konzeption und Einbettung in den internationalen Forschungsstand* (IETSR Discussion papers in Transdisciplinary Sustainability Research). Leuphana Universität, Lüneburg.

Schartinger, D. (2019). Social innovation with environmental impact: Current and future challenges. In J. Howaldt, C. Kaletka, A. Schröder, & M. Zirngiebl (Eds.), *Atlas of social innovation: 2nd volume. Atlas of Social Innovation: 2nd Volume: A World of New Practices* (pp. 176–178). oekom verlag.

Schmitter, P. C. (2002). Participation in Governance Arrangements: Is there any reason to expect it will achieve "Sustainable and Innovative Policies in a Multi-Level Context"? In J. R. Grote (Ed.), *Participatory governance: Political and societal implications* (pp. 51–69). Leske und Budrich. https://doi.org/10.1007/978-3-663-11003-3_3

Schneidewind, U., & Scheck, H. (2013). Die Stadt als „Reallabor" für Systeminnovationen. In J. Rückert-John (Ed.), *Research. Soziale Innovation und Nachhaltigkeit: Perspektiven sozialen Wandels* (pp. 229–248). Springer VS. https://doi.org/10.1007/978-3-531-18974-1_12

Schot, J., & Steinmueller, W. E. (2018). Three frames for innovation policy: R&D, systems of innovation and transformative change. *Research Policy*, *47*(9), 1554–1567. https://doi.org/10.1016/j.respol.2018.08.011

Sengers, F., Wieczorek, A. J., & Raven, R. (2019). Experimenting for sustainability transitions: A systematic literature review. *Technological Forecasting and Social Change*, *145*, 153–164. https://doi.org/10.1016/j.techfore.2016.08.031

Seyfang, G., & Haxeltine, A. (2012). Growing Grassroots Innovations: Exploring the Role of Community-Based Initiatives in Governing Sustainable Energy Transitions. *Environment and Planning C: Government and Policy*, *30*(3), 381–400. https://doi.org/10.1068/c10222

Seyfang, G., & Smith, A. (2007). Grassroots innovations for sustainable development: Towards a new research and policy agenda. *Environmental Politics*, *16*(4), 584–603. https://doi.org/10.1080/09644010701419121

Steen, K., & van Bueren, E. (2017). The Defining Characteristics of Urban Living Labs. *Technology Innovation Management Review*, *7*(7), 21–33. https://doi.org/10.22215/timreview1088

Suitner, J. (2021). Towards Transformative Change. Die Schlüsselelemente experimenteller Ansätze in der städtischen Klimawandelanpassung erforschen. Advance online publication. https://doi.org/10.34749/OES.2021.4608 (Der Öffentliche Sektor - The Public Sector 47(2): 53-64).

Suitner, J., Haider, W., & Philipp, S. (2022). Social innovation for regional energy transition? An agency perspective on transformative change in non-core regions. *Regional Studies.* Advance online publication. https://doi.org/10.1080/00343404.2022.2053096

Suitner, J., Krisch, A., & Aigner, A. (2022). All hail the new king? Critically reflecting on urban experimentation for transformative change. In J. Fritz & N. Tomaschek (Eds.), *Beiträge zum lebensbegleitenden Lernen und Wissenstransfer: Vol. 11. Transformationsgesellschaft. Strategien und Visionen für den sozialökologischen Wandel* (XX (accepted)). Waxmann.

Tassey, G. (2014). Innovation in innovation policy management: The Experimental Technology Incentives Program and the policy experiment. *Science and Public Policy*, *41*(4), 419–424. https://doi.org/10.1093/scipol/sct060

Torrens, J., Westman, L., Wolfram, M., Broto, V. C [Vanessa Castán], Barnes, J., Egermann, M., Ehnert, F., Frantzeskaki, N., Fratini, C. F., Håkansson, I., Hölscher, K., Huang, P., Raven, R., Sattlegger, A., Schmidt-Thomé, K., Smeds, E., Vogel, N., Wangel, J., & Wirth, T. von (2021). Advancing urban transitions and transformations research. *Environmental Innovation and Societal Transitions*, *41*, 102–105. https://doi.org/10.1016/j.eist.2021.10.026

Torrens, J., & Wirth, T. von (2021). Experimentation or projectification of urban change? A critical appraisal and three steps forward. *Urban Transformations*, *3*(1), 8. https://doi.org/10.1186/s42854-021-00025-1

Urmetzer, S., Lask, J., Vargas-Carpintero, R., & Pyka, A. (2020). Learning to change: Transformative knowledge for building a sustainable bioeconomy. *Ecological Economics*, *167*, 106435. https://doi.org/10.1016/j.ecolecon.2019.106435

Wanner, M., Bachmann, B., & Wirth, T. von (2021). Contextualising Urban Experimentation: Analysing the Utopiastadt Campus Case with the Theory of Strategic Action Fields. *Urban Planning*, *6*(1), 235–248. https://doi.org/10.17645/up.v6i1.3629

Wanner, M., Hilger, A., Westerkowski, J., Rose, M., Stelzer, F., & Schäpke, N. (2018). Towards a Cyclical Concept of Real-World Laboratories. *DisP - the Planning Review*, *54*(2), 94–114. https://doi.org/10.1080/02513625.2018.1487651

Wanzenböck, I., Wesseling, J., Frenken, K., Hekkert, M., & Weber, K. (2020). A framework for mission-oriented innovation policy: Alternative pathways through the problem–solution space. *Undefined*. https://www.semanticscholar.org/paper/A-framework-for-mission-oriented-innovation-policy%3A-Wanzenb%C3%B6ck-Wesseling/2895be93543ba8f573a98a4d05f157927bea0c69

Weber, K. M., & Rohracher, H. (2012). Legitimizing research, technology and innovation policies for transformative change. *Research Policy*, *41*(6), 1037–1047. https://doi.org/10.1016/j.respol.2011.10.015

Wirth, T. von, Fuenfschilling, L., Frantzeskaki, N., & Coenen, L. (2019). Impacts of urban living labs on sustainability transitions: mechanisms and strategies for systemic change through experimentation. *European Planning Studies*, *27*(2), 229–257. https://doi.org/10.1080/09654313.2018.1504895

Wittmayer, J., & Hölscher, K. (2017). *Transformationsforschung – Definitionen, Ansätze, Methoden.* Umweltbundesamt.

Wittmayer, J. M., Geus, T. de, Pel, B., Avelino, F., Hielscher, S., Hoppe, T., Mühlemeier, S., Stasik, A., Oxenaar, S., Rogge, K. S., Visser, V., Marín-González, E., Ooms, M., Buitelaar, S., Foulds, C., Petrick, K., Klarwein, S., Krupnik, S., Vries, G. de, . . . Härtwig, A. (2020). Beyond instrumentalism: Broadening the understanding of social innovation in socio-technical energy systems. *Energy Research & Social Science*, *70*, 101689. https://doi.org/10.1016/j.erss.2020.101689

Zapf, W. (1989). Über soziale Innovationen. *Soziale Welt*, *40*(1/2), 170–183.