Title: Overcoming Paralysis by Complexity

WP leader Prof. John Grin (j.grin@uva.nl), 31 August 2021

Description of proposed PhD research

Introduction

Decisive action is needed to reduce greenhouse gas emissions to net-zero in 30 years and to make the transition from a fossil fuel-based energy system to a more sustainable one. Non-fossil fuel systems are characterized by blurring boundaries between demand and supply, and by the emergence of novel, small, local actors that can operate nationally or internationally. They challenge existing regulatory and competitive structures. A swift transition requires the proper incorporation of many actors of different sizes and backgrounds (business, government, civil society), ensuring affordability and reliability, and taking into account societal desiderata such as the right balance between autonomy, responsibility and co-operation in such a way to pre-empt resistance and inertia. Decision-makers are facing a 'wicked problem' (Rittel & Webber, 1973), since demographic, economic, environmental, social, and technological dimensions are closely intertwined, while no blueprint exists for making the transition. It is tempting to reduce such wicked problem to smaller, manageable elements, and relay them to experts in a specific discipline, but by doing so we run the risk of missing the bigger picture. A more useful approach is to integrate the variety of disciplinary analyses of the just mentioned intertwined dimensions through systems analysis and evaluate the outcomes in terms of a predetermined set of core criteria. This procedure is then iterated while steps that contribute to positive results set the stage for developing further steps through serial learning. For bringing about acceleration, is important that these steps include steps (Termeer, 2018; Termeer & Metze, 2020) that may facilitate follow-on steps, so especially structural adaptations (Grin, 2006; 2021) like changes in key technologies, infrastructures, legislation and governance models that have been found to promote best practices, and which may thus form the core of systemic feedback loops around which a new system may emerge.

The object of analysis: the Province of Noord-Holland and the energy transition

The province of Noord-Holland (P-NH) is, together with other parties such as network managers, responsible designing a novel, flexible and hybrid energy infrastructure that is able to accommodate home construction and economic growth, while simultaneously implementing the energy transition. It has a special task in coordinating across municipal levels; that also implies mutually tuning, and spatially facilitating two Regional Energy Strategies (RES NH-North and RES NH-South) and the Industrial Cluster Energy Strategy Noordzeekanaalgebied (CES-NZKG), also aligning with the Metropole Region Amsterdam (MRA), the Den Helder Maritime Cluster (DHMC), the advises at the national level (TIKI, MIEK, PIDI, VAWOZ, PEH, TVW), and last but not least coping with public debate and public support. In addition, there are also different levels of scale; actors at these various levels range from an energy corporation around a village and the operator of an urban heat net to operators at various higher scale levels, like Tennet, Alliander, Stedin, and Gasunie. They are embedded, at these various levels, in structural contexts (legislation, existing infrastructure, physical planning policies, (trans-)national markets etc.)

This constitutes a major governance challenge: needed is both coordinating actors 'vertically' (between different scales: (inter-)national, regional and local) and horizontally, between multiple actors at the same level of scale (RES-CES; grid-grid etc.). Can P-NH do both, or are there better task divisions between P-NH and other parties – and how do the latter see this?

On top of that, the P-NH has extra-ordinary ambitions: to actively promote the energy transition (especially in terms of governance, infrastructure and land use) while navigating between local demands and those from actors at higher scale levels. Lower-scale actors are highly dependent on the higher-scale actors, who moreover also can draw on the fact that they need serve needs from different regions (nationally and transnationally). Higher scale actors need public support and systems that are attractive to them and affordable to systems. Actors at all levels share some key concerns: smart land use and system efficiency in economic, energetic and infrastructural term. These affect matters like operations, returns upon investment and market position for higher scale actors and values like livability, energy security and affordability for lower scale actors. Governance arrangements, i.e. actor roles and linkages and rules, need to support the desired operations, business model and societal value creation.

In order to investigate governance arrangements, and explore how they may change as part of the transition, variations of local practices will be investigated for an area (to be selected) that includes industrial plans, the built area and connections between them; also including its connection to higher level national networks.

Research problem and questions

Against this background, P-NH needs integrated system knowledge that helps to define, iterating between within and between these levels, a hybrid energy system and its structural conditions. Subsequent iterations may provide inputs in ongoing policy making, while policy proposals and decisions may be integrated into the options assessed in subsequent rounds of analysis. The research will provide inputs in this search process, and the team will monitor the iterative evolution of the governance structure so as to draw lessons for policy making beyond 2025 and for other transitions. This interaction of analysis with evolving policies and their implementation, and the attention to best practices enables the type of knowledge development fitting a wicked problem.

1) What hybrid energy system is envisaged in existing plans, and how does it perform in terms of system efficiency (economic, energetic and infrastructural), land use, and public support?
2) What are key merits, drawbacks and limits of these plans, what possibilities may help achieve a more optimal hybrid energy system, and what institutional and infrastructural demands on regional, provincial, national and (trans-)national level do they imply?
3) Given the findings in terms of question 2), what are key lessons for horizontal and vertical coordination (with due attention to (trans-)national actors, arrangements and infrastructures) and what governance arrangements does this imply?

Research design and methods

Question 1 is about identifying what system would result if the variety of incumbent plans would be integrated. Answering it will involve primarily document analysis, expert interviews and network analysis to map the key actors and energy generation assets, their structural context, legal provisions, market structure and infrastructure and the linkages between these components of the envisaged hybrid energy system (spatial and temporal depiction of flows of information, money and energy). This system depiction will then be formalized into a complex adaptive systems (CAS) model and POLDER will be used to assess the performance of this complex system in terms of the mentioned criteria, and relate these outcomes to key components and interactions in the system.

Question 2 will be answered by specific cases in the form of local plans understood as part of the envisaged hybrid (electricity, gas, and heat) energy infrastructure. Case selection will be such that (i)

they cover examples of some key types of energy provision (ii) including both relatively known and more innovative practices. Drawing on the work done under question 1, these local systems will be translated into formal terms, with emphasis on the governance arrangements that specify horizontal and vertical coordination, taking into account (differences in) actors' stakes/values at the same (horizontal) level. POLDER will then be applied for a 'zero measurement' of the performance of these systems, assuming that this system will also be implemented in similar localities. Next, based on the results, alternatives for optimizing the subsystem will be explored in three rounds of participatory design workshops, involving actors (to be) engaged in the subsystem, citizens and societal organizations, independent, innovative (legal, economic, technical etc.) experts and key actors from the RESs and Province.

The first round will sketch the contours of an optimized system for that case, and the second will generate 2-3 more specific elaborations of the system (actors, assets, structural elements and linkages), which subsequently will be assessed by POLDER on both the local and the inter-regional level; in another iteration round, adapted elaborations and syntheses, obtained from the first assessment, may be assessed. The results will be discussed in a final round of workshops, anticipating their institutional and infrastructural requirements at various levels, and ways to meet them (structural changes that can be seen as small wins that may accelerate further development).

Question 3 will be answered by translating the insights obtained from the cases analyses (question 2) into implications for governance, legal and market arrangements within and between RESs, and between the RESs and provincial and (trans-)national system levels.

Embedding of the PhD research project

The PhD will be part of the PACES-project "Pacing up the energy transition". The scientific aims of PACES are A) to identify the key actors, their interconnections, and feedbacks determining the speed of the energy transition, and B) to design and test interventions that can accelerate it. PACES aims to contribute to solving the wicked problem of energy transition by 1) developing an overarching interdisciplinary framework that does justice to the complexity of the energy transition while retaining the strengths of methodologies from the various disciplines, 2) developing a range of simulation models that yield simplified representations of the real world and link multiple temporal and geographical scales at which networks act, and 3) running integrated socio-technological simulations of the economy-energy-environment to iteratively design and evaluate interventions while coping with uncertainties. A breakthrough is achieved by designing, simulating, and testing models, policies, and interventions that enable alleviating the obstacles to pace up the energy transition. Crucial is the involvement of citizens, industry, and policy makers. We achieve this by adopting **POLDER** (**POL**icy **D**ecision-support and **E**vidence-based **R**easoning), an approach for integrated systems analysis to support decision making in complex adaptive systems.

The PACES-project is in the process of submission for a grant of the "Nationale Wetenschapsagenda" (NWO). In October the final proposal will be submitted and, if granted, the project will start late spring 2022. We have discussed to get started already with the case study Noord-Holland. To match the PhD "Overcoming paralysis by complexity", the University of Amsterdam (UvA) has already provided a Postdoc position to further develop the POLDER-methodology in the context of PACES. In parallel with the PhD research, the Postdoc will use POLDER to analyze complex interdependencies between regional plans with specific focus on:

- Actors and factors that determine the pace of the energy transition
- Efficiency versus resilience of the system (economic, energetic, infrastructural)

- Support of stakeholders
- Effects of uncertainties

Research team

PhD	To be determined
Supervising team	Prof. John Grin, MSc in physics (1986); full professor in political science at the UvA, specialized in the governance and politics of transitions, especially in the agrifood, water and energy domain. He is a member of the POLDER core team. Prof. Marija Bartl is Professor of Transnational Private Law at the Amsterdam Law School and the Director of the Amsterdam Centre for Transformative Private Law. Her research focuses on how private law could nurture socially and environmentally desirable economic practices. Prof. Ans Kolk is a political economist by training and full professor at the UvA, Amsterdam Business School. Her areas of expertise are in corporate social responsibility, sustainable development and sustainability, especially in relation to international business.
Other collaborators	Prof. B. van der Zwaan (Sustainable Energy Technology) Dr. C. Becker (POLDER methodology) Prof. C. Diks (Data Analysis and Economic Statistics) Prof. F. van Harreveld (Attitudes, Uncertainty and Behavioural change) Prof. P. Sloot (Complex Adaptive Systems) Dr. V. Vasconcelos (Data Driven System Dynamics) Dr. Y. Artzy-Randrup (Ecology, Evolutionary and Network Theory)

The team aims at close collaboration with experts from province of Noord-Holland. Experts of other stakeholders, like Alliander, PBL, RIVM, CBS, Rabobank, EZK, LNV, NZKG will also be involved.

The PhD-project can start as soon as agreed. Results of the research will be reported in oral presentations/discussions (frequency to be discussed) and finally in a PhD-thesis.