

Contents

1	Introduction	1
1.1	Background	1
1.2	Aim and Structure of the Study	2
2	Framework for the Development of a Long-Term Viable Energy System	5
2.1	General Aims of Energy Systems	5
2.2	Conceptual Role of Security and Safety for Energy Systems	7
2.3	Robustness as a Basic Aim for Energy System Development	8
2.3.1	Dynamic Stability	9
2.3.2	Social Robustness	13
2.4	Means for Tackling Complex Social Choices	14
2.4.1	Safe and Secure Energy Supply Through System Examination	14
2.4.2	Ethical Decision Support for Energy Transition	23
2.5	Summary and Conclusions	33
3	Prospects and Limits of Scientific Policy Advice for Future Energy Systems	35
3.1	Specific Challenges in Scientific Policy Advice	36
3.1.1	Academic Research and Scientific Expertise	36
3.1.2	Epistemic Values Involved in Expert Advice	38
3.1.3	Non-epistemic Values Involved in Expert Advice	42
3.2	Dealing with Risks, Uncertainty, and Ignorance in Expert Advice	46
3.2.1	Knowledge Deficits in Expert Advice	46
3.2.2	Using Non-epistemic Freedom to Fit Expert Advice to the Purpose	49
3.3	The Social Aspects of the Concept of Risk	52
3.4	Typical Characteristics of Uncertainty and the Precautionary Principle	55

3.4.1	Dimensions of Scientific Uncertainty	55
3.4.2	Post-normal Science	57
3.4.3	The Precautionary Principle	59
3.5	Summary and Conclusions	65
4	Characterisation of Recent Energy System Analyses	69
4.1	Characterisation Schemes for System Analyses	70
4.1.1	From System Correlations to Analyses	70
4.1.2	Derived Tools for Meta-Analysis of Studies	76
4.2	General Coverage and Actors of Currently Existing System Analyses	83
4.2.1	Research Themes	84
4.2.2	Institutions and Disciplines Involved	85
4.2.3	Conclusions	92
4.3	Examples of System Analyses Consulted for Specific Questions	95
4.3.1	Official Scenarios for Analysing Germany's Future Energy System	96
4.3.2	Analyses for Deriving Estimates of Balancing and Energy Storage Requirements	105
4.3.3	Analyses with Regard to Non-technical Parts and Framework Conditions	131
4.4	Summary and Conclusions	138
5	Specific Economic Problems and Uncertainties in the Context of Energy Systems	141
5.1	Some Problems of Sustainable Energy Policy	142
5.2	On Discounting: (Un-)Certainty, Time Trends and Generations	151
5.2.1	Theory of Discounting Under Certainty	151
5.2.2	A Theory of Discounting Under Uncertainty	152
5.2.3	Empirics	154
5.2.4	Policy	155
5.3	Oil Price Trends or Random Walk?	158
5.3.1	The Growth of Oil Prices from a GARCH Perspective	161
5.3.2	Is Two-Way Causality a Way Out? A Vector-Error Correction Perspective	163
5.4	The Impact of the EU-ETS on the Prices of Emission Certificates and Electricity	166
5.4.1	CO ₂ Cost Pass-Through Under Perfect Competition in Retail Markets	166
5.4.2	CO ₂ Cost Pass-Through under Imperfect Competition in Retail Markets	167

5.4.3	Capacity and Uncertainty: Profits in the Wholesale Market	168
5.4.4	Empirics: Profit Maximisation and Functional Forms of Price Elasticity Estimates	169
5.4.5	Improving the Empirics of Sluggish Consumer Behaviour	170
5.4.6	The Impact of Carbon Prices on Electricity Prices	171
5.5	Summary and Conclusions	174
6	Energy System 2050: Impacts of Uncertainties on the Optimal Electricity Generation Mix	175
6.1	Focus of the Analysis: Future Electricity Generation	175
6.2	Energy System 2050: Optimal Electricity Generation Mix?	177
6.2.1	Methodology	177
6.2.2	Application Case Study	179
6.2.3	Reference Scenario	181
6.2.4	Sensitivity Analyses.	183
6.3	Summary and Conclusions	186
7	Political Challenges in Managing Transitions of Energy Systems Beyond Pure Energy-Economic Modelling	187
7.1	Implications from System Analyses for Governance and Policy Instruments	187
7.1.1	General Considerations	187
7.1.2	Operational Incentives and Co-ordination	189
7.1.3	Investment Incentives and Co-ordination	190
7.1.4	Regulatory Settings and Co-ordination of Expectations.	191
7.2	Multi-level Governance and Europe's Energy Transition.	192
7.2.1	Energy Transition from a European Perspective	192
7.2.2	The German Energy Transition	202
7.2.3	Challenges to Effective Action	204
7.3	Summary and Conclusions	205
8	Conclusions and Recommendations.	207
8.1	Reflections on Improving Scientific Policy Advice for Future Energy Systems	207
8.2	Recommendations	212
8.2.1	General Aims of Scientific Policy Advice.	212
8.2.2	Dealing with Uncertainty	213
8.2.3	Practical Implications for the Design of Energy System Studies	214
8.2.4	Beyond Pure Techno-Economic Analyses.	215

Appendix A.	217
Appendix B.	225
Appendix C.	227
Glossary	231
References.	237
List of Authors	251
Further volumes of the series <i>Ethics of Science and Technology</i> <i>Assessment</i> (Wissenschaftsethik und Technikfolgenbeurteilung)	255

Improving Energy Decisions

Towards Better Scientific Policy Advice for a Safe and
Secure Future Energy System

Droste-Franke, B.; Carrier, M.; Kaiser, M.; Schreurs, M.;
Weber, C.; Zieseimer, Th.

2015, XLIII, 257 p. 31 illus., 12 illus. in color., Hardcover

ISBN: 978-3-319-11345-6