Renewable Energy and Landscape Quality

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Climate change was considered the biggest potential threat to the global economy in a survey of 750 experts at the World Economic Forum in 2016 (http://reports.weforum.org/global-risks-2016/). This risk is linked to other global risks such as social instability and large-scale involuntary migration (ibid.) which shows the interrelation between environmental, economic, and socio-cultural aspects at the global scale. Both the problems of climate change mitigation/renewable energy production and the loss of landscape/environmental quality have to be addressed at various scales from global policy down to local action.

On a regional and local level, Nuertingen-Geislingen University (NGU) as a university of applied sciences intensively pursues inter- and transdisciplinary research and teaching of economic, ecological, and societal aspects of sustainable development. The German name of the University—Hochschule für Wirtschaft und Umwelt or University for Economy and Environment—underlines this integrative approach. Also, on the research map of the German Rectors’ Conference, NGU is included with two research priorities related to environment/landscape and energy/economy:

- Applied agricultural research, landscape development, environmental planning and nature conservation
- Sustainable management in the energy, automotive, and real estate industries

Against this background, the COST Action TU1401 ‘Renewable Energy and Landscape Quality’ has been fully within the research scope of our university and contributed significantly to the international visibility of NGU as a research institution with a strong focus on transfer and application. Leading an international research network of this size with more than 200 participants from 37 countries in Europe and beyond would not be possible without both institutional support of the university as well as personal dedication and devotion of the faculty and staff involved.

With 97 contributing authors, the book Renewable Energy and Landscape Quality as a main product of the four-year COST Action shows the potential of international and interdisciplinary collaboration. I hope that this book finds a responsive audience, so that future policies, political decisions, and planning documents can contribute to optimise trade-offs between renewable energy systems and landscape quality protection by promoting an effective and efficient renewable energy policy without jeopardising the assigned values and inherent qualities of European landscapes.

Nuertingen, April 2018

Prof. Dr. Carola Pekrun
Vice-Rector for Research and Transfer at Nuertingen-Geislingen University
In response to climate change, limited fossil fuels, and rising energy demand and prices, renewable energy is being heavily promoted throughout Europe. While objectives to boost renewable energy and trans-European energy networks are ambitious, it is increasingly understood that public acceptance becomes a constraining factor, and general support for green energy does not always translate into local support for specific projects. Perceived landscape change and loss of landscape quality have featured heavily in opposition campaigns in many countries, even though renewable energy can facilitate sustainable development, especially in disadvantaged regions rich in wind, water, biomass, geothermal, or solar energy.

Climate change mitigation and adaptation is a major societal challenge, and renewable energy is a core element in the transition to a low-carbon society. This will reshape our landscapes. It is unlikely that existing landscape management mechanisms will be effective in adapting to climate change and facilitating renewable energy development. New deliberative, interdisciplinary, and integrated approaches are needed to inform and guide the transformation process and to create a vision and coalition for reconciling renewable energy systems and landscape quality across public, stakeholders, and sectoral, administrative, and geographical boundaries.

Against this background, COST Action TU1401 ‘Renewable Energy and Landscape Quality (RELY)’, running from 16 October 2014 to 15 October 2018 investigated the interrelationships between renewable energy production and landscape quality, and the role of public participation for the acceptance of renewable energy systems. Starting as a relatively small network with around 20 academics from 18 institutions in 13 European countries and Canada at the proposal stage, the partnership grew rapidly over the lifetime of the Action: more and more countries joined the Action and individual attention was raised through networking tools and events like training schools, special sessions and co-organisation of scientific conferences, and a traveling exhibition. In the final phase of the Action, the research network consisted of more than 200 individual members from nearly 100 institutions (academic, governmental, and non-governmental) in 35 European countries, Canada, and Israel. The disciplinary backgrounds of the members involved include social sciences, engineering, political sciences, and interdisciplinary fields like geography, landscape planning, and landscape architecture. With this wide coverage in terms of geographical scope and disciplinary background, the Action network formed an ideal basis to overcome fragmented national and sectoral research, language, and cultural barriers. Moreover, the Action consolidated existing research networks across the natural science/social science/engineering divide, thereby creating a network of networks:

- EEEL: Emerging Energies, Emerging Landscapes
- PECSRL: The Permanent European Conference for the Study of the Rural Landscape
- EUCALAND: European Culture expressed in Agricultural Landscapes
- RESERP: Spanish Renewable Energy and Landscape Network
- IALE-Europe: International Association for Landscape Ecology—European Chapter
- NLRN: Nordic Landscape Research Network
- NIES: Nordic Network for Interdisciplinary Environmental Studies
This book presents the results of almost four years of collaboration. The large network of the Action has made it possible to produce a pan-European synopsis of 32 contributing countries regarding their national situations concerning renewable energy and landscape quality (section 1).

The Action was organised in four working groups (WGs): WG 1 reviewed specific renewable energy production systems and their impacts on landscape character and quality in Europe from a past, present, and future perspective and produced a systematic review of the nexus between renewable energy systems and Europe's landscapes' qualities (section 2). WG 2 assessed landscape functions and qualities and their sensitivity to and potential for specific renewable energy production systems. These analyses were used to produce: (i) a typology of best practices of sustainable, landscape-compatible renewable energy production systems, (ii) guidance for assessing the potential of areas for specific renewable energy systems in terms of effects on landscape quality or character, (iii) a catalogue of relevant criteria, indicators, and respective GIS-available proxy-data for assessing the suitability of landscapes for renewable energy systems (section 3). WG 3 investigated socio-cultural aspects of sustainable renewable energy production and proposed modes and means of integrating specific aspects of renewable energy in participatory toolkits to increase public acceptance of renewable energy projects (section 4). WG 4 focused on the synthesis of findings, the dissemination of results towards different target groups, and the facilitation of collaboration across working groups by providing a multi-lingual glossary of terms (section 5).

COST stresses cooperation in science and technology by addressing academics, public and private (research) institutions, as well as non-governmental organisations (NGOs), in order to increase research impact on policy-makers, regulatory bodies, and national decision-makers as well as on the private sector. That emphasis is also reflected in this book: to supplement existing communication channels like scientific articles, conference presentations, and the Action's website (http://www.cost-rely.eu/), a book format and layout were chosen, which is intended to motivate potential readers to explore the multi-facetted aspects of renewable energy landscapes. At the same time, the book addresses policy-makers at EU and national levels as well as decision-makers in public agencies and business to encourage internationally accepted best practice. Following the general principle of the European Landscape Convention, and general provision of the Aarhus Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters, that the public is entitled to environmental information, this book can also inform and empower citizens and NGOs to build on solid research results in participation and decision-making processes.

It is with great appreciation that we acknowledge the funding provided by the COST Association over the past four years as part of the EU Framework Programme Horizon 2020. Without that specific funding scheme that allows both cooperation and exchange, targeting a wide geographical scope across Europe and beyond, leveraging national research investments and building capacity by connecting high-quality scientific communities in Europe and worldwide, this book would not have been possible.
The main objective of the Action was to develop a better understanding of how European landscape quality and renewable energy deployment can be reconciled to make socio-environmental contributions to the sustainable transformation of energy systems. Four Working Groups put their focus on different aspects during the four-year lifetime of the Action:

1. Renewable energy production systems and impacts on landscape quality
2. Landscape sensitivity and potentials in terms of renewable energy production
3. Socio-cultural aspects of sustainable renewable energy production
4. Synthesis of findings and dissemination

The Core Group of the Action consisted of the Action Chair Michael Roth from Germany and Action Vice-Chair Sebastian Eiter from Norway, the working group chairs and vice-chairs as listed in Figure 0.2.1, and the STSM Coordinator, Serge Schmitz from Belgium. The position of WG4 vice-chair was transferred during the Action from Malgorzata Lachowska (Poland) to Isidora Karan.

In addition the activities of the working groups, the Action was quite active in dissemination activities and events. Figure 0.2.2 shows the time table of the work done during the four years of the Action.

The Action was submitted by academics from 13 European countries plus Canada. At the kick-off meeting in October 2014, the Action had already grown to members from 27 European countries plus Canada, and it kept growing to 200 participants from
Regarding **gender balance**, COST RELY was doing fine: 47% of all participants were female. In the Core Group, 50% of the members were female. The share of female participants at meetings was between 37% (kick-off Meeting) and 53% (Lisbon, Portugal, 2015). Half of the STSMs were carried out by female participants and 59% of the training school participants were also female.

The action chair and three out of four WG vice-chairs are **early career investigators** (ECI), who were also well represented within the whole Action.

35 European countries as well as from Canada and Israel until the final conference in September 2018.

Besides Cyprus and Luxembourg **inclusiveness target countries** (ITC) were well represented in the Action. Almost 50% of the participating countries and almost 40% of participants belong to ITCs, as well as all four WG vice-chairs. The share of participants from IT countries at meetings was between 40% (Lisbon, Portugal, 2015) and up to 67% (Brno, Czech Republic, 2018). Nearly 65% of the STSMs between 2015 and 2018 were carried out by members from ITCs and nearly half of the participants of the two training schools also came from ITCs. Meetings in ITCs were held in Bosnia & Herzegovina, Czech Republic, Croatia, Hungary, Portugal, and Slovenia.
Figure 0.2.3
Countries participating in the COST Action RELY.
Author: Sina Röhner.
Figure 0.2.4
Meetings and STSMs of the COST Action RELY.
Author: Tadej Bevk.
1.1 Albania
1.2 Austria
1.3 Belgium
1.4 Bosnia and Herzegovina
1.5 Bulgaria
1.6 Croatia
1.7 Czech Republic
1.8 Estonia
1.9 France
1.10 Germany
1.11 Greece
1.12 Hungary
<p>| | | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>48</td>
<td>1.13</td>
<td>Iceland</td>
<td>52</td>
<td>1.14</td>
<td>Ireland</td>
<td>54</td>
<td>1.15</td>
</tr>
<tr>
<td>62</td>
<td>1.19</td>
<td>Malta</td>
<td>64</td>
<td>1.20</td>
<td>Montenegro</td>
<td>66</td>
<td>1.21</td>
</tr>
<tr>
<td>74</td>
<td>1.24</td>
<td>Romania</td>
<td>76</td>
<td>1.25</td>
<td>Serbia</td>
<td>78</td>
<td>1.26</td>
</tr>
<tr>
<td>86</td>
<td>1.29</td>
<td>Sweden</td>
<td>88</td>
<td>1.30</td>
<td>Switzerland</td>
<td>90</td>
<td>1.31</td>
</tr>
<tr>
<td>88</td>
<td>1.30</td>
<td>Switzerland</td>
<td>92</td>
<td>1.32</td>
<td>United Kingdom</td>
<td>96</td>
<td>1.33</td>
</tr>
<tr>
<td>60</td>
<td>1.18</td>
<td>Lithuania</td>
<td>68</td>
<td>1.22</td>
<td>Norway</td>
<td>72</td>
<td>1.23</td>
</tr>
<tr>
<td>72</td>
<td>1.23</td>
<td>Portugal</td>
<td>78</td>
<td>1.26</td>
<td>Slovakia</td>
<td>82</td>
<td>1.28</td>
</tr>
</tbody>
</table>
Situation of Renewable Energy
The French Landscape Law was passed in 1993, which aimed at protecting and developing landscapes across the breadth of contexts (natural, urban, or rural). Twenty years later the national debate about renewable energy commenced. Only now, after France hosted the COP21 in 2015 and in order to meet the enacted climate obligations, is RE increasing its share of energy production.
In 2015, RE represented 9.4% of primary energy consumption. Except for hydropower, of which France is the third biggest producer in Europe after Norway and Sweden, the use of RE is at an early stage. Compared to other countries, there are relatively few wind turbines, solar thermal, or photovoltaic panels. Since December 2017, the national energy company EDF has been contacting private households to promote the installation of photovoltaic panels on their rooftops.

Data on Landscape Quality
A national policy to publish a landscape atlas has been supported at the regional level by the DIREN (Regional directorates for the environment) (Davodeau n.d.). Since 2009, the DIREN have been progressively replaced by the DREAL (Regional directorates for environment, planning, and housing). For more information and to view the landscape atlas, see www.statistiques.developpement-durable.gouv.fr/lessentiel/ar/279/1129/atlas-paysage.html.

Data on Landscape Quality
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Data on the environment are edited annually by the SOeS (Service for Observation and Statistics) and published by the Ministry of Ecological and Inclusive Transition. Environmental impact assessments are required in planning processes. The content of the assessment is described in article R.122.5 of the Environmental Code which refers to landscape but not to landscape quality. Different types of protected areas exist in France, such as national parks, regional nature parks, and nature reserves. Although the legislation concerning the environment distributes the relevant authority to different levels of administration (state, regional, departmental, and municipal), the legislation concerning landscape gives an essential role to the national level, in terms of defining the legal framework for different policies for the management of natural areas.

Interaction between Renewable Energy and Landscape Quality
Environmental impact assessments have to be carried out when RE installations are planned. For example, the planning of offshore wind power plants requires an assessment that considers the landscape (Ministère de l’Environnement, de l’Energie et de la Mer 2017), as does the installation of onshore wind power and, on a case-by-case basis so do solar panels (Ministère de l’Environnement, de l’Energie et de la Mer 2017).
According to the Environmental Code, public participation has to be included into the decision-making process relating to projects, plans, and programmes. Public involvement has already led to several achievements, e.g. the Charte de pays (charter of pays, a strategic orientation paper resulting from the collaboration...
between elected officials and public and private stakeholders which provides a vision of territorial evolution for the next ten years and determines favoured development axes), a wind power charter, and directives and objectives for local development. The ‘communauté de communes’ was recognised as pioneering with the Ardenne metropole obtaining EU LEADER project funding. For citizens with a strong attachment to the landscape as a part of their heritage, landscape quality is a very sensitive issue with respect to the acceptance of renewable energy projects, mainly onshore and offshore wind farms.

Solar panels are more acceptable to citizens due to lower impacts on landscape quality. An impressive example are the on-ground solar panels at Les Mées, Alpes de Haute Provence. A construction of which faced a challenge of avoiding negative visual impacts for the village of Les Mées and Puimichel. The project required an investment of approximately 70 M euros between May 2010 and January 2011. The ground preparation and construction phase of the project employed 350 people. It is located on a 36 ha field, comprising 79,000 modules, with a total capacity of 18.2 MW. Annual production of the site is 26 GWh, providing electricity for approximately 9,000 families, and displacing the emission of more than 9,200 t CO₂ annually.

<table>
<thead>
<tr>
<th>RE type</th>
<th>Installed capacity (MW) 2015</th>
<th>Year of the first plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind power onshore</td>
<td>10,013</td>
<td>2000</td>
</tr>
<tr>
<td>Wind power off-shore¹</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marine energy</td>
<td>241</td>
<td>2008</td>
</tr>
<tr>
<td>Small hydropower</td>
<td>2,000</td>
<td>1830</td>
</tr>
<tr>
<td>Large hydropower</td>
<td>25,400</td>
<td>1900</td>
</tr>
<tr>
<td>Solar PV</td>
<td>6,191</td>
<td>1990</td>
</tr>
<tr>
<td>Solar thermo-electric (only on pilot sites)</td>
<td>1.01</td>
<td></td>
</tr>
<tr>
<td>Geothermal</td>
<td>17.2</td>
<td>1985</td>
</tr>
<tr>
<td>Biomass</td>
<td>365</td>
<td>2003</td>
</tr>
<tr>
<td>Biogas</td>
<td>332</td>
<td>2000</td>
</tr>
</tbody>
</table>

¹ In 2011/2012, four projects were attributed off Fécamp, Courseulles-sur-Mer, Saint-Brieuc and Saint-Nazaire, cumulating a power of 1928 MW
In 2013/2014, two projects were attributed off Tréport and the Yeu islands and Noirmoutier, accumulating a power of 992 MW
In 2016, two projects were announced in the frame of a third call for tender off Dunkerque and the Oléron Isla.
Situation of Renewable Energy

In Italy, the demand for energy over the last decades increased steadily until 2005, when it started to decrease due to an economic crisis (Italian National Energy Balance 2013). With regards to fossil sources, natural gas surpassed oil in electricity production in 2000; in 2016, coal covered 20% and biofuels 10% of the total production (199 TWh). In 2015, combined heat and power plants passed traditional power plants and covered 60% of the production. Concerning electric energy, until the early 1960s hydroelectricity covered a good share of generation (82%), but in the following decades there was a rapid increase of thermal generation.

In 2016 electricity demand reached 314 TWh, while the internal gross generation capacity reached 290 TWh. Production by renewables covers 108 TWh. Some technologies are rapidly evolving (SISTAN & Terna 2017), in particular photovoltaics and wind. Efficiency of hydroelectric plants have improved and especially small plants exploit the remaining bodies of water. Moreover, the directive delegates the responsibility for authorising the installation of RET to regions, which are obligated to draw up specific guidelines.

The Italian government issued a first action plan in 2012, and in 2017 a new strategy was approved (National Energy Strategy 2017). It affirms that by 2030 Italy must

• Reduce energy consumption from 1372 TWh (in 2015) to 1256 TWh
• Increase energy consumption from renewable sources from 17.5% to 28%, in particular 55% in electricity (from 33.5%), 30% in thermal energy (from 19.2%), and 21% in transport (from 6.4%)
• Decrease energy costs and reduce dependence from other countries
• Stop energy production from coal
• Improve the quality of the oil refinery chain
• Reduce CO₂ emissions of 39% in 2030 and of 63% in 2050
• Invest in research, sustainable mobility, and resilient energy provision and delivery networks and processes.

The planned investments to improve networks, RE production, and efficiency are 175 billion euros by 2030.

Data on Landscape Quality

In Italy landscape is protected by the Code of Cultural Heritage and Landscape of 2004 (modified in 2008), which updates
previous laws (1939, 1985), to reflect concepts and definitions of the ELC. A large part of the territory is protected, if considered appropriate, both for its outstanding values and intrinsic characters of places. Regions must take care of the protected landscapes by elaborating landscape or territorial plans. Such plans must ‘analyse landscape characteristics, created by nature and history’. They must define detailed frameworks and identify ‘the measures for the correct insertion … of territorial transformation projects’. Few regions approved an updated landscape plan, but all regions manage landscape assessment procedures. Besides the protected landscapes, there are 871 natural parks and protected natural areas, which cover more than 10% of the national area, and 51 UNESCO sites. Other sectoral provisions cover forests, historical heritage sites, hydro-geological fragile areas, etc.

**Interaction between Renewable Energy and Landscape Quality**

Diverse authorities are involved in the assessment and authorisation of RE plants, but a key role is played by regions. They are responsible for the authorisation of RE plants. At the national level a Ministerial Decree of 2010 defined ‘Guidelines for the authorisation of RE plants’. This document sets out the criteria by which regions should identify measures for an appropriate landscape integration, identify unsuitable areas, and define compensatory measures. The Ministry of Culture proposed guidelines for wind energy plants to guarantee landscape design principles for RET by considering the characters of places (morphological, formal, historical, and perceptive factors). Currently, the regions are the main promoters of directives and guidelines; in general, these are heterogeneous documents that consider landscape aspects only partially, aiming at streamlining the process, developing an implementation tool according to the energy policies and, when present, the regional energy plan. Guidelines elaborated within regional landscape plans are different. They provide rules and formulate criteria to support design activity with particular suggestions oriented toward the treatment of landscapes. Guidelines specifically address renewable energy plants. This is the case for Lombardy and Apulia, whose documents identify the most suitable areas for installation and suggest specific studies to evaluate landscape compatibility, while providing examples of good and bad practices. Veneto and Sardinia regions, as well as some provinces, have elaborated guidelines and documents for the assessment of PV plants. The regional directives and guidelines for renewable energies are both tools for design support and decision making. In general, they are oriented to facilitate the construction of plants providing criteria and parameters for the assessment of environmental compatibility.

<table>
<thead>
<tr>
<th>Number of plants</th>
<th>Gross generation capacity in GW</th>
<th>%</th>
<th>Production in TWh</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydroelectric</td>
<td>3927</td>
<td>22.7</td>
<td>19.4</td>
<td>44</td>
</tr>
<tr>
<td>Thermo-electric</td>
<td>5285</td>
<td>64.9</td>
<td>55.4</td>
<td>199</td>
</tr>
<tr>
<td>Geothermal</td>
<td>34</td>
<td>0.8</td>
<td>0.7</td>
<td>6</td>
</tr>
<tr>
<td>Wind</td>
<td>3598</td>
<td>9.4</td>
<td>8.0</td>
<td>18</td>
</tr>
<tr>
<td>Photovoltaic</td>
<td>732053</td>
<td>19.3</td>
<td>16.5</td>
<td>23</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>744897</td>
<td>117.1</td>
<td>100.0</td>
<td>290</td>
</tr>
</tbody>
</table>

Source: Sistan & Terna, 2017

*Table 1.16.1 Renewable energy production in Italy*
Situation of Renewable Energy
The Netherlands is facing a major challenge with regard to its energy supply. Fossil fuels will ultimately run out. Moreover, they increase greenhouse gases. The Dutch National Energy Agreement therefore states that CO₂ emissions should be reduced by 80 to 95% by 2050 and that RE should constitute 14% of the total production in 2020 and 16% in 2024. In 2016 the consumption of energy from renewable sources was 5.9%. The total net electricity production in 2014 was 11039 GWh (Central Statistics Office, [CSO], 2018). The first wind turbines were installed in 1981 (0.25 MW) onshore and in 2007 (108 MW) offshore. In 2018, 2294 wind turbines had a total capacity of 4.2 GW (Bosch & van Rijn 2018).

Data on Landscape Quality
Dutch national law requires an environmental impact assessment. Strategic environmental assessments are also a tool which focuses on the consideration of environmental consequences in plans and programmes, with specific emphasis on the environment. The Netherlands’ Commission for Environmental Assessment uses the Council of Europe’s definition of landscape. As such, landscape can relate to both urban and rural settings, as well as to existing and new attributes. The Cultural Heritage Agency compiled descriptions of landscape character for 78 historic regions. These are intended to inspire municipalities and others to put current environmental changes in a broader time-depth perspective (Cultural Heritage Agency 2018).

- Different landscape mapping projects by national and provincial governments provide various types of data. The most relevant and comprehensive sources are listed as web services (Dutch National Spatial Data Service 2018).
- The Netherlands have assessments considering landscape quality for planning processes for 3 windturbines/15 MW or more. To determine the information required in the environmental assessment, three steps are necessary: 1. Describe or determine the ambition; 2. Describe the landscape qualities; and 3. Determine a tailor-made approach. Every province has developed maps and reports on landscape quality, primarily with a heritage aspect (Cultural Heritage Agency, landschappenederland.nl, bronnen en kaarten). Certain landscapes are protected as World Heritage Sites (Beemsterpolder, Dutch Defense Line), or as cultural monuments (over 450 villages & townscapes, partly agricultural landscapes as well). Furthermore, landscapes can be protected by environmental/spatial planning instruments through the adaptation of provincial efforts. There are 20 national parks as well, but there is no strict legal framework regulating or protecting them.

Interaction between Renewable Energy and Landscape Quality
The transition to alternative forms of energy will have a major impact on the environment. This however has also occurred in the past. Peat extraction left behind large artificial lakes as well
as new settlements along the larger and smaller canals. Following the invention of the wind mill, thousands of new structures soon dotted the open landscape. What is different now is the tremendous speed at which the landscape is changing. This acceleration increases the challenge to complete the transition to a climate-neutral lifestyle solely based on sustainable energy within the next 35 years. Some new energy sources, such as geothermal energy or heat-cold storage, will more or less blend in with the landscape and raise little protest. New wind farms and solar plants, however, will profoundly alter the environment. Finally, we should remember that energy production has also generated a wide range of landscapes and features which today are highly appreciated, such as the Kinderdijk windmills.

The national government is mostly involved in the development of large wind parks (> 100 MW). The national policy for onshore wind energy is focused on the nationally zoned areas for wind energy. Provinces are responsible for wind parks 10-100 MW. Each province has developed their own strategies and zoning categories. These actions are agreed upon through discussions with the national government.

Municipalities are responsible for wind parks < 10 MW. Many municipalities already have developed or are developing policies for RE. Some municipalities, particularly the larger ones, have produced a specific wind vision or policy. In Amsterdam, wind turbines must be at least 2 km away from the world heritage site. An extensive cartographic overview of all existing wind turbines in the Netherlands can be found at Bosch & van Rijn (2018).

Concerning solar energy, there is no specific national policy related to the placement of solar farms in rural areas. Policies are made at the provincial level. Generally, provinces try to prevent agricultural land from being used for solar farms. Different policies apply to farms up to 5 ha and those larger than 5 ha. Many municipalities stimulate individuals and companies to place solar panels on existing surfaces. In Amsterdam there is about 11 km² of suitable rooftop space. The placement of solar panels is primarily influenced through adherence to local regulations related to building and neighbourhood aesthetics and further through rules related to protection of the character of villages and cities (Huub van de Ven 2014).

Many communities attach importance to considering landscape quality when developing projects and plans. Nevertheless, schemes or projects to improve spatial quality or to make existing landscape the primary concern when implementing plans often fail to hold their own in environmental assessments. There is no national consensus on a definition of landscape quality. This intricate situation has complicated the development of processes and evaluation frameworks for the country as a whole. Experts have begun to argue for the movement away from landscape quality to environmental quality (‘leefomgeving’) which, by default, comprises other parameters such as smell and sound but also, in parts, functionality and environmental performance of the country.

<table>
<thead>
<tr>
<th>Wind power onshore</th>
<th>2010</th>
<th>2015</th>
<th>Forecast 2020</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3739 GWh</td>
<td>5880 GWh</td>
<td>6000 MW</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Wind power offshore</th>
<th>2010</th>
<th>2015</th>
<th>Forecast 2020</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>467 GWh</td>
<td>1036 GWh</td>
<td>4450 MW</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Photovoltaic power</th>
<th>2010</th>
<th>2015</th>
<th>-</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>333 GWh</td>
<td>1436 GWh</td>
<td></td>
</tr>
</tbody>
</table>

Table 1.21.1
Wind and solar energy consumption by source and production forecast

Figure 1.21.2
“Electricity production by energy source, CSO, 2018, wind, sun and water, biomass, nuclear energy, other fossil fuels, hard coal, natural gas”
Large-scale hydropower stations in mountainous areas have always been the main source of electricity production in Norway. (Photo: Sebastian Eiter)
By Daniel Herrero-Luque
Situation of Renewable Energy

The UK Committee on Climate Change (CCC) is an independent statutory body. In 2014, it reported that the UK would meet its immediate emission reduction targets due to increased renewable electricity generation and a change from coal to gas power (CCC 2014). The Energy Act 2013 has a binding decarbonisation target which, developed from The Climate Change Act 2008, sets out to achieve an 80% reduction in greenhouse gas emissions from 1990 levels by 2050. The focus on decarbonisation rather than RE generation was centred on the desire to promote gas power as a ‘low carbon’ alternative to coal (HM Government 2011).

By 2016, the gross final energy consumption from renewable sources in the UK was 8.2%, up from 1.1% in 2004 (Eurostat 2018). The contributions of different types of RE have changed significantly, with hydropower providing the greatest proportion in 2000, dropping to fifth largest by 2016 (Figure 1.32.1). Considerable emphasis is now being placed on marine renewables, particularly on tidal power, and expansion of offshore wind energy. The devolved administrations of Scotland, Wales, and Northern Ireland have established their own policies and targets.

Figure 2 illustrates the generation of RE. It shows an increase in the contribution of bioenergy, and seasonal differences with wind contributing more in winter (Q4 and Q1) and solar in summer (Q2 and Q3).

In Scotland and Wales, in particular, there is encouragement for community-led RE development. This forms part of an increased emphasis of policy-makers on sustainable development.
and diversification in rural areas, and social and environmental justice.

The types of RE generation varies across the UK reflecting the distribution of resources (Figure 1.32.3). In 2016, 66% of renewable generation was from England, and 23% from Scotland. The greatest amounts of RE were from onshore wind, principally from Scotland and England. Solar PV is becoming increasingly significant, increasing in England by 29% and in Wales by 18% between 2015 and 2016.

Data on Landscape Quality

At a UK level, there is neither single body responsible for landscape, nor a single dataset which represents its characteristics. Responsibility is divided across the devolved administrations for Scotland (Scottish Natural Heritage), Wales (Natural Resources Wales), and Northern Ireland (Northern Ireland Environment Agency), with the relevant UK government department having responsibility for England (Defra).

Several public policies make explicit reference to landscapes and their enhancement, protection, or management. Examples are the Northern Ireland Landscape Charter (Northern Ireland Environment Agency 2014) and the Scottish Land Use Strategy (Scottish Government 2016).

Across the UK, data on landscapes have been generated through the mapping of landscape character. This has followed the approach set out by The Countryside Agency and Scottish Natural Heritage (2002). The outputs are spatial datasets at national or local authority levels. This mapping has been undertaken by...
INTRODUCTION: ENERGY LANDSCAPE AND LANDSCAPE QUALITY
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<th>Section</th>
<th>Title</th>
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<td>Introduction of RE Types and Their Impacts on Landscape</td>
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<td>Pan-European Policy Aspects of RE and Landscape Quality</td>
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<td>128</td>
<td>2.2.1</td>
<td>Overview of European Policies on RE</td>
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<td>128</td>
<td>2.2.2</td>
<td>Overview of European Policies on Landscape</td>
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<td>2.2.3</td>
<td>Integration of RE and Landscape among Energy, Territorial, Environmental, and Other Policies</td>
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<td>130</td>
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<td>Landscapes in Existing Impact Assessments for Renewable Energies</td>
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<td>130</td>
<td>2.3.1</td>
<td>Impacts on the Visual Landscape</td>
</tr>
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<td>133</td>
<td>2.3.2</td>
<td>Moving from Visual Impact to Impact on Character Approach</td>
</tr>
</tbody>
</table>
In this chapter, a broad overview is provided for describing the state of RE production and the share of RE in total energy consumption for all the countries that have participated in the COST Action RELY. It should be noted that, apart from the EU countries, these include several non-member states. The basis for the overview is data for 2015 from the Eurostat database. A series of cartograms for the main sources of RE as well as total RE production by country is provided in Figure 2.1.1. The cartograms were created using a density-equalising algorithm based on Gastner and Newman’s (2004) approach. In the transformed maps, geometric accuracy is sacrificed, but the area of each country corresponds to the quantity being mapped while at the same time aiming to preserve each country’s shape. This enables a quick grasp of the geographical distribution of the variable in question (Hennig 2013). The complementing pie chart provides guidance to each energy type’s share in the overall RE production in Europe. Marine energy production was excluded from this map series due to its negligible overall share of significantly below 1%. The development of RE capacity has been influenced by a range of complex cultural, contextual, socioeconomic, political, and physical factors (Ellis et al. 2007), which have led to an uneven pace and extent of development. For the majority of the countries, RE production still accounts for less than 15% of domestic energy consumption. The share of RE is lowest in Luxembourg, Malta, Bel-
Primary production of renewable energy in Europe
Each country is proportional in size to its use of primary energy from renewable sources

(a) All main types of energy (excluding marine)

(b) Biomass

(c) Hydro

(d) Wind

(e) Geothermal

(f) Solar

Share of main types of energy in total renewable energy production

Author: Benjamin Hennig, Source: Eurostat, 2015

Figure 2.1.1
Cartograms showing total RE production (a) and of the five most important RE types (b-f) by country, 2015
Energy Landscape and Landscape Quality

usually considered disturbing (Hastik et al. 2015, Frolova 2017). Meanwhile, the perception of other visual elements may depend on the original state of the landscape and its cultural value. Frolova et al. (2015a) for example show that artificial lakes are often considered attractive, many adverse impacts of hydropower plants can be mitigated: diverse solutions such as fish ladders help mitigate the impact on the species that would otherwise be threatened by the drastic changes to their ecosystems (Čada 2001). Power stations and power lines as well as the accompanying infrastructure are considered especially disturbing to the landscape (Hastik et al. 2015, Frolova et al. 2015a) and thus they should be placed underground to reduce their visibility whenever feasible. Utilising existing old infrastructure such as abandoned mills for the construction of small hydropower plants may help with both reducing the monetary cost of a project and reducing the impact on the landscape (Stevovic et al. 2016). Additionally, based on their comparative analysis of power plants in Norway, Bakken et al. (2014) show that landscape impacts of large hydropower plants may be reduced significantly, for example by establishing reservoirs from natural lakes, or by building large run-of-river plants which do not rely on reservoirs at all.

Potential Positive Impacts
Landscape impacts of hydropower plants need not necessarily be all negative. Large dams and artificial lakes can often become major regional attractions, boosting tourism and local income (Hastik et al. 2015, Frolova et al. 2015a). For example, hydropower infrastructure now plays a significant part in the local environment and became an important feature of the landscape in many European mountains (Frolova 2017).
2.1.3 Wind Energy

Marina Frolova & Georgia Sismani

General Overview

In 2015, the installed wind power capacity in the EU was 142 GW: 131 GW onshore and 11 GW offshore. Wind power was installed more than any other form of power generation (44.2% of total capacity) (EWEA 2016). Germany has the largest installed capacity in the EU (45 GW), followed by Spain, the UK, and France. Sixteen EU countries have over 1 GW capacity installed, while nine of them have more than 5 GW (Figures 2.1.1 and 2.1.3.1).

Direct Landscape Impacts

Wind energy landscapes are characterised by considerable height (up to 160 m) of wind turbines (WTs), making their visual or perceived impact on landscape very pronounced (Figure 2.1.3.2) (Hurtado et al. 2004, Wolsink 2007, Möller 2010, Torres-Sibille et al. 2009).

As for offshore wind energy, this is a relatively young but continuously growing industry. The result has been in large-scale deployment of offshore wind farms (OWFs) in many EU coastal countries, in particular in the UK, Germany, Denmark, Belgium, the Netherlands, and Sweden.

Figure 2.1.3.1
Wind energy production across European countries. Authors: Karl Benediktsson & Daniel Herrero-Luque.
In case of OWFs, some potential negative effects could be mitigated through strategic planning (Bergström et al. 2014) and appropriate site selection (Lindeboom et al. 2011). Landscape and seascape character types can provide a good basis for designing guidelines of WFs. All the associated elements, other than WTs, should also be located and designed to respect the character of surrounding landscape (WEDG 2006).

**Potential Positive Impacts**

Although landscape is often cited as an argument in the conflicts around WFs, instead of being considered as a problem for local inhabitants, WTs can even form a positive part of a local landscape and sense of place and affirm an identity in a given landscape (Frolova et al. 2015b). From the aesthetic point of view, WTs can be perceived as sculptural elements in the landscape, evoke positive association where related to modern structures, and be associated with technological efficiency, progress, environmental cleanliness, and utility (WEDG 2006).

As in case of onshore WFs, prior experience of the public with OWFs may significantly influence their perception towards them and thus, at some point they could be considered as part of the local landscape (Ladenburg 2009, Ladenburg and Dubgaard 2009). Many studies indicate that OWFs may also lead to ecosystem benefits, as consequence of reduced pressures from shipping, commercial trawling, and dredging in the area. This may enable the establishment of large areas of seabed, and consequently, creation of a new habitat (Gill 2005, Inger et al. 2009, Wilson and Elliott 2009). Thus, may also be a potential increase in local biodiversity (van der Molen et al. 2014).

**Mitigation Strategies**

Landscapes that previously contained large technical installations (industrial activities, harbor areas, etc.) can more easily assimilate a WF, due to thematic association with industrial structures (Danish Energy Agency 2009). Similarly, WFs could be placed into other visually complex contexts, such as power lines and towers, agricultural buildings, houses, and roads (DEHLG 2006).

The colour of WTs is important for mitigation of their landscape impact. Numerous studies show that ‘no single color of WT will consistently blend with its background and it is more important to choose a color that will relate positively to a range of backdrops seen within different views and in different weather conditions’ (SNH 2009, 8).

Many landscape and visual impacts of WFs could be minimised by the appropriate selection of design, layout, and location (MEEDDM 2010), by avoiding their visibility from sensitive viewpoints (SNH 2009), and by technical monitoring and specific restoration actions (MEEDDM 2010).
2.1.4 Solar Energy

Alessandra Scognamiglio, Georgios Martinopoulos, Emilio Muñoz-Cerón & Marina Frolova

General Overview
Solar energy systems compete with conventional fuels mainly in two applications: electricity and domestic heat generation (hot water and space heating). The most common solar system for electricity production (off and grid connected) is photovoltaics (PV) as solar thermal power (STP), also known as concentrated solar power (CSP) systems, are at an early deployment stage (Rio et al. 2018). Solar thermal collectors are the systems most widely used for domestic heat generation.

At the end of 2016 the worldwide installed PV capacity was about 303 GW, with a market growth in 2016 of about 50%, as 76 GW were added (IEA 2018). The leading country is China, followed by Japan and the USA (representing 26%, 14%, and 13% of the cumulative worldwide capacity, respectively); within the EU (20.5%), Germany and Italy are leading with 14% and 6% respectively (Figures 2.1.1. and 2.1.4.1). The targets set by most EU countries for 2020 were vastly underestimated due to the decrease of PV prices coupled with the incentives provided during the previous years. Moreover, an increase of solar PV electricity...
2.1.5 Geothermal Energy

Karl Benediktsson

General Characteristics
Geothermal resources are categorised as either low or high enthalpy, with temperature of 150 °C at surface pressure often used to separate the classes (Martín-Gamboa et al. 2015). They are either used directly, e.g. for space heating, or for the production of electricity. Geothermal energy contributed some 6% of all RE in Europe in 2015 (Eurostat 2015), but this is very geographically concentrated, with most of the production in only three countries: Italy, Turkey, and Iceland (Figures 2.1.1 and 2.1.5.1) albeit potentially available in many other parts of the continent. A high geothermal gradient (the rise in temperature with depth) is an indicator of geothermal potential. This characterises several regions in Europe (Hurter and Haenel 2002), especially in the three countries already mentioned, as well as parts of Greece and most of Hungary. Large areas of France, Spain, Serbia, Macedonia, and Romania also have rather high geothermal gradients.

Technical Characteristics
Geothermal fluids from high-enthalpy fields are suitable for electricity production. The first such power plants used dry steam (without a liquid component) taken straight out of the ground, but...
The true renewability of geothermal energy resources is open to question (Barbier 2002). Low-enthalpy systems based on naturally flowing hot water are indisputably renewable. However, if greater volumes of steam or fluids are extracted from a subsurface reservoir than are flowing into it, the situation is similar to mining (Arnórsson 2011). This is especially a concern in large projects making use of high-enthalpy fields to produce electricity. To ensure the long-term renewability of a geothermal project, the size of the reservoir thus needs to be very carefully assessed beforehand and closely monitored after use has commenced.

most newer installations use single flash or double flash technology, where the fluid is taken to the surface under pressure and then ‘flashed’ to steam (DiPippo 2015). The use of high-enthalpy fields for space heating and similar purposes requires the use of heat exchangers. Water from low-enthalpy geothermal fields is often suitable for direct use, e.g. for heating of buildings or bathing purposes. It can also be used for electricity generation, although mostly on a small scale using ‘binary systems’ with a secondary working fluid to drive turbines. This technology, which is still developing, could considerably enlarge the role of geothermal energy for electricity production in countries without high-enthalpy resources.

Figure 2.1.5.2
Geothermal pipelines at Nesjavellir, SE-Iceland. The power station is just to the left of the picture (Photo: Brynja Rán Egilsdóttir)
3

LANDSCAPE POTENTIAL AND VULNERABILITY TO RENEWABLE ENERGY DEVELOPMENT
What Fits Where? Landscape Approach to Renewable Energy Development

Introduction: From Issue to Opportunity

Landscape System

Landscape Dynamics

Landscape Character

Landscape as Resource

Concluding Thoughts: The Narrative of Energy Landscape

Developing Renewables in Crowded Landscapes: In Search of International Smart Practice

Introduction

Questing a 'Smart Practice' in Renewable Energy Development

Research Method and Procedure

Dataset of Smart Practice Case Studies

Results

Discussion and Policy Implications

Narrating the Smart Practices of Renewable Energy Development

Tackling Energy Poverty with Renewables: Solar Energy in Peripheral Rural Areas

From Wasted Land to Megawatts: Developing Renewable Energy on Post-industrial Brownfields

Energy Roads and Roofs: Providing Synergy with Existing Infrastructure

Farming, Fishing, and Fermenting: A Green Island Economy

Exploiting Water Courses Sustainably: Seeking a Synergy of Hydropower with Environment

Harvesting Energy and Food: Land Use Synergy via Technological Innovation

Energy Tourism: Embracing Visibility of Renewables as an Asset in the Contemporary Place Competition

The Potential and Vulnerability of Landscapes for Specific Renewable Energy Production Systems

The Bond between Landscapes and Renewable Energy

The How and Who of the Participative Pan-European Expert Assessment

A Spatial Representation of the Experts' Assessment

Discussing Limitations and Future Improvements for This Assessment

Next Steps towards Research and Publications
3.4
THE POTENTIAL AND VULNERABILITY OF LANDSCAPES FOR SPECIFIC RENEWABLE ENERGY PRODUCTION SYSTEMS

Authors: Adolfo Mejia-Montero, Michael Roth & Bohumil Frantál

3.4.1
The Bond between Landscapes and Renewable Energy

Traditionally renewable energy production systems (REPS) have been spatially assessed solely on the basis of resource distribution. This positivist approach has systematically ignored the inherent geographic bond of REPS with social, environmental and cultural elements of pre-existent landscapes. Multifunctional landscapes are able to provide a variety of functions, resources, and options over different land uses. However, most of the times land uses are interconnected, creating competitiveness among stakeholders (local residents, farmers, tourists, nature conservationists, etc.), or between certain landscape functions or features (such as e.g. cultural or aesthetic). Prone to conflict are, in this sense, primarily landscapes characterised by heterogeneity, fragmentation, dynamics, and competition of potential users for limited resources and space —typically peri-urban landscapes at the interface of urban and rural spaces (see e.g., von der Dunk et al. 2011).

Landscape changes are therefore, to a large extent, a by-product of market forces and sectorial policies (Mann & Jeannieux 2009), whose impacts often have the form of unintended consequences (Röhring & Gailing 2005). However, while some landscape functions are regulated (e.g. laws on nature and landscape protection, laws on the protec-
tion and exploitation of mineral resources, etc.), other landscape functions (aesthetic or cultural) usually lack standardisation and are controlled by informal institutions in the form of cultural traditions and norms (Mann & Jeanneaux 2009).

The multifunctionality and heterogeneity of landscapes makes it impossible to create a comprehensive institutional system to regulate all areas, or to reach general consensus on visual fit and compatibility between specific REPS with specific types of landscapes. This is also due to perceptions and evaluations varying in geographical, cultural, and socioeconomic contexts, traditions, and personal experiences.

This is why the present work comprises the first highly participative pan-European expert assessment (99 experts from 28 different European countries) looking at compatibility between different European landscapes, represented by 44 Corine Land Cover (CLC) classes, and different REPS. CLC was chosen as a proxy for landscapes due to its great resolution and the potential homogeneity to assess different European physical landscapes.

The results of this work will hopefully support downscaling to policy-making and guidelines at the national level in Europe, to assist the European energy transition without jeopardising its landscape quality, maximising the multifunctionality of synergies between landscapes and REPS, and improving the overall long-term quality of energy landscapes.

### 3.4.2 The How and Who of the Participative pan-European Expert Assessment

In order to assess the compatibility between CLC and REPS an assessment matrix and questionnaire were developed, with both categories displayed as rows and columns respectively, using as inspiration the work of Burkhard et al. (2009, 2012) assessing compatibility between Ecosystem Services (ESS) and CLC. This questionnaire was then shared with the RELY network of experts, for them to rank each combination of CLC and REPS depending on their professional perception of compatibility, including options for respondents who didn’t feel confident enough to assess specific values (0 = Not relevant, 1 = Completely compatible, 2 = Rather compatible, 3 = Neutral, 4 = Rather conflicting, 5 = Absolutely conflicting, 9 = I don’t know/can’t judge).

In a parallel fashion and attached to this document, a second matrix to assess compatibility between Ecosystem Services (ESS) and REPS included. To enrich the analysis of results each respondent was assigned a number, country of procedence, and area of knowledge: technology (engineers, physicist, etc.), people (sociologists, human geographers, etc.), landscape (landscape architects, landscape managers, etc.), and multi (geographers, energy planning, etc.). A total of 99 expert responses (64,251 data cells), from 28 European countries,
SOCIO-CULTURAL ASPECTS OF RENEWABLE ENERGY PRODUCTION
4.1 Public Acceptance of Renewable Energy Projects: A Focus on Wind Energy

4.1.1 Introduction

4.1.2 Concerns behind Non-acceptance

4.1.3 Wind Energy Acceptance across Europe: What Do Experts Think?

4.1.4 Conclusions and Implications

4.2 Participatory Planning of Renewable Energy with a Focus on Best Practice

4.2.1 Introduction

4.2.2 Standard Participatory Planning in Europe

4.2.3 Innovative Practices of Participatory RE Planning in Europe

4.2.4 Type of Participation in the Planning Processes: Case Studies

4.2.5 Characteristics of Innovative Practices and Regional Differences

4.2.6 Illustrative Case Studies of Innovative Practice

4.3 Tool-box for Effective Renewable Energy Planning

4.3.1 Introduction

4.3.2 Literature and Tool-boxes on Effective Participatory Planning

4.3.3 Towards a Tool-box
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<thead>
<tr>
<th>Project name</th>
<th>County, country</th>
<th>T</th>
<th>I</th>
<th>L</th>
<th>Innovative aspect</th>
</tr>
</thead>
<tbody>
<tr>
<td>AU Energiekultur Kulmland</td>
<td>Oststeiermark, Austria</td>
<td></td>
<td></td>
<td></td>
<td>innovative actor—energy manager; innovative approach—building a regional energy vision, building trust</td>
</tr>
<tr>
<td>CH Solar modules on avalanche barriers</td>
<td>St. Antönien, Grisons, Switzerland</td>
<td></td>
<td></td>
<td></td>
<td>innovative approach—bottom up initiative, multiple use of resources</td>
</tr>
<tr>
<td>CH Linthal 2015</td>
<td>Linthal, Grosstal, Canton of Glarus, Switzerland</td>
<td></td>
<td></td>
<td></td>
<td>innovative approach—well-designed involvement process, building trust and progress in level of participation</td>
</tr>
<tr>
<td>CH Solarpark La Boverie</td>
<td>Payerne, Yverdon Switzerland</td>
<td></td>
<td></td>
<td></td>
<td>innovative approach—building vision on energy region, energy city, multiple use of resources</td>
</tr>
<tr>
<td>DE Energy strategy/policy Zellertal</td>
<td>Arnbruck and Drachselsried (county: Regen), Bavaria, Germany</td>
<td></td>
<td></td>
<td></td>
<td>innovative visualisation techniques—scenario simulation, interactive mapping</td>
</tr>
<tr>
<td>DE GIS-based and participative visual landscape assessment</td>
<td>Mecklenburg-Western Pomerania, Germany</td>
<td></td>
<td></td>
<td></td>
<td>innovative visualisation techniques—GIS, 3D analysis</td>
</tr>
<tr>
<td>DE Interactive visual landscape assessment as a basis for the geodesign of wind parks</td>
<td>Saarland, Germany</td>
<td></td>
<td></td>
<td></td>
<td>innovative visualisation techniques—GIS, scenario simulation</td>
</tr>
<tr>
<td>DE Dezent Zivil</td>
<td>Schopfheim, Baden-Wuerttemberg, Germany</td>
<td></td>
<td></td>
<td></td>
<td>innovative visualisation techniques 3D simulations, innovative approach—bottom up and high proactive initiative</td>
</tr>
<tr>
<td>DE Energy village Wildpoldsried</td>
<td>Wildpoldsried, Bavaria, southern Germany</td>
<td></td>
<td></td>
<td></td>
<td>progress in participation level, innovative approach—building a local energy vision</td>
</tr>
<tr>
<td>NL Energiewerkplaats Fryslân The Energy Atelier Friesland</td>
<td>Province of Friesland, Netherlands</td>
<td></td>
<td></td>
<td></td>
<td>innovative approach—locally tailored approach, innovative techniques—interactive mapping, 3D scenarios, new actors—local energy cooperation</td>
</tr>
<tr>
<td>BIH Micro hydropower plant Čajdraš</td>
<td>Cajdara, Zenica, Bosnia and Herzegovina</td>
<td></td>
<td></td>
<td></td>
<td>innovative approach—multiple use of resources as a goal</td>
</tr>
<tr>
<td>BIH Solar power plant Kalesija</td>
<td>Kalesija, Bosnia and Herzegovina</td>
<td></td>
<td></td>
<td></td>
<td>innovative actor—financial private participation</td>
</tr>
<tr>
<td>CZ Biogas station in Pustêjov</td>
<td>Pustejov, Moravian Silesian Region, Czech Republic</td>
<td></td>
<td></td>
<td></td>
<td>innovative technique—study trip</td>
</tr>
</tbody>
</table>

Table 4.2.5.1
Assessment results of the case studies on innovative participation practices
<table>
<thead>
<tr>
<th>Project name</th>
<th>County, country</th>
<th>T</th>
<th>I</th>
<th>L</th>
<th>Innovative aspect</th>
</tr>
</thead>
<tbody>
<tr>
<td>HR Island Krk—Energy Independent Island</td>
<td>Island Krk, Primorsko—Goranska County, Croatia</td>
<td>⫡</td>
<td></td>
<td>⫡</td>
<td>progress in participation level; innovative approach—financial participation by inhabitants and learning by established models</td>
</tr>
<tr>
<td>HR Biogas Gundinci</td>
<td>Municipality of Gundinci, Brod-Posavina County, Croatia</td>
<td>⫡</td>
<td></td>
<td>⫡</td>
<td>progress in participation level; innovative actor—UNDP innovative approach—multiple use of resources</td>
</tr>
<tr>
<td>HU Coach-BioEnergy</td>
<td>Szada, Hungary</td>
<td>⫡</td>
<td></td>
<td>⫡</td>
<td>innovative approach—multiple use of resources; innovative techniques for information—letters, posters, bringing together—forums and study trips</td>
</tr>
<tr>
<td>HU Csaba Vaszkó—bioenergy feed stock production</td>
<td>Tiszatarjan, Borsod-Abaúj-Zemplén County, Hungary</td>
<td>⫡</td>
<td></td>
<td>⫡</td>
<td>innovative approach—integration of local symbols, meanings and economy context</td>
</tr>
<tr>
<td>SR Energy efficient Kindergartens in Belgrade</td>
<td>Beograd</td>
<td>⫡</td>
<td></td>
<td>⫡</td>
<td>progress of the participation level—broad public information and call for consultation</td>
</tr>
<tr>
<td>SR Small biomass power plant</td>
<td>Dragacica</td>
<td>⫡</td>
<td></td>
<td>⫡</td>
<td>innovative approach—financial participation by farmers</td>
</tr>
<tr>
<td>SR Ecoremediation of degraded areas by energy crops production</td>
<td>Sremska Mitrovica</td>
<td>⫡</td>
<td></td>
<td>⫡</td>
<td>innovative approach—financial participation by farmers multiple use of resources</td>
</tr>
<tr>
<td>FR Ailes des Crêtes wind farm</td>
<td>Chagny and Bouvellermont, Ardennes, France</td>
<td>⫡</td>
<td></td>
<td>⫡</td>
<td>innovative approach—shared benefits and learning by established models</td>
</tr>
<tr>
<td>FR Energ’Ethique 04</td>
<td>Digne-les-Bains, Alpes de Haute Provence, France</td>
<td>⫡</td>
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**TYPOLOGY**  
- ⫤ legalistic  
- ⫩ normative  
- ⫥ instrumental  
- ⫦ substantive

**INCLUSIVENESS**  
- ⫤ narrow  
- ⫥ broad

**LEVEL**  
- ⫤ information  
- ⫥ consultation  
- ⫥ involvement  
- ⫥ collaboration  
- ⫦ empowerment
OUTREACH OF COST RELY AND REFLECTION ON FUTURE STRATEGIES
Transformations in European Energy Landscapes: Towards 2030 Targets

Policy Context

Landscape Change

Renewables and Landscape Change

Integrated Landscape Change

Conclusions

Adaptive Management Strategies for Renewable Energy Landscapes

Introduction

Landscape Change and Adaptive Management

Pathways of Landscape Change

Conclusions

Open Windows to European Energy Landscapes

The Photograph Database Project

Mapping the RELY Photographs

Views of Renewable Energy Landscape Sites

Speaking a Common Language: The COST RELY Glossary as a Basis for Transdisciplinary and International Collaboration

Introduction

Methodological Approach to Glossary Preparation

Overview of Glossary Terms with Examples

Discussion

Conclusion: Future Use

Outreach of the COST Action RELY: Summary of Dissemination Activities

Awareness-raising

RELY Education

Final Remarks
management decisions and actions (e.g. expansion or decommissioning of a development).

An example of such adaptive management strategies in relation to renewable energies (and indirectly the landscape change induced by them) is the so-called ‘floating cap’ for the new installations of wind turbines in Germany. The ‘floating cap’ was introduced as a reaction to the fact that, in 2014 and 2015, more wind turbines had been built than planned. These wind turbines could not all be connected to the electricity grid and/or, the energy transmission system in general could not accommodate all of the energy they produced. With the reform of the Renewable Energy Sources Act in 2017 in Germany, a flexible instrument of reducing feed-in tariffs was introduced, mainly to control the economic efficiency of the system. Although principally an economically motivated adaptive management strategy, this is an illustration of how, even with national policy, flexible approaches are possible.

Fazey et al. (2009, 416) argue that many adaptation strategies focus on improvising short-term capacity to deal with environmental change, but can increase vulnerability to unforeseen changes in the future. Landscapes in which renewable energy systems are being introduced often have characteristics of providing capacity (renewable energy) in response to environmental change (climate change), and in some cases are exposed to risks that are new to an area. For example, the conversion of land use to the production of woodland biomass energy
Landscapes can be managed to adapt to climate change, led by changing societal priorities. Such societal priorities are amongst the driving forces that continuously modify the 'state' of a landscape, making it neither steady nor constant. They may undergo a process of development that can be chaotic and autonomous (Antrop 2005, 31), with more intense dynamics of change leading to it being faster and more extensive (Antrop and Van Eetvelde 2017, 142), i.e. cumulatively large-scale. Precisely which processes of landscape change are dominant, and the consequences of these changes, can vary under different geographic and climatic conditions. Such influences are exerted mainly through the policy-induced acceleration of processes of intensification and extensification, and has an associated increase in the risk of forest fire. The magnitude of the risk may remain small, but the exposure and vulnerability may be significant. Therefore, over a long term the potential for 'disruptive' events increases.

Human responses to drivers for renewable energy or territorial-related policies and socio-economic conditions include investments in financial and social capital. Actors responding to opportunities for the development of renewable energy are taking advantage of technologies which are new, or as they emerge in different places at different times. The consequences for landscapes have been changes in their characteristics, the types and rates of which varies across Europe reflecting differences in biophysical, economic, and social opportunities for such change.
forms and scales were recorded (Figure 5.3.2.2). The sources of renewable power resources illustrated in the photographs are biological, geo-thermal heat, sun; water, and wind. The dominant rural land use for land-based installations is agriculture and forestry. Installations are omnipresent and can even be found in remote, mountain areas, where photographs show the presence not only of hydroelectric power stations, but also of roof and ground-mounted photovoltaic systems. Finally, the database also includes examples of power infrastructure, renewable resources, new siting practices and lastly, but no less importantly, renewable energy landscape bad practices.

5.3.2 Mapping the RELY Photographs

The photo database includes photographs submitted by members from countries ranging from Portugal to Romania and from Greece to Iceland. The map of the photo database sets out renewable energy landscape practices in twenty-one European countries with ample regional representation (Figure 5.3.2.1). Energy systems are well represented by a wider set of resource and installation typologies defined in the COST RELY Glossary (http://cost-rely.eu/resources/glossary). As the map shows and the table proves, solar landscapes are the most common, followed by wind landscapes. Examples of the latter were submitted from thirteen coun-

Figure 5.3.2.1
COST RELY Photograph Database Map. The map shows a predominance of wind and solar farms, both of which are usually associated with scenic landscapes (Source: J.J. González 2017, developed for COST RELY)

Figure 5.3.2.2
COST RELY Photograph Database Chart. The chart shows a preference for both wind and solar farms scenarios—overcoming regional differences. (N. Mestre 2018, developed for COST RELY)
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5.6 IMPACT THROUGH EDUCATION

Isidora Karan

5.6.1 Awareness-raising

Renewable energy is widely considered a desirable way of production energy in the context of sustainable and environmentally responsible development, even though there is community resistance towards renewable energy systems construction. This is mostly related to transformation of recognisable landscape characteristics, but also to negative perceptions of energy landscapes in general (Kontogianni et al. 2014, Silva, and Delicado 2017, see 4.1.). Energy landscape potentials and qualities are not recognised as such and a better understanding of how renewable energy deployment can be reconciled to contribute to the sustainable transformation of energy landscapes. Recent researcher has indicated that there is a yawning gap which needs to be addressed in the area of energy education and awareness on different levels. There is also a lack of expertise when it comes to comprising combinations of technical and natural sources of energy within a landscape (Sodha 2014). In order to further improve renewable energy development, the awareness of the two-way interaction between renewable energy systems and landscape quality should be increased. That implies an extra effort that should be added to the education of both experts and general public. It is important to recognised that awareness-raising cannot be a purely top-down process but needs to be seen as a ‘multi-directional transfer of knowledge’ and ‘co-creation of meaning’ (Council of Europe 2002).

5.6.2 RELY Education

In the framework of the RELY (Renewable Energy and Landscape Quality) COST Action, various educational activities have been undertaken in or-

Figure 5.6.1 Participants of the COST RELY training school in Dublin, Ireland, 2016. Photo: Michael & Sandra Roth.
Early stage researchers, such as Georgia Sismani from Greece, were particularly invited to participate.

The greatest benefit of attending an STSM is the chance to work in person with other experts of your field and thus gain valuable knowledge and experience. ... It offers an opportunity to see how the host institution works, to come in contact with new methodologies and software and to exchange knowledge between the two institutions. This may lead to further research ideas and publications. ... The most important points I kept from this experience are the contacts I made with the host institution and the valuable experience I gained for future research. Overall, an STSM establishes the opportunity to foster the collaboration between the two institutions. Georgia Sismani, Aristotle University of Thessaloniki

Outcomes of the STMs were published in international scientific papers and/or presented at academic conferences, some were also disseminated to a wider audience (e.g. articles translated in national languages and published in national magazines). This in turn contributed to further dissemination of the RELY results and to raising awareness among societies.

**Training Schools**

Training schools provide intensive training in emerging research topics, but in the same time also cover appropriate retraining as part of life-long learning. Furthermore they serve to create networks for future cooperation. Training schools were addressed mainly at early stage researchers, but also at PhD students and MSc students. The two training schools organised within the COST Action RELY gathered more than 40 participants: young researchers and practitioners from diverse disciplines and from many parts of Europe. The first training school on Renewable Energy and Landscape quality: Techniques, Communities and Planning, was...
Editor Profiles

alphabetical order

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Matthias Buchecker is senior researcher at the research unit Economics and Social Sciences of the Swiss Federal Institute WSL. He studied geography at the university of Berne and completed a doctoral thesis on participatory landscape development. Since 1999, he has directed projects at WSL on people-environment-interactions in the research fields landscape development, recreation, river management, natural hazards, and most recently also renewable energies.

2011-2013 Leader of WSL project within the EU-7th Framework Project ‘Building a Culture of risk prevention in Europe’ (KULTURisk).
2012–2013: Leader of the project ‘Social Acceptance of photovoltaic panel sites in a Alpine tourism region’ in collaboration with the Energy Region Obergoms.
2013–2018: Leader of the PhD-project ‘Analyzing the contribution of deliberative planning in risk management to social learning.’ Swiss National Found
2016–2019: Leader of the PhD project ‘Mapping meaningful places as a tool for participatory planning of renewable energy projects’. SBFI, COST Action TU1401

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Csaba Centeri is an associate professor at the Szent István University. His main research interest is nature conservation and land use change related issues, especially in connection with soil and soil erosion, and wildlife impact. He also started working with agricultural landscapes, landscape protection, and renewable energy production, where soil and nature conservation play an important role.

Fekete István Programme (mapping the possible areas for producing renewable energy from biomass in a Trans-Danubian region, Hungary)
EUCLAND Network
COST-RELY
Bio-Bio, Indicators for biodiversity in organic and low-input farming systems (FP7)
EU-FP7 ENVIEVAL, Development and application of new methodological frameworks for the evaluation of environmental impacts of rural development programmes in the EU (Grant Agreement No. 312071)

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Monitoring the Norwegian mountain dairy farm landscape (Norwegian Forest and Landscape Institute) 2009–2014.
Landscape change (Research Council of Norway) 2008–2014.
Agricultural buildings and the cultural landscape (Norwegian Ministry of Agriculture and Food) 2009–2012.
Indicators for biodiversity in organic and low-input farming systems (EU FP7) 2009–2012
Land use changes in urban pressure areas—threats to food production and landscape qualities (Research Council of Norway) 2009–2012.

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RNDr. Bohumil Frantál, PhD is a leading senior scientist at the Department of Environmental Geography, Institute of Geonics, Czech Academy of Sciences. In his research he focuses on social-spatial contexts of ongoing energy transition, particularly renewable energy development and related land use
conflicts, environmental risk perceptions, urban renewal, and spatial models of behaviour. His principal publications address the issues of social acceptance of renewables, nuclear power, and coal mining. He also works as a lecturer at Palacky University in Olomouc.

Recent research projects:
2016–2018: ‘Exploring social-spatial diffusion of renewable energy projects in the Czech Republic: lessons for adaptive governance of energy transition’ (Czech Science Foundation No. 16-04483S)—Co-investigator
2014–2018: Integrated Spatial Planning, Land Use and Soil Management Research Action (INSPERATION), (Horizon 2020, Grant No. 681256)—Member of research team
2011–2014: ‘Energy Landscapes: innovation, development and internationalization of research’ (ENGEFA) (CZ.1.07/2.3.00/20.0025)—Project leader
2010–2013: ‘Tailored Improvement of Brownfield Regeneration in Europe (TINBERE)’ (EU’s 7th Framework Programme, No. ENV.2010.3.1.5-2)—Member of research team
2009–2011: ‘Spatial models of behavior in the changing urban space from the point of view of time geography’ (Czech Science Foundation No. 403/09/0885)—Co-investigator
2008–2010: ‘The use of wind energy: evaluation of spatial relations, environmental aspects and social context by the means of GIS’ (Grant Agency of the Czech Academy of Sciences No. KJB700860801)—Member of research team

Title: ADAPTation to sustainable energy transition in Europe: environmental, socio-economic and cultural aspects CSO2017-86975-R, funded by Spain’s Ministry of Economy, Industry and Competitivity, 2018–2021 (chair);
Title: Energía eléctrica y paisaje: Evaluación del paisaje terrestre y marítimo para una ordenación sostenible, CSO2011-23670, funded by Spain’s Ministry of Science and Innovation, 2012-2015 (chair);
Title: Ressources paysagères et ressources énergétiques dans les montagnes sud-européennes: Histoire, comparaison, expérimentation, funded by Ministère de la Culture and de la Communication de France, Direction générale des patrimoines de France, Bureau de la recherche architecturale, urbaine et paysagère de France, Ministère de l’Écologie, du Développement durable, des Transports et du Logement de France, Direction de la recherche et de l’innovation de France y Atelier international du Grand Paris (AIGP) (Chair of WG)

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Isidora Karan is an architect and urban designer. She was awarded a PhD in architecture (2015) from the University of Granada and pursued postdoctoral research at the National Autonomous University of Mexico in (2016). She has worked in practice on the projects of urban planning and design (2009–2011, 2016). She is a partner in the Center for Spatial Research (NGO) and teaching assistant (University of Banjaluka).

Projects:
Plan of detailed regulation for the area under the influence of Highway M-16.1., Bosnia and Herzegovina, 2009
General Urban Plan for Vlasenica Municipality, Bosnia and Herzegovina, 2016 (First prize at 26th International Urban Planners Exhibition in Serbia)
Small-scale urban intervention in Banjaluka, Bosnia and Herzegovina (2017–ongoing)

International competitions:
Recognition for project for The Sustainable Theatre, World Stage Design, Cardiff, 2013 (exposition and award)
First prize for the Urban Design of Memorial Zone DONJA GRADINA in Bosanska Dubica, Banja Luka, Bosnia and Herzegovina, 2009 (exposition and award)
First prize for the Urban Design of Old Market Veselin Maslesa in Banja Luka, Bosnia and Herzegovina, 2009

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Dr. Alexandra Kruse is an expert in UNESCO World Heritage and cultural landscapes. She is director of in situ World Heritage (whconsult.eu). In addition, she is an expert in natural heritage and nature sites, and project management. She has long experience in documentation. She is initiator and secretary general of the international network ‘Institute for
Research on European Agricultural Landscapes (EUCALAND) e.V. (eucaland.net). Since 2006 this network has been working on classifying and raising the awareness of the importance of European agricultural landscapes, their values for cultural heritage, and biodiversity. Projects: Erasmus - FEAL: Multifunctional farming and agricultural landscapes (feal-future.org), UNESCO nomination dossier ‘Großglockner High Alpine Road’, Republic of Austria, Altes Land, Germany: Holler Route (cycling route within the framework of EC program of European Cultural Routes) and preparation of a UNESCO World Heritage nomination, COMUS—Community-Led Urban Strategies in Historic Towns—by the Council of Europe, assigned as expert for Armenia including Eco-tourism concepts (http://pjp-eu.coe.int/en/web/comus)

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Sina Röhrer studied landscape planning at Nürtingen-Geislingen University and geographical information science at Salzburg University. Since 2015, she has been employed as research associate at the Institute of Landscape and Environment of Nürtingen-Geislingen University where she is involved in research projects on landscape quality, renewable energy, and grid expansion and in lectures on GIS and landscape related topics.


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Prof. Dr. Michael Roth studied landscape architecture and landscape planning in Dresden. He obtained his PhD at the School of Spatial Planning, Dortmund University of Technology. He held research and teaching positions at TU Berlin (2002–2006), TU Dortmund (2006–2013), Michigan State University (2011–2012), University of British Columbia (2013), and University of Natural Resources and Life Sciences in Vienna (2016). Since 2013 he has been professor for landscape planning and landscape informatics at Nürtingen-Geislingen University (Germany).

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‘Forest 2020’, Political economy of forest monitoring & protection, funded by the UK Space Agency.

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