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Editorial

Making the Most of Failure and Uncertainty: Welcome Surprises and Contingency in Energy Transition Research

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Energy transitions inherit complex processes full of surprises, unintended consequences, erroneous decisions, uncertainties, paradoxical situations, and sometimes sheer failures. Since the future is per se open, uncertain, contingent, indeterminable, and partly veiled in ignorance, the trajectories of energy transitions can only partly be foreseen. Instead of exploiting surprises and unforeseen events as silver linings and learning from processes during crisis situations, the main focus is on success stories and best-practice examples. This, as we argue in this Editorial, may sometimes hinder progress in energy transitions and the effective usage of more renewable energy sources. The papers discussed in this Editorial deliver pointers on how to make the best out of failure and paradoxical developments in current energy issues and also illustrate different ways of coping with uncertainties. Given the highly multi- and interdisciplinary perspectives as well as geographical distribution of the five papers selected, they may hopefully serve as encouragement to present learning from failure as valuable lessons in energy research and to explore ways of dealing with uncertainties in the face of energy challenges.

The paper by Velenturf [1] delivers a framework for the integration of a circular economy in offshore wind parks. Instead of focusing on linear success stories and optimization processes, the author also mentions challenges in circular-economy-related research both as regards the processes of the objects of study but also in the research process itself. These include difficulties in assessing resource availabilities, competition between investors, and especially not-well-thought-through end-of-use solutions for decommissioned components and materials. Velenturf's solution to such a complex set of problems is to enable the integration of the risks of unintended consequences into circular economy concepts. The focus on "growing offshore wind without circular economy", as the author suggests, may be able to "reduce carbon impacts but would likely cause trade-offs with clean water and nature conservation". Paradoxically, the narrow focus "on recycling could lead to more pollution and costs in comparison to durable designs and the race to reduce costs for the private sector to grow offshore wind in the near-term can lead to higher decommissioning costs that may, moreover, have to be paid by the public later on". Consequently, Velenturf suggests learning from failure to open new possibilities to develop local supply chains that in turn may reduce some of the risks and uncertainties for offshore wind farms.

Coming from a completely different angle, Wagner and Götz [2] build their analysis on Germany's failed role as a pioneer in energy policy. By doing so, they implicitly focus on the management of unintended consequences via a categorization of five closely coupled processes and areas of innovation: decarbonization, digitalization, decentralization, democratization, and a diversification of service orientation. The authors argue that these five areas are nowadays very closely related to each other, so that looking at them independently, one cannot explain why the overall energy transition may have slowed

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down or has even temporarily failed. In the end, Wagner and Götz implicitly call for further experimental processes and tests *in* and *with* society to learn from failure as much as possible. Thereby, they highlight the need for inclusive participation of the public in the German energy transition in order to ensure a broad societal commitment to overcome the (unforeseen) challenges ahead brought about by experimental processes. In this regard, the authors also refer to the emergence of the "yellow vest" movement in France as a result of the political failure to involve the wider public in the transformation of the energy system.

Nascimento et al. [3] focus on the management of smart buildings in France. Instead of discussing merely best-practice processes of energy consumption, the authors focus on anomalies and even outliers since they are crucial to identify novel opportunities and innovative elements to reduce energy consumption. Unlike earlier symmetrical data-distribution techniques, Nascimento et al. work around the issue of unknown data distribution by using regression-based methods where an outlier is labelled as such "if a remarkable deviation occurs between the actual value and its expected value produced by the regression model". By so doing, the authors were able to employ a hybrid method, which they call "forecast error", in order to detect outliers in the power consumption of a tertiary building. A random forest algorithm was used as "the regression method and the three-sigma rule, the median absolute deviation, the boxplot, the skewed boxplot, and the adjusted boxplot were chosen as outlier detection techniques". This article nicely shows that forecasts based on statistical modeling are, on the one hand, a necessary component of ongoing energy transitions, but on the other hand, are also a complex and uncertain endeavor. What can be known, measured, and thus, modeled is always inevitably limited and also ridden with uncertainty. Unforeseen developments constantly prove models and forecasts wrong. Nevertheless, they are crucial to gain a vague idea of the future.

Yet again from another angle, Blumberga et al. [4] focus on processes referred to as lock-in mechanisms, that is, the dependency of actors on practices and technologies that cannot be changed or adapted without substantial effort and costs—costs that may even severely harm an organization. In a certain way, lock-in effects can be seen as the result of the unreflected accumulation of knowledge expectations, unobserved rebound effects, or unintended consequences of goal-oriented activities. The innovative methodology exemplified in a case study from Latvia allows a better understanding of why well-intended goals of the energy transition are often hard to reach. This is done by illustrating multi-causal social and technical relations in processes of transitions that are suggested to become tools to understand how and when lock-ins are likely so a system can react to such tendencies more effectively. Similar to Wagner and Götz [2], Blumberga et al. point to the importance of inclusive participation by arguing that their "simulation model can be used as a 'hybrid forum' by decision-makers and other stakeholders in the democratic decision-making process". Finally, Blumberga et al. offer suggestions for what pathways towards an energy transition are best suited to lead to potential lock-outs.

Finally, Nicolas et al. [5] tackle a classical topic of how to cope with uncertainty and unavoidable ignorance in decision making. Given the current imperfect knowledge of all the climate change mechanisms, the authors study how uncertainties weighing on the climate system impact optimal technological pathways. In their paper, the authors present what they label "a robust approach" to handling climate uncertainty in their own integrated assessment models (IAMs). Nicolas et al. conclude that in climate parameters radiative forcing sensitivity directly multiplies the CO_2 concentration so that even "a small variation of this parameter leads to a strong impact on the CO_2 abatement timing". Using such results together with their generic method, the authors were able to bring to light hedging technological trajectories and offer new insights on technological transition pathways, despite much uncertainty. The article also shows that climate models and forecasts are an essential component of (political) decision-making aiming to improve the quality of decisions by opening up a window to the future. As already mentioned above, the future is always uncertain und unknown, but decisions have to be made, even though they may be based on (specified) ignorance. Reducing uncertainties in models and forecasts is thus an important task that will never be finished.

Given the interpretation of the above introduced examples from *Energies* and their potential to learn from processes of failure, the question arises: why do authors not accept unintended side-effects and even failure more and share their experiences more widely with readers of this journal? After all, failure can often be a necessary basis for subsequent success. It is thus high time that more articles on failed research and surprising turns in implementation processes become part of *Energies*' standard article set up. The articles touched upon in this short Editorial, however, give us hope that setbacks can be used quite effectively. To build on such work but also to depart from it in order to move further, we thus encourage authors to consider submitting material that focuses on failure, rebound effects, and surprise. This should also include research results and reports on processes that might otherwise not have been considered suitable for publishing because they were not rendered clear-cut and successful enough by mainstream standards.

In conclusion, we want to highlight the importance of acknowledging inevitable uncertainties and ignorance and exploring ways of inclusive participatory decision-making in such contexts. Instead of trumpeting safety when there is none, research needs to address uncertainty and contingency in creative ways. Thus, more research on the multiple ways different actors deal with uncertainties and failure (including the researchers themselves) is a highly relevant avenue for future research on energy and society.

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References

1. Velenturf, A.P.M. A Framework and Baseline for the Integration of a Sustainable Circular Economy in Offshore Wind. *Energies* **2021**, *14*, 5540. [CrossRef]
2. Wagner, O.; Götz, T. Presentation of the 5Ds in Energy Policy: A Policy Paper to Show How Germany Can Regain Its Role as a Pioneer in Energy Policy. *Energies* **2021**, *14*, 6799. [CrossRef]
3. Martin Nascimento, G.F.; Wurtz, F.; Kuo-Peng, P.; Delinchant, B.; Jhoe Batistela, N. Outlier Detection in Buildings' Power Consumption Data Using Forecast Error. *Energies* **2021**, *14*, 8325. [CrossRef]
4. Blumberga, A.; Gravelsins, A.; Blumberga, D. Deliberation Platform for Energy Transition Policies: How to Make Complex Things Simple. *Energies* **2022**, *15*, 90. [CrossRef]
5. Nicolas, C.; Tchung-Ming, S.; Bahn, O.; Delage, E. Robust Enough? Exploring Temperature-Constrained Energy Transition Pathways under Climate Uncertainty. *Energies* **2021**, *14*, 8595. [CrossRef]