International Journal of
Sustainable Energy Planning and Management

Energy Transition and Sustainability

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ABSTRACT

This issue presents some of the latest findings within energy planning research and form a special issue for the 2021 5th *Annual Conference of the Portuguese Association of Energy Economics* as well as for the *2020 Sustainable Development of Energy, Water and Environmental Systems conference series.* The work presented probes into the effects of the European emissions' trading system on innovation, and the development of the Chinese wind power industry. Notable is also an analysis of people at Portuguese universities revealing lesser knowledge of renewable energy technologies but a more positive attitude towards this among women – and vice versa among men. EnergyPLAN-based energy systems analyses with cases from Iran and Serbia are presented, and different indicators for energy systems analyses are deliberated in a Mexican context. Marine energy developments in Columbia, the United Kingdom, Canada and Denmark are discussed with a focus on siting and barriers. Also, barriers against solar energy exploitation in Indonesia are explored as are barriers against energy savings in Nigeria.

Keywords

Policy
Planning
Energy systems analyses
Resources
Barriers

http://doi.org/10.5278/ijsepm.6850

1. Special APEEN issue on Energy Transition and Sustainability

This special issue presents research on energy transition and sustainability, as presented at the 5th Annual Conference of the Portuguese Association of Energy Economics (APEEN), which was organized by the Center for Environmental and Sustainability Research (CENSE) at NOVA School of Science and Technology in 2021 [1].

Climate change and sustainability are challenging energy systems to new levels of innovation, in terms of technology, regulation and social values. The decarbonization of energy systems may have implications for the sustainability of the Planet, as several examples already show, as land use change due to mega PV farms and expansion of mineral extraction areas with ecosystems losses to supply energy technologies. Moreover, pathways to achieve carbon neutral systems have to consider social aspects to avoid and revert social inequalities. Public policies and regulation are crucial to tackle energy transition towards carbon neutrality while preserving, and even restoring, the Planet's sustainability.

Public policies and instruments have been fundamental to accelerate the energy transition and to tackle sustainability issues, although its effectiveness and impacts need to be assessed. Silva et al. [2] assess the impact of the European Union emission trading system (EU-ETS) on the companies' eco-innovation, by using the Community Innovation Survey data and a stringency indicator for the period 2012-2014 for 13 European countries. The results show the EU-ETS has had limited and some controversial effects, and discusses other

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eco-innovation enhancing instruments, as technology related policies.

The role of public policies in energy transition is also taken by Brusiło [3] regarding the wind power industry in China, supported by the so-called Revealed Comparative Advantage (RCA) index, for the period 2000-2019. Although the continuous support of the Chinese state authorities to the international competitiveness and innovativeness of the national wind power industry, the author found a comparative disadvantage in wind power products, despite the significant increase in export volumes and installed capacity.

Alongside public policies, energy literacy is a powerful tool to boost sustainability. Martins et al. [4] used the heteroskedastic ordered probit over data from Portuguese university members to explore the differences between men and women regarding the level of engagement in the transition to a more sustainable future. Results show that women tend to have lower levels of knowledge about energy, but a more positive and sustainable attitude and behaviour.

2. Special SDEWES issue on Energy Transition and Sustainability

The SDEWES (Sustainable Development of Energy, Water and Environmental Systems) conference series has proven an import venue for the discussion and dissemination of results on studies of the transition towards a renewable energy-based society.

In this issue, Bijelic and Rajakovic [5] use the widely applied EnergyPLAN energy systems analyses tool [6,7] to analyse feasible options for Serbia to transition its energy system. Their starting point is a lack of attention to the renewable energy transition the Western Balkan. In their work, the authors focus on scenarios based on increased penetrations of wind power and photo voltaics. As noted by the authors, high penetrations – here up towards 80% - are only realistic "with the sector coupling approach".

Western Balkan has previous been used as a testing ground for what in other places is denoted smart energy systems approach [8] with notable contributions from Bačeković [9,10] and Dominković [11,12].

3. Energy systems analyses

Noorollahi et al. [13] also apply the EnergyPLAN tool to study a geographical area with too little focus on renewable energy transitions. In their analyses of the city of Qazvin, Iran, they investigate the technical, environmental and economic feasibility of switching heating demands from natural gas to renewable energy. If the alternative is to export the saved natural gas, then the pay-back time of the investment according to the authors would be as low as three years.

Gamst et al. [14] address energy systems modelling using a more generic approach based on linear programming. As opposed to the analytical programming forming the basis of EnergyPLAN, this opens up for potentially time-consuming heuristics. Thus, in their analyses they seek ways to decrease the complexity of the issue through a time aggregation technique. Through these techniques, they reduce the time consumption by 75-90%.

Lastly, in this section on energy system analyses, Hernandez-Hurtado & Martin-del-Campo [15] analyse different sustainability indicators for the transition of the Mexican power system. They introduce indicators for Average capacity diversification, Natural gas importation, New clean power plants, Total cost, Generation-consumption regional balance, Average emission factor, and Intended Nationally Determined Contributions goals met. These are related to previous overviews in e.g. [16], though e.g. the share of clean coal-fired power plants is novel here in the context of renewable energy

4. Energy Savings and Resources

Indonesia is the fourth largest contributor of carbon dioxide emissions to the atmosphere despite good prospects for renewable energy exploitation. An ambitious PV implementation policy is targeting homeowners, however, the uptake is below expectations. Gunawan et al. [17] take this as a starting point for exploring why this is the case finding explanations in knowledge and awareness but also in economic conditions including feed-in-tariffs and net-metering structures.

Energy conservation should be the first step in the transition towards renewable energy systems. Nigeria is a country with good prospects for energy conservation – however there is a lack of focus on this essential element. Umoh & Bande [18] investigate the reasons for this situation, finding a lack of attention to best practice and that e.g. the government should work harder on phasing our inefficient lighting technologies.

5. Marine and offshore energy

Bastidas-Salamanca & Rueda-Bayona [19] investigate offshore windpower in Columbia with a focus on developing an approach for site-selection based on techno-environmental characteristics. One thing in particular, for instance, is that the authors consider the proximity of ports a postive thing where others according to the authors list this as a negative thing which may exclude otherwise potentially interesting sites. The work follows up on previous work from the journal focusing on offshore wind power however from a Danish German perspective where the market is more mature, and where focus is on e.g. the development of off-shore grids [20]. It is also in line with a focus point the SDEWES conferences on offshore wind and wave energy siting and resource assessment [21–25].

Lastly, Proimakis et al. [26] explore the landscape for other marine energy technologies. Based on interviews with stakeholders in the United Kingdom, Canada and Denmark, the authors find that financing is a major hurdle for the development and installation of other marine energy technologies. Apart from economic issues, small-scale development and testing facilities are also facing hurdles in terms of environmental impact assessments. One driver for the technology could be local ownership as also advocated by e.g. Hvelplund [27–29] and Gorroño-Albizu [30]. Aaen et al.[31] take the additional step and debate the term *"sensemaking"* – that technologies need to make sense for local public acceptance.

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