

# Policy dialogue on the assessment and convergence of renewable energy policy in EU member states

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## Introduction to the Special Issue

With Directive 2009/28/EC, the European Parliament and Council have laid the grounds for the policy framework for renewable energy sources (RES) in Europe until 2020. The European Union (EU) aims at a share of at least 20% RES in the European gross final energy demand by 2020 and at least 27% until 2030. European Member States (MS) have developed a variety of support instruments such as feed-in tariffs, premiums, investment incentives and quota systems (certificate trading for RES electricity-E, obligations for RES heat-H). To ensure that the RES-targets are reached, coordinated policy efforts and diffusion of best practices in RES policy design are required to support RES deployment in all MS. In this context, the optimization of the design of RES support policies, as well as the continuous evolution of cooperation mechanisms are key focus points of the policy debate.

This special issue aims at supporting the policy dialogue on the assessment and convergence of RES policies in European Member States, aligning latest practices, innovations and case studies with academic frameworks and theories. Five articles have been selected that contribute to the policy dialogue on the assessment and convergence of renewable energy policy in EU Member States.

The special issue opens with an article by Gustav Resch, Marijke Welisch, Lukas Liebmann, Barbara Breitschopf and Anne Held, who aim at contributing to the RES policy debate by evaluating costs and benefits resulting from enhanced RES development in the European Union in the 2020 and 2030 frame. To this end, they develop a standardized

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analytical concept based on the specialised energy system model Green-X that considers the diversity of present RES policies and depicts the costs and benefits of RES deployment at three different levels (energy system, micro and macro level), while avoiding double counting of economic effects. The results of the analysis allow for a transparent evaluation of costs and benefits of RES deployment and constitute a valuable tool for cross-country comparisons and policy assessment. In the 2020 frame, the quantitative results derived show that costs and benefits of fulfilling RES targets are rather unevenly distributed among EU Member States. Therefore, stronger cooperation between countries will be of mutual benefit. In the 2030 frame, the agreed target of 27% RES appears feasible to achieve but not without a financial burden for the EU and at country level. A clear and guiding framework and the removal of currently prevailing non-economic barriers is a key necessity to keep the cost burden low and to balance costs with accompanying benefits.

In the second article, Inga Boie, Mario Ragwitz and Anne Held provide a comprehensive analysis of the impact of energy policy and the regulatory environment on the deployment of renewable energy technologies for the case of Germany and present a forecasting model for future RES diffusion. In the context of this study, a composite indicator for assessing the framework conditions for RES development, with a focus on wind energy (onshore) and photovoltaic (PV), has been developed. The presented indicator approach has three key components. First, the indicators are based on in-depth, semi-structured interviews with RES developers and energy sector stakeholders to identify the main drivers and barriers (determinants) for RES diffusion. Second, a questionnaire-based survey was developed to understand the relevance (weights) of the individual determinants. Finally, an analysis of past RES diffusion patterns was carried out leading to the deduction of a model for short-term RES diffusion forecasts. The results highlight the substantial impact of both, economic and non-economic framework factors on the development of PV and wind energy in Germany and show that the application of such composite indicators is a promising approach to understand and predict patterns of RES diffusion and to support policy making.

The third paper, by Barbara Breitschopf, Anne Held and Gustav Resch, presents a framework for a detailed cost and benefit assessment of RES deployment which is applied to the case of Germany. While the first paper by Resch et al. is focusing on a model-based analysis of future RES cost and benefits, this third paper sets the focus on the cost and benefits, as they actually occurred and puts the accent on a thorough analysis of concepts and required data. The developed concept expands on a wide-ranging analytical framework, which helps to identify the different effects of policies, such as burdens and pass-through mechanisms to final energy consumers. The impacts of RES are classified on three levels: the energy system, the micro-level and the macro-economic level. While the assessment at the system level mainly comprises direct and indirect additional costs and benefits of RES-development, the micro-level examines the supplementary expenditures or revenues of the different actors and price effects. Finally, we capture the impacts of RES-use on the national economy from a macro-economic perspective. Both RES electricity and heat are investigated. The results of the comprehensive quantitative impact assessment of the German renewable energy use suggest that higher generation costs due to RES deployment in the electricity and heat sector are partly compensated by positive effects mainly related to avoided emissions at the system level. At the level of the electricity market, small power consumers bear a major share of the policy costs, while other actors profit

from the use of renewable energy technologies. The presented concept facilitates a differentiated evaluation of a wide range of effects of RES deployment and provides valuable insights into the distribution of the resulting costs and benefits across different economic actors.

In the next article, Dimitrios Angelopoulos, Robert Brückmann, Filip Jirous, Inga Konstantinavičiūtė, Paul Noothout, John Psarras, Lucie Tesniere and Barbara Breitschopf provide a methodology for the assessment of the most critical risk components related to renewable energy investments. They present a quantification of the cost of capital for new onshore wind energy investments in all EU Member States. As a cornerstone of their paper, the Weighted Average Cost of Capital (WACC) has been used and quantified based on diverse methods such as the Capital Asset Pricing Model (CAPM). In order to validate the model results, a series of interviews with renewable energy project developers and financiers across the EU has been conducted. The outcomes of this study demonstrate that, apart from country-specific risks, especially policy-related risks exert a high impact on the cost of capital for RES investments. Further they show that significant differences exist depending on the geographical region and the level of market development. Thereby, the paper contributes to the RES policy dialogue, particularly by pointing out effective measures for tailored, risk-reducing policy designs.

The final paper of this special issue, authored by Marijke Welisch, Gustav Resch, André Ortner and Christoph Zehetner, focuses on the assessment of the merit-order effect and the market values of renewable energy technologies, namely wind and solar PV, while considering the historical electricity price development in several European countries. The approach builds on a multivariate regression analysis and ex-post calculations in order to depict the impact of renewable electricity on spot market prices, market values and the merit-order effect. The outcomes of this study show a consistent, negative impact of renewable electricity feed-in on electricity spot market prices and a decrease of the market value of renewable electricity with rising RES shares. By providing cross-country comparisons and insights into a large geographical spread of European electricity markets, this paper provides valuable implications for policy makers.

As guest editors, we hope that this special issue contributes to the policy dialogue on the assessment and convergence of renewable energy policy in the EU context and to an efficient deployment of renewable energy sources in the 2030 frame.

## **Dr. Haris Doukas**

### *Biographical notes*

Dr. Haris Doukas is a mechanical engineer (Aristotle University of Thessaloniki – AUTH, 2003), holding a PhD degree on the decision support systems for the sustainable energy sector's operation (National Technical University of Athens – NTUA, 2009). Dr. Doukas is currently an assistant professor in the School of Electrical & Computer Engineering, NTUA. His areas of expertise include the development of models and decision support systems for energy and climate policy. In these fields, he has more than 70 scientific publications in international journals and numerous announcements in international conferences, chapters in books, etc. For his work, Dr. Doukas has received awards by the State Scholarship Foundation (IKY), the NTUA, the AUTH, the Technical Chamber of Greece (TCG) and the Hellenic Operational Research Society (HELORS).

## **Dr. Wolfgang Eichhammer**

### *Biographical notes*

Dr. Wolfgang Eichhammer is head of the Competence Center *Energy Policy and Energy Markets* at the Fraunhofer Institute for Systems and Innovation Research. He is further professor for Energy Efficiency and Energy Systems Modelling at the Copernicus Institute of Sustainable Development, Utrecht University. He is a physicist (PhD) with professional experience in a large number of countries in energy efficiency, renewable energy sources and climate protection. He is a technical advisor, among others, to national governments, the EU Commission and the EU Parliament, the World Bank and private companies in questions related to strategic developments for energy efficiency and renewables. In the field of energy efficiency, he has supported the EU Commission in the development of the Directive for the Energy Performance of Buildings, the Energy Services Directive and the Energy Efficiency Directive. For the German government, he worked on financing instruments to promote the transformation of the German energy system. He and his colleagues are further working on the reform of the German financing schemes for renewable energy sources as well as on projections for technological developments in the energy field with a time horizon up to 2050.

## **Dr. Alexandros Flamos**

### *Biographical notes*

Dr. Alexandros Flamos is assistant professor of Techno-economics of Energy Systems at the University of Piraeus (UNIPI). He has a degree in Electrical and Computer Engineering and a PhD in the area of Decision Support Systems, applied in energy and environmental policy and planning. He teaches Energy Management and Technoeconomics of Energy Systems at graduate and post graduate level at UNIPI and at the National Technical University of Athens (NTUA). He has over 15 years of working experience in the scientific areas of Decision Support Systems, Energy Management and Planning and their applications for analyzing energy and environmental policy, energy and environmental modeling, security of energy supply and energy pricing competitiveness. He has held the position of scientific coordinator/senior researcher in more than 30 EC-funded projects related to energy systems management, appraisal, planning, etc. and as consultant in projects funded by international donors. He has more than 80 publications in high impact international scientific journals and international conferences.

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