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EDITORIAL

Energy strategy research – Charter and perspectives of an emerging discipline

This Charter is aimed at helping all energy system stakeholders – authors, editors, academics, practitioners, and decision-makers in energy business, government and non-government organizations (NGOs) alike – to maintain focus in their energy strategy research. It defines and describes the subject area covered by energy strategy as an emerging and holistic research discipline, for which Energy Strategy Reviews (ESR) provides the peer-reviewed publication platform. ESR provides authoritative content on strategic decision-making and vision-sharing related to society's energy needs including all aspects of energy strategy analysis, energy system modeling, feasible project options, scenarios, the decision-making process and stakeholder process modeling. The type of presentation can be an analysis, case study or report review. *Energy Vision* contributions are by invitation only, and written by a high profile leader from a prominent industrial organization, international agency, non-governmental organization, consultancy or research institution in energy. ESR frequently receives manuscripts that deal with detailed technical solutions, often for a subset of local energy systems. Such material is unsuitable for the scope and purpose of this journal (see aims & scope, and author guidelines at: http://http:/www.journals.elsevier.com/energy-strategy-reviews//). The ESR editorial board and guest editors for special issues have jointly prepared the points below. These are not intended as "golden rules", but as guidelines for establishing the contours of energy strategy research and its practical applications.

1. *Scope, scale and perspectives of energy strategy research*. Energy strategy research, development and implementation encompass the analysis, planning, decision-making and practical steps required to go from a present energy system to a future energy system. The system may be studied in local, regional, national, or global context so as to meet certain aspirations: security of supply, access to affordable and reliable energy, limiting environmental impacts of energy use, and creating sustainable communities. Various perspectives can be taken by energy system modelers, corporate strategists, governments and energy end-users (Fig. 1a–d).

2. *Focus on the future and energy transformation process*. An informed energy strategy recognizes the need for fundamental transformations in our energy systems to respond to changing societal needs, perceptions, choices and emerging planetary boundaries. Energy strategy research is a holistic discipline which strives to effectively combine technology solutions, business principles, economics, political and social sciences in order to achieve more informed, accurate, measurable and effective strategies that can be evaluated for future energy solutions. To optimize future energy systems, the development of new and improved system options and their implementation strategy must take into account progress in data analysis, foresight methods, science and technology as well as the uncertainties related to the input parameters (i.e., regulations, financing and technology issues) and future conditions (i.e., changing markets, depletion of fossil fuels, climate change, and revised regulations). Studying the possible options for directing the dynamics of the energy transition process is a core part of energy strategy research.

3. *Strategy implementation and lessons learned*. Energy strategy modelers and analysts need to be connected with policy makers who are concerned with implementing these models in both the public and the private sectors. Personal accounts of energy strategy decision-making processes by senior and major decision-makers are part of energy strategy knowledge development. Dissemination of human ingenuity to develop and implement sustainable energy solutions is an essential part of energy strategy research that includes both models and practitioner insights. Forward-looking energy strategy research leverages insights and understandings gained from past strategy choices that have been operationalized. Measured and verified analyses of the outcomes from previously implemented energy strategies provide a solid foundation for the formulation of new strategies which is why the assessment of historic energy evolution and choices is part of energy strategy research.

4. *Energy system model perspective*. From an energy system modeler perspective (Fig. 1a) a range of energy resources and technology solutions may be considered for the energy strategy development process. Energy system models and energy strategy models go hand-in-hand. The former have an academic emphasis and the latter include an additional aspect of practical application. Advances in the efficacy and/or efficiency of a particular energy system are part of the core topics studied by energy strategy as a discipline. However, such studies should not have too narrow of a scope. The best energy solutions should reflect system analyses that take into account a wide range of societal boundary conditions: leverage of economics, availability of resources and technologies, and environmental footprint reduction.

5. *Corporate strategy perspective and partisan energy visions*. We recognize the reality of partisan energy strategies. Energy strategies developed by companies and professional societies (Fig. 1b) are commonly dedicated to a particular subset of energy systems. An energy strategy and the associated project options for its realization can be classified as partisan when aimed at promoting maximum market penetration of one particular or a limited set of energy technology options with individual groups competing to grow market share and creating

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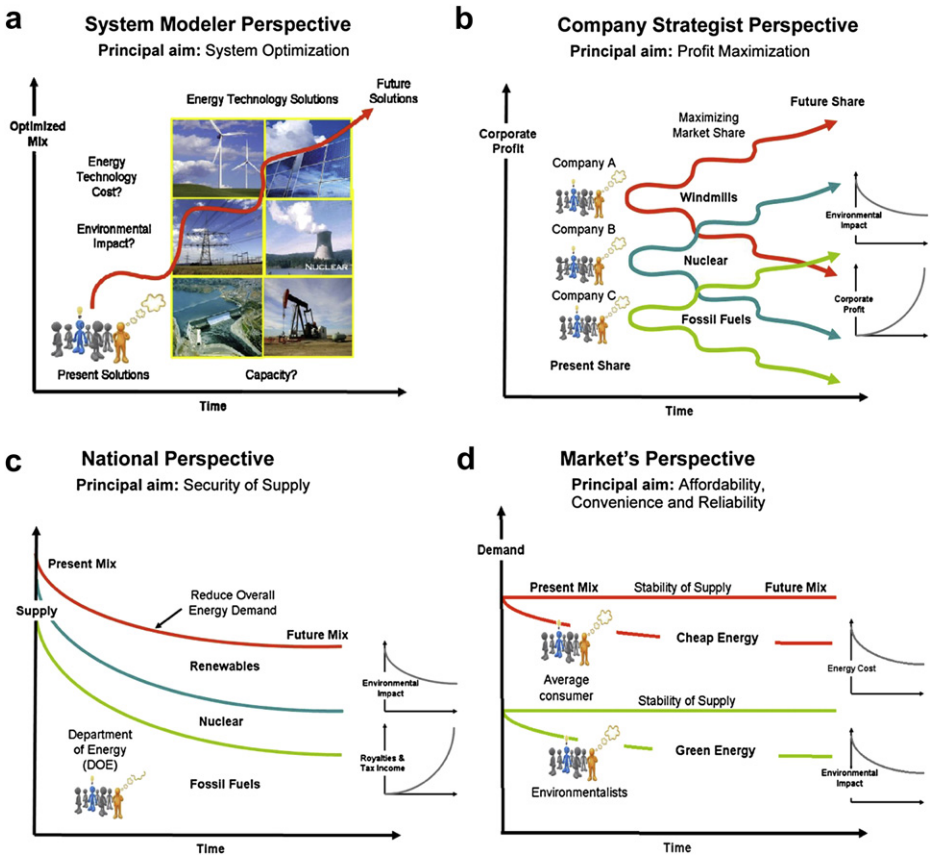

Fig. 1. a–d. Examples of stakeholder perspectives involved in, and affected by, energy strategy decisions. All players start from a present energy system state and have a vision for a future state, but may have different objective functions for system optimization. a: Energy system modelers generate a range of possible solutions based on simulations and scenarios with logical operators and desired directions to devise optimal strategies. b: Companies promote energy strategies that maximize their profits and advocate fair competition, but compete to maximize market share and profits, often focused on a subset of the energy system. c: Arbitrary energy mix scenario highlighting how governments investigate energy strategy options and policies to generate royalties and taxes, stimulate natural resources development, provide anti-trust regulation and fair market access for all (in theory). Reduced reliance on fossil fuels is accounted for in the scenario shown which incorporates the effects of policies fostering demand side management, efficiency improvements and life style changes. d: Consumers prefer free choice of energy and energy system providers. Environmentalists favor green energy and lower overall energy use, and average consumers are less sensitive to environmental concerns but prefer cheap energy.

profits for one or more subsets of the energy system at the expense of other subsets (see the profit-driven objective of companies in Fig. 1b). Hence the biased perspective may address and investigate the broader question of what optimization parameters are viable from a corporate perspective. Informed comparisons of corporate energy strategies (integrated and hybrid analyses, economics, funding and technology) — along with the highlighting of synergies and antagonisms — are part of energy strategy research. Companies and their affiliated partners are not necessarily acting alone in their preferential choices to promote one or more energy system options (see point 7).

6. *Government energy strategy perspective and balanced solutions*. From a government perspective (Fig. 1c), an energy strategy may be based on the full range of primary energy resources and related technology solutions. Optimization criteria are important to better understand the highest utility or lowest cost for energy, and choices should be supported by energy system models and life cycle analyses that assess optimization possibilities based on established or new boundary conditions (e.g., expansion of energy infrastructure, cartelization, embargos on technology transfer, market penetration and commercialization of end-use technologies, greenhouse gas emission reduction targets, and more general targets for the reduction of the environmental footprint). A national energy strategy may include the development of a portfolio of balanced solutions as a way of hedging against future uncertainties, which explains why energy strategy research is concerned with the management of risk and uncertainty.

7. *National energy strategy and partisan policies*. A national energy strategy plan can be partisan: optimizing national energy without consideration of other nations can occur and may lead to global tensions. Energy strategy development and implementation include a fair component of energy policy-making. Energy strategy research seeks to alert for national energy strategies, policies and regulations that inappropriately facilitate choices based on populist demand, antiquated public perceptions, special interest groups and vested interests of providers of ineffective energy systems. Political rhetoric and manipulating markets for the benefit of specific companies, governments and NGOs should not be mixed with energy system analysis but could be an area of critical appraisal, particularly when assessing their impact on energy system development and choices. Energy strategy research develops and documents knowledge that is in the best interest of local and global communities and for the planet's sustainable future.

8. *Energy market perspective*. Research about energy market behavior (Fig. 1d) and assessments of the societal needs, environmental impact and economic implications of current energy systems and future energy strategy scenarios are part of the energy strategy development process and represents a significant area for research. Penetration rates of new technologies, their limitations and potential evolution in regional or global context are part of energy strategy research and require

an open-minded approach that includes energy solutions with multifaceted and multi-disciplinary aspects. Sustainable energy solutions that reduce and reverse their impacts on the environment should be based upon measurable results and require networking with all relevant disciplines ranging from the natural sciences, quantitative and qualitative economics, behavioral economics, applied mathematics, engineering, and social sciences.

9. *Stakeholder alignment on strategy choices*. Research of the key factors and solutions to overcome impediments to energy strategy implementation, including the effective management of stakeholder processes, are part of the energy strategy research discipline. This includes studies of the dynamics and drivers in the alignment process between leading private and public sector decision-makers to optimize strategy choices for future energy systems. Research of major energy development projects is part of energy strategy as a discipline, as long as the strategic dimension remains the principal focus.

10. *Technology tools*. Technology tools that support and improve energy system and strategy models are considered part of the core topics studied by energy strategy as a discipline. Research into algorithms and optimization methods for system control are not part of energy strategy's disciplinal core focus, unless they touch upon topics that affect strategy choices such as transitioning from regular to smart grid systems and explicitly address the strategic dimensions.

It is recognized that the guidelines suggested here for energy strategy research may not prevent the adoption of sub-optimal outcomes in future energy system decisions. Government energy strategies, whilst appearing long term, in reality often need to ensure that these will sufficiently satisfy all stakeholders (the electorate) to ensure re-election of the incumbent political party at the next election. This means long-term objectives are sometimes traded for short-term political support. Likewise, corporate strategies with capital expenditure for long-term programs must still ensure their projects generate sufficient short-term profits to comply with bank covenants and provide dividend streams to meet shareholder expectations. This means long-term solutions that are deemed too expensive today by a majority of stakeholders may need to wait until all concerned agree we cannot afford to let future generations pay the price for forfeiting such long-term solutions.

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