

10th International Conference on Applied Energy (ICAE2018), 22-25 August 2018, Hong Kong, China

The role of values in analyzing energy systems: Insights from moral philosophy, institutional economics, and sociology

Christine Milchram^a, Carolin Märker^{b*}, Jürgen-Friedrich Hake^b

^aFaculty of Technology, Policy and Management, Delft University of Technology, Jaffalaan 5, 2628 BX, Delft, The Netherlands

^bInstitute of Energy and Climate Research, Forschungszentrum Jülich GmbH, 52425 Jülich, Germany

Abstract

In efforts to mitigate climate change, energy systems are undergoing a profound transition towards low-carbon systems. This transition does not only involve changes in energy technologies but importantly it is shaped and incentivized by changes in the rules and regulations that govern energy markets. It is a normative transition, focused at achieving secure, affordable, and sustainable energy provision. In a multidisciplinary approach, this paper proposes a framework that highlights the role of normative principles – i.e. values – in socio-technical systems. Building on the Institutional Analysis and Development (IAD) framework, the analysis explicates how values relate to institutional change in the case of the energy transition.

© 2019 The Authors. Published by Elsevier Ltd.

This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>)

Peer-review under responsibility of the scientific committee of ICAE2018 – The 10th International Conference on Applied Energy.

Keywords: Energy policy; energy transition; institutional analysis; IAD framework; values

1. Introduction

Energy systems are currently undergoing profound transition processes towards low-carbon systems. This transition does not only include changes to technologies or infrastructures but also to rules and regulations (i.e. institutions). With climate change targets set by national governments and the international Paris Agreement, policy makers take a central role in the energy transition by changing institutions that govern energy markets. As such, we see energy systems as socio-technical systems, “where technologies, institutional arrangements (e.g. regulation,

* Corresponding author. Tel.: +49 2461 61-5347; fax: +49 2461 61-2540.

E-mail address: c.maerker@fz-juelich.de

norms), social practices, and actor constellations [...] mutually depend on each other” (Rohracher, 2008, p. 147). In addition, the energy transition is an inherently normative transition towards sustainability that partly comprises purposefully steered changes which are embedded in and influenced by institutional settings. Current literature on energy systems often suffers from a deeper understanding of institutional change processes as well as the normative reasons behind these changes. An analysis of values can provide insights into these reasons because values are relatively stable underlying normative guiding principles for changes in a society (Van de Poel and Royakkers, 2011).

In this paper, we propose a novel framework for institutional analysis that identifies the role of values in institutional change. We build on the Institutional Analysis and Development (IAD) framework, developed by Elinor Ostrom and colleagues (Ostrom, 2005), for two reasons. Firstly, it is one of the most established frameworks in institutional analysis. Secondly, it was developed to deal with socio-ecological systems that are – similar to socio-technical systems – characterized by their complex nature. We combine the IAD framework with an interdisciplinary approach using conceptualizations of values from institutional economics, moral philosophy, and sociology. Identifying the role of values for the elements of the IAD framework offers valuable insights into institutional change within energy systems. Our framework allows for comparative analyses, e.g. regarding acceptance, evaluation or rejection of certain technologies.

Section 2 describes the concept of values and their role for institutional and technological design. Then the IAD framework is introduced in Section 3 and expanded by a value perspective in Section 4.

2. Conceptualizing values

Values are defined in a general sense as fundamental normative guiding principles for changes in a society, which are considered to be shared intersubjectively (Van de Poel and Royakkers, 2011). However, the concept of a value is used differently in various academic disciplines. In moral philosophy, values are criteria to make statements about the ethical goodness of options for action and normative human principles worth striving for (Pojman, 1997, p.12). Values are things that different individuals can relate to and generally hold important (Taebi and Kadak, 2010; Van de Poel, 2009). In the field of ethics of technology, values are analogously used to make statements about ethical and social consequences of technologies. Typical values include health, well-being, and safety (Shrader-Frechette and Westra, 1997). In other words, values are identifiable entities that are embedded in technologies and should be considered in design choices.

In institutional economics, values are seen as influencing the behavior of economic actors but more importantly as part of formal institutions. Institutional economics broadens neoclassical economic analysis by examining institutions and trying to understand how they influence human behavior and how they emerge (Knudsen, 1993). Values influence the design of formal institutions (e.g. the formal rules of the game) (Correljé et al., 2015; Williamson, 1998). Formal institutions are therefore not value-free; they should endorse the values for which they were designed.

In sociology and social psychology, values are studied as principles that influence human behavior (Rokeach, 1973). Extensive theoretical and empirical work on conceptualizing and measuring values has been conducted based on the seminal contributions of researchers, such as Schwartz, Bilsky and Rokeach (for reviews, see Cheng and Fleischmann, 2010; Dietz, Fitzgerald and Shwom, 2005). Examples for individuals’ value priorities include orientations, such as self-direction, achievement, power, and universalism (Schwartz, 1992).

All three conceptualizations of the concept of a value will be used as the basis to include a value-perspective in our framework for institutional analysis in the discussion section. Before that, we outline the IAD framework in Section 3.

3. The Institutional Analysis and Development (IAD) framework

The IAD framework (Figure 1), developed by Elinor Ostrom and colleagues, identifies important elements of socio-ecological systems and their interrelations (Ostrom, 2011). Ostrom’s definition of institutions is based on Douglass North, who defines them as formal and informal ‘rules of the game’ that shape the behavior of actors. Institutions are political, social, and legal rules that form the basis for activity and are needed to organize human

behavior in a structured way to stabilize the societal system (Gagliardi, 2008). In this definition, institutions do not include organizations, which are instead denoted as ‘actors’.

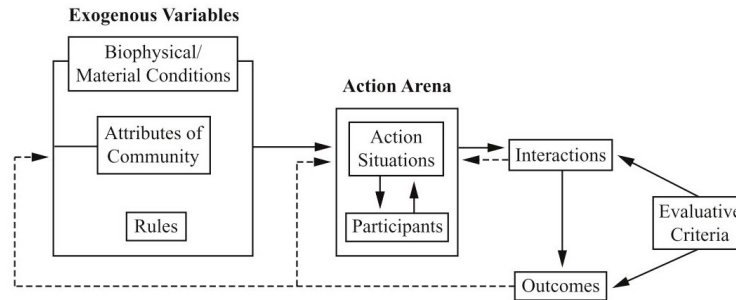


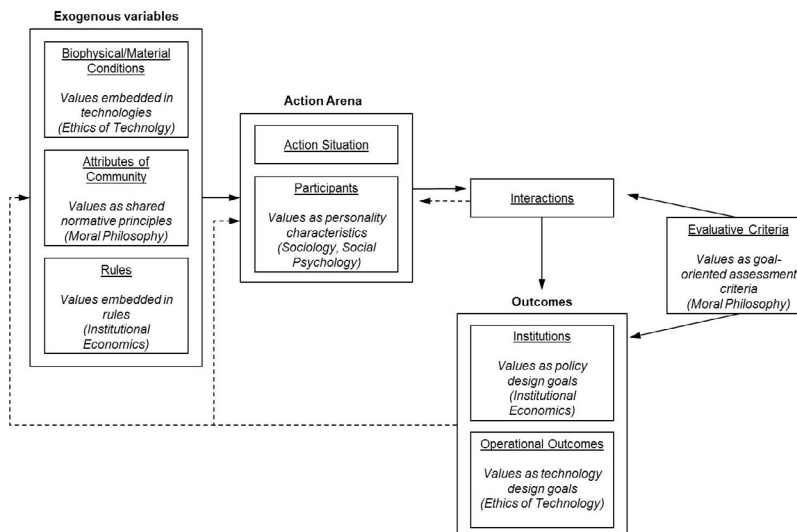
Fig. 1. IAD framework (Ostrom, 2005, p. 15)

The IAD framework defines certain system elements that can be categorized into exogenous variables, the action arena, interactions, evaluative criteria, and outcomes (Figure 1). Important or decisive events are captured in the element of action situations that are used to analyze human behavior within the institutional context (Ostrom, 2011). Using the IAD framework for an analysis of energy systems in this paper, the decarbonization of national energy systems constitutes the main coordination problem in which various action situations, such as policy and innovation processes across multiple scales, are embedded.

The participants are human actors – individuals and organizations – that take part in an action situation (Ostrom, 2011). Meanwhile, they are influenced by the biophysical and material context, the socio-economic conditions as well as the existing institutional setting. The outcome of an action situation and the processes of interaction are assessed using various evaluative criteria, determined by the participants in and by those observing the action situation. These criteria, for example, can be sustainability or distributional equity (McGinnis, 2011). In the following discussion, the IAD elements are explained in further detail and expanded by a value perspective.

4. Discussion: Adding a value perspective to the IAD framework

A consideration of underlying values requires expanding the original IAD framework. The following paragraphs describe the role of values in related elements of the IAD framework, using the conceptualizations of values outlined in Section 2. The results of our analysis are summarized in Figure 2.



IAD elements (e.g. Rules)

Value aspects relevant for IAD elements (Source Discipline) (e.g. Values embedded in rules (Institutional Economics))

Fig. 2. IAD framework highlighting the role of values (adapted based on Ostrom (2005, p. 15))

4.1. Participants

Participants can act as individuals or groups representing an entity. Ostrom defines participants as fallible learners that can learn from mistakes and gain more and more information over time. Meanwhile, their action choices are influenced by incentives or constraints of exogenous variables (Ostrom, 2011).

Assuming that human behavior is driven by personal or professional characteristics and attributes the sociological and psychological definition of values can deliver important implications for actor behavior regarding energy systems. Values work as principles influencing or driving human behavior and are thus specific characteristics of personality (Schwartz, 1992). For example, Perlaviciute and Steg (2015) investigated the effects of egoistic values (e.g. valuing wealth and social power) and biospheric values (e.g. valuing unity with nature and environmental protection) on evaluations of nuclear and renewable energy. They found that strong biospheric values led survey respondents to ascribe significantly more importance to the environmental consequences of nuclear and renewable energy. Additionally, the stronger respondents' biospheric values, the more negative consequences they ascribed to nuclear energy. The opposite effect was observed for renewable energy, where biospheric values were positively correlated with positive evaluations of renewable energy.

4.2. Evaluative criteria for outcomes and patterns of interaction

The conceptualization of values in ethics of technology and institutional economics allows us to outline the role of values as evaluative criteria for outcomes and patterns of interactions. Concerning outcomes we apply the definition of Pahl-Wostl et al. (2010), who defined three types of possible outcomes of action situations: institutions, knowledge, and operational outcomes. The latter, for example, also captures the innovation of new technologies for which the definition of values from ethics of technology offers important implications. Values can be used to define and design essential characteristics of technologies. This is grounded in the understanding that technologies cannot be seen as neutral objects but as value-laden (Flanagan, Howe and Nissenbaum, 2008; Winner, 1980). In the same way, values can serve as design principles and characteristics of institutions. This implication, however, mostly derives from institutional economics: values are influential for institutional change and become embedded in institutions through value judgements (Bush, 2009).

To assess the performance of a system, outcomes as well as patterns of interactions are judged by specific evaluative criteria. Ostrom mentions various types of these criteria, e.g. sustainability, distributional equity, and consistency with other moral values (Ostrom, 2011). Evaluative criteria include values as they are defined in moral philosophy: goal-oriented assessment criteria and normative principles that are worth striving for and that socio-technical developments should adhere to (Shrader-Frechette and Westra, 1997). Two examples highlight how values can serve as evaluative criteria for outcomes and interaction patterns. Firstly, if the focus of an action situation is to incentivize investment in renewable energy technologies, the outcome (i.e. the actual investment in renewables) can be assessed using values as evaluative criteria. A hypothetical region A with a high degree of small-scale solar power might be compared with region B with a focus on hydropower. Region A is likely to incorporate the values of consumer empowerment and participation in energy generation to a higher degree, while this might come at the expense of system reliability due to a higher degree of intermittent supply. Region B is likely to focus on values of emission-free, large-scale, relatively secure energy supply, while this might come at the expense of local ecosystems near hydropower dams. Secondly, and with regard to interaction patterns, the degree to which a variety of stakeholder groups is involved in decision-making processes on the siting of wind parks (i.e. the degree of procedural justice) might influence the acceptance of the wind park by local communities (Devine-Wright, 2005).

4.3. Biophysical/material conditions

The biophysical/material conditions in the IAD framework describe the physical environment of an action situation (Ostrom, 2005). This includes the physical and human resources needed to produce and provide goods and services, such as capital, labor, technology, sources of finance, and distribution channels (Polski and Ostrom, 1999).

In our understanding of energy systems as socio-technical systems it is important to stress that the biophysical/material conditions include the humanly devised technologies to generate, distribute, and consume energy.

Research in ethics of technologies allows us to understand that values are embedded in the technologies to generate, distribute, and consume energy through the design and use of these technologies. As values are seen as design goals, engineers create technologies with the aim to incorporate specific values (Shilton, Koepfler and Fleischmann, 2013). Ethicists analyze the moral repercussions of using certain technologies and not others because technologies do not only fulfil the specific function for which they were designed but can have unintended side-effects (Barry, 2001). As an example, we look at the value implications of hydropower dams. While often considered as sustainable, because they offer emission-free energy generation, important moral repercussions include effects on the river ecosystem and distributive justice, particularly with respect to downstream water supply and the fair distribution of water along the entire length of the river.

4.4. Attributes of community

The attributes of the community in the IAD framework describe the social and cultural context of the focal action situation (Polski and Ostrom, 1999; McGinnis, 2011). Attributes that are important in affecting action situations include values or behavior generally accepted in the community, the level of common understanding about the structure of types of action situations, the degree of homo-/heterogeneity in preferences, the size and composition of the community, and the extent of inequality of distribution of basic assets among those affected.

Although the literature on the IAD framework explicitly mentions values as important attributes of a community, insights from moral philosophy are helpful to define values in the context of a community in greater detail: values are normative principles about what is a good and right development in a given community. The degree to which a community perceives certain values to be important influences the potential outcomes that are subject to choice in an action situation and the actual outcome that participants decide upon. An example of such shared normative principles for energy policy that need to be considered in an institutional analysis can be seen in the three focus objectives of the European Union's energy strategy and policy: security of energy supply, affordability of energy for consumers, and environmental sustainability (European Commission, 2018). This was not always the case. Until approximately halfway through the first decade of the 21st century, European energy policy was dominated by a neoclassical perspective to create efficient markets. However, as policy makers increasingly recognized the threats associated with anthropogenic climate change and the need to decarbonize the energy system, the reduction of carbon emissions by moving away from the use of fossil fuels became an important goal for European policy making (Correljé et al., 2015).

4.5. Rules

The rules in the IAD framework denote the exogenous institutional environment of the action situation. Values are influential for institutional change and seen as entities that are embedded in institutions (Correljé et al., 2015). Because of this, the exogenous rules shaping an action situation will embed the values for which they were previously designed. In a similar way as values are seen as embedded in technologies, rules are value-laden. Essentially, institutional economists view a change of rules as a change of value judgement by the community involved in creating rules (Knudsen, 1993). The example of European energy policy mentioned above can be extended to illustrate how values become embedded in rules. Because of the shared understanding of energy security, affordability of energy for consumers, and environmental sustainability, these three values have become the EU's focus objectives. For example, as the value of environmental sustainability was operationalized by European energy policy makers in terms of reducing carbon dioxide emissions, it became embedded in the design of a range of policies, such as the European Emissions Trading Scheme and national support schemes for wind and solar power generation (Correljé et al., 2015).

5. Conclusion

In this paper, we have developed a novel framework to analyze normative reasons behind institutional change processes in energy systems. Using the IAD framework as a basis, we expand it by a value perspective. We draw from conceptualizations and insights on values in moral philosophy, institutional economics, and social psychology/sociology to highlight the role of values for different IAD elements. The examples used above show that values serve as evaluative criteria for different system designs. Hence, our framework allows cross-sectional, comparative analysis of energy systems. Taking the example of acceptance or rejection of certain technologies, our analysis can either provide possible retrospective explanations, where techno-economic approaches fell short or be used for a pre-assessment of certain technologies that might touch core societal guiding principles. This paper shows that a value perspective is needed when examining factors and challenges regarding institutional change in energy systems.

Acknowledgements

Funding for work on this article has been provided by the Netherlands Organization for Scientific Research (NWO) under the Responsible Innovation Program [Grant No. 313-99-305], the Amsterdam Institute for Advanced Metropolitan Solutions (AMS), and TFECO B.V. The authors like to thank Rolf Künneke, Sandra Venghaus, Holger Schlör, and Geerten van de Kaa for valuable comments on previous versions of this article.

References

- Barry, C., 2001. The Ethical Assessment of Technological Change: An overview of the issues. *Journal of Human Development*, 2(2), pp.167–189.
- Bush, P.D., 2009. The Neoinstitutionalist Theory of Value: Remarks upon Receipt of the Veblen-Commons Award. *Journal of Economic Issues*, 43(2), pp.293–306.
- Cheng, A.S. and Fleischmann, K.R., 2010. Developing a meta-inventory of human values. *Proceedings of the ASIST Annual Meeting*, 47.
- Correljé, A., Groenewegen, J., Künneke, R.W. and Scholten, D.J., 2015. Design for Values in Economics. In: J. van den Hoven, P.E. Vermaas and I. van de Poel, eds., *Handbook of Ethics, Values, and Technological Design: Sources, Theory, Values and Application Domains*. Dordrecht: Springer Netherlands, pp.639–666.
- Devine-Wright, P., 2005. Beyond NIMBYism: Towards an integrated framework for understanding public perceptions of wind energy. *Wind Energy*, 8(2), pp.125–139.
- Dietz, T., Fitzgerald, A. and Shwom, R., 2005. Environmental Values. *Annual Review of Environment and Resources*, 30(1), pp.335–372.
- European Commission, 2018. *Energy Strategy and Energy Union*. [online] Available at: <<http://ec.europa.eu/energy/en/topics/energy-strategy-and-energy-union>> [Accessed 19 Jan. 2018].
- Flanagan, M., Howe, D.C. and Nissenbaum, H., 2008. Embodying values in technology: Theory and practice. In: J. Van Den Hoven and J. Weckert, eds., *Information technology and moral philosophy*. New York: Cambridge University Press, pp.322–353.
- Gagliardi, F., 2008. Institutions and economic change: A critical survey of the new institutional approaches and empirical evidence. *Journal of Socio-Economics*, 37(1), pp.416–443.
- Knudsen, C., 1993. Modelling Rationality, Institutions and Processes in Economic Theory. In: U. Mäki, B. Gustafsson and C. Knudsen, eds., *Rationality, institutions and economic methodology*. London, UK: Routledge, pp.265–299.
- McGinnis, M.D., 2011. Networks of Adjacent Action Situations in Polycentric Governance. *Policy Studies Journal*, 39(1), pp.51–78.
- Ostrom, E., 2005. *Understanding Institutional Diversity*. [online] Princeton: Princeton University Press, Princeton, New Jersey: Princeton University Press. Available at: <<http://www.amazon.com/dp/0691122385>>.
- Ostrom, E., 2011. Background on the Institutional Analysis and Development Framework. *Policy Studies Journal*, 39(1), pp.7–27.

- Pahl-Wostl, C., Holtz, G., Kastens, B. and Knieper, C., 2010. Analyzing complex water governance regimes: The Management and Transition Framework. *Environmental Science and Policy*, 13(7), pp.571–581.
- Perlaviciute, G. and Steg, L., 2015. The influence of values on evaluations of energy alternatives. *Renewable Energy*, 77, pp.259–267.
- Pojman, L.P., 1997. What Is Moral Philosophy? In: K.S. Shrader-Frechette and L. Westra, eds., *Technology and Values*. Lanham, Md.: Rowman & Littlefield Publishers, pp.11–23.
- Polski, M.M. and Ostrom, E., 1999. An Institutional Framework for Policy Analysis and Design. In: D.H. Cole and M.D. McGinnis, eds., *Elinor Ostrom and the Bloomington School of Political Economy: A Framework for Policy Analysis*. Lanham, Md.: Lexington Books, pp.13–47.
- Rohracher, H., 2008. Energy systems in transition: contributions from social sciences. *International Journal of Environmental Technology and Management*, 9(2–3), pp.144–161.
- Rokeach, M., 1973. *The nature of human values*. New York: Free Press.
- Schwartz, S.H., 1992. Universals in the Content and Structure of Values: Theoretical Advances and Empirical Tests in 20 Countries. *Advances in Experimental Social Psychology*, 25(C), pp.1–65.
- Shilton, K., Koepfler, J.A. and Fleischmann, K.R., 2013. Charting Sociotechnical Dimensions of Values for Design Research. *The Information Society*, 29(5), pp.259–271.
- Shrader-Frechette, K.S. and Westra, L., 1997. Overview: Ethical Studies about Technology. In: K.S. Shrader-Frechette and L. Westra, eds., *Technology and Values*. Lanham, Md.: Rowman & Littlefield Publishers, pp.3–10.
- Taebe, B. and Kadak, A.C., 2010. Intergenerational considerations affecting the future of nuclear power: equity as a framework for assessing fuel cycles. *Risk Analysis*, 30(9), pp.1341–1362.
- Van de Poel, I., 2009. Values in engineering design. In: A.W.M. Meijers, ed., *Handbook of the Philosophy of Science*. pp.973–1006.
- Van de Poel, I. and Royakkers, L.M.M., 2011. *Ethics, technology and engineering: an introduction*. Chichester, West Sussex: Wiley-Blackwell.
- Williamson, O.E., 1998. Transaction Cost Economics: How It Works; Where It is Headed. *De Economist*, 146(1), pp.23–58.
- Winner, L., 1980. Do Artifacts Have Politics? *Daedalus*, 109(1), pp.121–136.