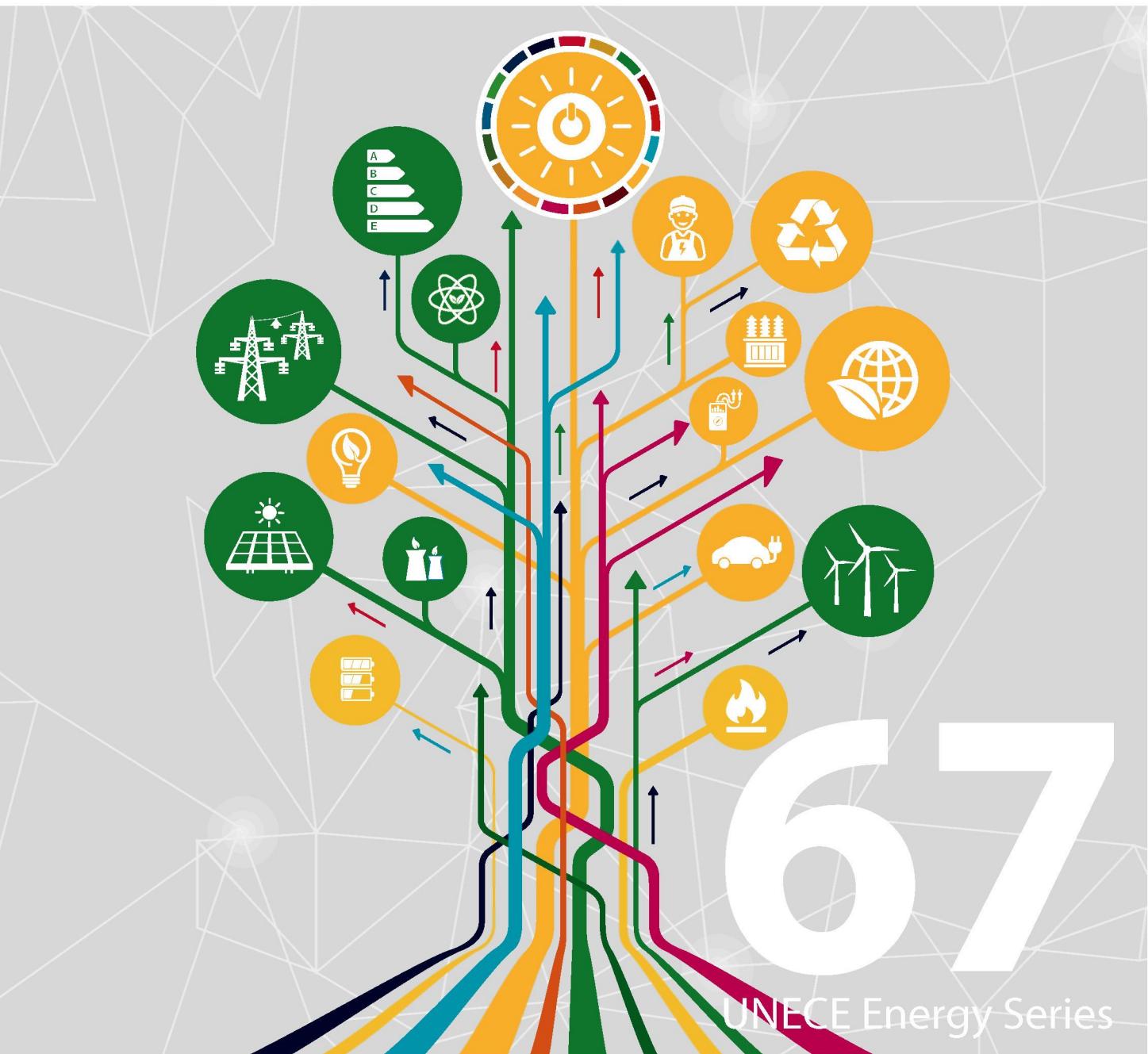


Pathways to Sustainable Energy

Accelerating Energy Transition in the UNECE Region



Contents

Foreword.....	iii
Acknowledgements	iv
Glossary.....	vii
Abbreviations	x
Executive Summary.....	xi
Policy Imperatives	xiii
1. Introduction	1
2. Pathways Project Design	2
2.1. Defining Sustainable Energy	3
2.2. Measurement of “Sustainable Energy” that can be Incorporated in Integrated Climate and Energy Assessment Models	4
2.3. Policy Scenarios for the Modelling Exercise	6
3. Modelling Results for Sustainable Energy Scenarios in the UNECE.....	7
3.1. Sustainable Energy in the UNECE Region Today.....	7
3.2. Energy Demand: Projections for the UNECE Region up to 2050.....	8
3.3. Energy Demand: Projections for UNECE Subregions up to 2050.....	9
3.4. Energy Supply: Projections for the UNECE Region up to 2050	12
3.5. Energy Supply: Projections for UNECE Subregions up to 2050.....	14
3.6. Projections for Investment Requirements in the UNECE Region up to 2050	16
3.7. Pillar I: Modelling Implications for Energy Security and Regional Interdependence	19
3.8. Pilar II: Modelling Implications for Energy and Environmental Sustainability	21
3.9. Pillar III: The Importance of Energy Affordability	22
3.10. Trade-offs and Synergies between the Three Pillars of Sustainable Energy	23
4. Solutions to Attain Sustainable Energy in the UNECE Region.....	27
4.1. Pursue Energy Efficiency as the Basis for Systemic Efficiencies	28
4.2. Address GHG Emissions from the Fossil Fuels.....	29
4.3. Accelerate the Interplay between Renewable Energy and Renewable / Decarbonised and Low Carbon Gases.....	30
4.4. Address the Social and Economic Impact of the Energy Transition.....	32
4.5. Increase Investments in Renewable Energy in Subregions and Accelerate Energy Transition in Low-Income Countries.....	33
4.6. Embrace Water-Energy-Food Nexus Approach Across the Whole Region	35
4.7. Sustainable Resource Management for Energy Storage Solutions	36
5. Conclusions	38
6. Annex	39
6.1. Scenario Building Process	39
6.2. Early Warning System Concept.....	39
6.3. Linking the Sustainable Energy Pillars to the 2030 Agenda.....	40
6.4. Measuring “Sustainable Energy” in Integrated Assessment Models	43
6.5. Summary of the Pathways Project KPIs for Sustainable Energy	43
References	46

List of Figures

- Figure 1 Pathways to Sustainable Energy Subregions
Figure 2 Energy for Sustainable Development
Figure 3 Modelling Approach
Figure 4 From Storylines to Policy Pathways
Figure 5 Primary Energy Demand in the UNECE Region by Policy Scenario
Figure 6 Final Energy Demand in the UNECE Region by Policy Scenario
Figure 7 Final Energy Demand in UNECE Subregions by Policy Scenario
Figure 8 Electricity Generation in the UNECE Region by Policy Scenario
Figure 9 Electricity Generation Capacity in the UNECE Region by Policy Scenario
Figure 10 Electricity Generation in UNECE Subregions by Policy Scenario
Figure 11 Comparing Investment Requirements in the UNECE Region by Policy Scenario
Figure 12 Energy Trade Balances in UNECE Subregions by Policy Scenario
Figure 13 CO₂ Emissions in the UNECE Region by Policy Scenario
Figure 14 Energy Poverty in the European Union
Figure 15 Trade-offs and Synergies based on Energy and Environment Indicators in the UNECE Region by Policy Scenario
Figure 16 Energy for Sustainable Development in the UNECE Region
Figure 17 Integrated Coal Value Chain
Figure 18 Interplay between Renewable Energy and Natural Gas
Figure 19 Environmental, Economic and Social Concerns
Figure 20 Non-renewable vs. Renewable Electricity Generating Capacity by Subregions and Policy Scenario
Figure 21 Water-Food-Energy Ecosystem Nexus
Figure 22 Global Demand for Metals
Figure 23 Demand for Battery Energy Storage for Selected Countries
Figure 24 Elements of an Early Warning and Planning System Highlighting the Role of Indicators and Modelling
Figure 25 Links to SDGs in Defining the Framework of Energy for Sustainable Development

List of Tables

- Table 1 Scenario Descriptions and Variations
Table 2 Indicators for Measuring Energy Security Criteria
Table 3 Indicators for Measuring Energy for Quality of Life Criteria
Table 4 Indicators for Measuring Energy and Environment Criteria