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Fostering renewable energy with smart specialisation? Insights into European innovation policy

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Markus Steen, Department of Industrial Management, SINTEF Teknologi og samfunn, NO-7465 Trondheim, Norway; Fabian Faller, Department of Geography, Christian Albrechts Universitat zu Kiel Institut fur Sozialwissenschaften, DE-24118 Kiel, Schleswig-Holstein, Germany; Eli Fyhn Ullern, Department of Industrial Management, SINTEF Teknologi og samfunn, NO-7465 Trondheim, Norway

Contact: markus.steen@sintef.no

Abstract

The transition to a low-carbon economy is a major challenge confronting policymakers at all government levels. In the European Union (EU), ambitious targets for reductions in greenhouse gas emission are linked to aspirations of fostering green growth at national and regional levels. These aspirations have been manifested in a recent radical policy change through the introduction of the smart specialisation research and innovation strategy (RIS3) for national and regional development. The novelty of the RIS3 compared with previous EU innovation policy is that it aims to develop regional competitiveness based on the harnessing of regional assets rather than focusing on the provision of innovation infrastructure. In this article, the authors employ a mixed-methods research approach both to explore the nature and content of energy-related priority settings in RIS3 strategies in the EU and to address the question of regions' abilities to foster renewable energy through their place-based strategies. The article contributes to the literature on policy strategies for realising EU energy and emissions targets and the RIS3 aim of developing competitive advantages. The main conclusions are that energy-related priority settings vary substantially within RIS3, and that regional innovation policy ambitions may be hindered by unconducive policy frameworks at national levels.

KEYWORDS

Europe, innovation policy, regional development, renewable energy, smart specialisation

Introduction

Decarbonisation of the energy sector is one of the main challenges confronting policymakers on all scales (Coenen et al. 2015). The European Union (EU) aims to reduce greenhouse gas emissions by 40% by 2030 compared with 1990, and to achieve at least a 27% share of renewable energy in its energy mix (European Commission 2014). These supra-level policy targets trickle down to national government levels, where they largely mirror different countries' potential for expanding the deployment of renewable energy technologies. In turn, national policies and processes are coupled with regional and local policies (Essletzbichler 2012, Matti et al. 2017). However, achieving decarbonisation is not merely a matter of technology diffusion and deployment. Renewable energy technologies such as wind and solar photovoltaic (PV) systems have grown rapidly in recent years and have thus become interesting from a regional 'green growth' point of view. This also applies to less mature renewable energy technologies and technologies that enable smarter and more efficient energy distribution and use.

The point of departure for this article is that regions can play an important role in fostering renewable energy and a more sustainable energy system. That is, in achieving decarbonisation, regions and place-based strategies and activities are important for the discovery and usage of localised energy sources, for mobilisation of heterogeneous actor networks around regional 'sustainable energy' visions, and for capitalising on place-based innovation and technology development processes. It is therefore timely to investigate the role of regions in fostering renewable energy through their innovation strategies, not least due to the relatively recent (2014) introduction of the regional smart specialisation (RIS3) research and innovation (R&I) strategy for national and regional development. RIS3 represents a radical break with previous EU innovation policy, and from the perspective of the European Commission it is seen as an important instrument for achieving key energy policy targets.

Previous research on RIS3 has primarily addressed conceptual issues or focused on particular regional and/or national RIS3 strategies (e.g. Foray 2014; Pugh 2014; Morgan 2016a). To our knowledge, no studies to date have explored RIS3 strategies across Europe targeting the same or similar sector type. One open question is whether regions, via their RIS3 strategies, converge around a limited set of technologies or industries, or conversely whether there is variety in terms of what regions identify as key areas for resource allocation for innovation. Given the inherent path-dependency of energy systems (Simmie et al. 2014), it is also important to understand how priorities are set and strategies developed at the regional

level. Against this background, in this article we ask how regions can foster renewable energy through their innovation strategies and thus contribute to decarbonisation. We present and discuss the RIS3 framework, provide an account of key EU energy policy targets, discuss how regions can foster renewable energy, and derive theory-based research questions. Based on a mixed-methods research design, we explore the scope and content of energy-related priority settings in RIS3 strategies across the EU and critically examine the strategies, strategy development process, and priority-setting rationales underlying energy-related RIS3 priorities in three regions in Germany, Spain and Norway. Finally, we discuss our findings and present our conclusions.

Background

More than two-thirds of all EU regions have chosen at least one energy-related priority in their RIS3 strategies, making energy the most popular 'priority area' in RIS3 strategies across Europe (Navarro & Uihlein 2016). This reflects, first, that regions across Europe aim to take part in the new value-creating industrial and entrepreneurial 'green turn' (Cooke 2010). Second, and perhaps more indirectly, it indicates that the grand challenge of combating global climate change is taken seriously also at regional and local governance levels. If successful, RIS3 strategies may contribute to innovation and technological development necessary for more sustainable ways of producing, distributing, and consuming energy, which would support the broader European targets of substituting fossil fuels with renewable energy sources, thereby increasing energy efficiency and realising energy savings.

Smart specialisation – a policy strategy in the making

The notion of regional smart specialisation (RIS3) can be traced back to the end of the 2000s and discussions in the EU 'Knowledge for Growth' expert group (Foray 2014). Although it had never been piloted in practice and therefore has not generated any empirical evidence that can be draw upon (Marques & Morgan 2018), the development of RIS3 strategies quickly became an ex-ante conditionality for receiving European Structural and Investment Funds (Valdaliso et al. 2014).

The governing idea behind RIS3 is that in our era of globalisation, regions – particularly less advanced and transition regions – need to develop both generic and specific capabilities linked to particular technologies and industries that would enable them to achieve competitive advantages in certain market niches. According to Foray (2014, 492), 'the idea is

neither to narrow down the development path of a region nor to produce some sort of technological monoculture, [but rather to] generate new options or new specialities in order to diversify the structures of the regional economy'. Thus, RIS3 entails a fundamental shift in regional development policy from focusing on a particular industry or knowledge domain to nurturing recombinant innovations at the intersections of related sectors with complementary capabilities (McCann & Ortega-Argilés 2015). Consequently, areas prioritised for R&D and upgrading strategies ('priority areas' for innovation policy) should be based on existing regional assets with the aim of reaping the benefits of cross-fertilisation between technological domains (Iacobucci & Guzzini 2016, Morgan 2016b). This reflects how an important purpose of RIS3 is to avoid European regions competing head-on or duplicating their sector-based strategies, but to focus rather on their pre-existing competences and potentials for further development (Morgan 2016b). Lastly, RIS3 emphasises transnational and transregional learning and cross-regional collaboration for further strategy development.

In RIS3 strategy development, a key instrument is the entrepreneurial discovery process (EDP) for identifying region-specific assets (Foray et al. 2012). The EDP starts with a diagnosis of the regional context and potential for innovation, and continues with the establishment of a sound and inclusive governance structure, the production of a shared future vision for the region, the selection of a limited number of priority areas for regional development, and the establishment of suitable policy instruments and mixes, and ends with the integration of monitoring and evaluation mechanisms.

The intention behind the policy-facilitated EDP is to bring together a broad set of stakeholders (e.g. from policy, business, academia) who mutually identify potential development activities based on a broad understanding of innovation, with the aim of generating structural changes in the regional economy via modernisation and diversification of existing sectors (Foray 2014, 494). The rationale behind a broad stakeholder process is to avoid both government 'picking winners' and established industries triumphing over emerging industries that may have substantial future potential. The vested interests of industry and political actors may either foster or counteract path creation and renewal, and the more specialised a region is, the more likely it is that powerful regional actors will influence development processes (Boschma & Frenken 2011; Moodysson et al. 2015).

However, as noted by Valdaliso et al. (2014), the EDP is both positively and negatively prone to path-dependent regional institutional contexts. Hence, RIS3 strategies may clash with other, long-standing, regional policy objectives. Additionally, path dependence may constrain energy system transformation processes in governance structures

that are necessary for RIS3 development and implementation (Capello & Kroll 2016; Morgan 2016b). This points to the differing adaptive capacities of policy actors due to established 'political habits, practices and routines' (Kroll 2015, 5). For example, Pugh (2014, 152) found that the Welsh RIS3 strategy largely followed a past policy approach based on cluster rationales, even omitting 'the important entrepreneurial discovery process to identify the real strengths of the region'.

RIS3 strategy development and implementation is also likely to be influenced by national institutional frameworks, such as centrality of government, levels of regional autonomy, or regional endowments (e.g. in terms of resource allocation). Variations along these dimensions imply that regional conditions for RIS3 development vary and are likely to be shaped by institutional context and quality of governance (McCann & Ortega-Argilés 2014). Challenges in RIS3 governance also occur between political levels and various operational bodies in the implementation phase. Together, this hints at some likelihood of path-dependent policymaking in RIS3, and tensions between policy ambitions at different levels of governance.

RIS3 and European energy policy – a brief overview

RIS3 has been assigned an important role in reaching the EU energy targets at the crossroads of energy and innovation policies. As such, the role of RIS3 is to support R&I in low-carbon technologies as a crucial dimension of the 'EU Energy Union',[1] and 'to help governments in their decision-making processes concerning long term innovation strategies and smart allocation of resources' (Navarro & Uihlein 2016, 3).

In 2007, EU leaders identified security of supply, competitive markets, and sustainability as three pillars for European energy policy. In 2009, the EU set its 20-20-20 targets for 2020, which aimed at a 20% reduction in CO_2 emissions, a 20% increase in energy efficiency, and 20% of energy derived from renewable energy sources compared with 1990 levels (European Commission 2010). An important aspect of the energy policy strategy was to foster 'green growth' through innovation and technological and industrial development. In the foreword to the 'Energy 2020' EU policy document, the then European Commissioner for Energy (European Commission 2010, 1) states that 'we need a step change in our research and innovation policies. Europe … must keep this leadership position'.

The share of renewable energy in the European energy mix grew from 8.5% in 2004 to 16% in 2014 (Eurostat n.d.a). In that period, Germany and Spain had the strongest growth rates for renewable energy in Europe, from 5.8% and 8.3% respectively in 2004 to 18% and

20% respectively in 2014. By contrast, Norway's already high share of renewable energy in its energy mix grew from 58.1% in 2004 to 69.2% in 2014 (Eurostat n.d.). Recently, the EU set new and more ambitious targets for the period 2020–2030 (European Commission 2014), aiming at a 40% reduction in greenhouse gas (GHG) emissions by 2030 compared with 1990, and a minimum 27% share of renewable energy in total energy production.

To support energy-related RIS3 activities, a thematic energy and smart specialisation platform (S3PEnergy) was launched by the European Commission in 2011. Data for part of our analysis were derived from this platform. By offering various services, including funding and facilitating partnerships, S3PEnergy aims to foster alignment of local, regional, and national policy priorities to achieve EU energy targets. It is intended as 'an enabling tool for regions to coordinate, rationalise and plan their respective energy strategies, develop a shared vision on knowledge-based energy policy development, and set up a strategic agenda of collaborative work' (European Commission n.d.a).

The role of regions in promoting renewable energy

In the academic literature, regions are seen as important for promoting renewable energy in at least three fundamental ways: deployment, technological development, and influence on national and supranational energy policy (Essletzbichler 2012; Dewald & Fromhold-Eisebith 2015; Mattes et al. 2015). Our analysis focuses on the former two, whereas the latter is addressed briefly in the final sections of the article.

First, as administrative-political units, regions can promote the deployment of renewable energy technologies either through setting targets for local or regional markets or by creating demand for renewable energy (market formation). Regions differ considerably in their opportunities for deploying renewable energy technologies, primarily due to considerable differences in their natural resource endowments (Hansen & Coenen 2015). A number of studies show that specific local or regional actor constellations have been critical to early niche market formation and for subsequent scaling up of deployment to national or even international scales (e.g. Dewald & Fromhold-Eisebith 2015). Furthermore, regional governance structures are important for the shift towards more decentralised energy systems (Faller 2014). Moreover, new forms of energy organisation and ownership are enacted primarily at the regional and local scale (Moss et al. 2015). However, in most countries, regional aspirations of renewable energy deployment will critically depend on national-level support policies (e.g. subsidy schemes). Hence, regional-level attempts to develop new research and development (R&D) and innovation capacities related to renewable energy or

any other technology may be vulnerable to rescaling and rescoping of policy interventions at other governance levels (Dawley 2014).

Second, region-specific clusters or innovations systems are important for the development of renewable energy technologies and industrial capacity (Simmie et al. 2014, Matti et al. 2017). Knowledge creation, experimentation, innovation processes, and industrial development are to large extent place-based processes and are strongly linked to the particular resource and knowledge bases of cities and regions (Hansen & Coenen 2015). However, innovation in and processes of industry emergence and transformation are shaped by exogenous factors and contexts, implying that it is crucial to account for the place-specificity of economic activities while simultaneously keeping in mind their embeddedness in multi-scalar innovation and production networks (Binz et al. 2014).

Analytical approach

In order to address our main research question of how regions can foster renewable energy through their innovation strategies and thus contribute to decarbonisation, our analytical approach centres on two issues related to different subquestions. Combining these two analytical dimensions implies a mixed-method approach, which is introduced in the next section.

The first analytical focus is on the multilevel interplay of energy policy and regional capacities (for a discussion, see Matti et al. 2017). An extensive analysis of energy-related RIS3 priorities reflects how and to what extent overarching European energy ambitions correspond to regional-level strategies and whether or not they are based on R&I capabilities and/or business and market opportunities. Hence, we ask: What is the scope and content of energy-related priority settings in RIS3 strategies across the EU? Which R&I capacities and business and market opportunities underlie choices of RIS3 priorities? Does a supranational strategy, such as RIS3, lead to a regional convergence around a limited set of technologies or industries or does it lead to variety in terms of what regions identify as key areas for resource allocation for innovation?

However, our extensive mapping of energy-related RIS3 priorities neither illuminates why particular priorities are chosen, nor the role of the entrepreneurial discovery processes, the implementation of the place-based approach, pitfalls or barriers in terms of lacking regional assets or vested interests, or challenges created by non-alignment between strategies, targets, and interests at different policy levels. Therefore, these more qualitative issues are

addressed in our second analytical focus, wherein we employ a comparative case study approach.

Methodology

We use two main approaches to answering the questions of how European regions can foster renewable energy through RIS3 strategies. First, we provide a mainly descriptive and quantitative account of the extent and variety of energy-related priorities in RIS3 strategies across Europe. This mapping exercise is based on the EYE@RIS3 online database (European Commission n.d.b) and complemented with a qualitative content analysis of a recent descriptive report on energy in RIS3 by the EU Joint Research Centre (Navarro & Uihlein 2016). The EYE@RIS database contains information on regions' R&I capabilities, business areas, and target markets, and their links to EU-wide policy objectives (referred to as EU Priorities), all of which have subcategories; for example, 'energy distribution' and 'power generation/renewable sources' are subcategories under the R&I capability of 'energy production and distribution'. The EU policy objectives or 'priorities' in the EYE@RIS database (11 in total) have been developed by S3PEnergy on the basis of the societal challenges identified in Horizon 2020 (the EU Framework Programme for R&I) as well as the 'headline policies' in the EU's 'Innovation Union' flagship initiative. The EYE@RIS3 database also provides access to RIS3 strategy documents.

In our second approach, we take a closer look at the strategy documents of three regions through a qualitative content analysis of the RIS3 strategies of Galicia (Spain), Nordland (Norway) and Schleswig-Holstein (Germany). The cases were chosen because they are leading renewable energy deployment regions in their national contexts and because further renewable energy-related development is part of their RIS3 strategies. The inclusion of a non-EU region (Nordland) enriches our case comparison by shedding light on the perceived potentials of RIS3 in a non-core region that is not obliged to follow the priority setting process. In order to substantiate our findings and obtain preliminary insights into the role of vested interests and openness towards change (novelty), we draw on secondary data sources in the form of renewable energy-related policy documents, reports, websites, and media, and for Schleswig-Holstein also some interview data. This second approach answers Navarro & Uihlein's call for a more detailed assessment of RIS3 strategies in order to gain a better understanding of renewable energy development processes (Navarro & Uihlein 2016, 32).

The role of energy in RIS3 – an extensive mapping of renewable energy targets in the EU

In this section we address two of our secondary research questions: *What is the scope and content of energy-related priority settings in RIS3 strategies across the EU? Which R&I capacities and business and market opportunities underlie choices of RIS3 priorities?* According to Navarro & Uihlein (2016, 19), 162 out of 1167 RIS3 strategies at NUTS 1–3 levels (Eurostat n.d.b) in 198 European regions are linked to energy. They find that the five-top energy-related R&I capabilities relate also to energy efficiency, smart grids, e-mobility, bioenergy, and wind energy. Beyond this, our research shows that energy-related RIS3 strategies are primarily connected to four of the 11 priority areas defined by the EU: Digital Agenda, Sustainable Innovation, Key Enabling Technologies, and Blue Growth. Our extensive analysis (Figs. 1–4) focuses on linkages between these four priority areas and energy-related RIS3 strategies. It should be noted that although some regions do not indicate an energy-related R&I capability, 'energy production and distribution' may still be a target market. For example, Cantabria (Spain) links its stated R&I capability in maritime engineering to both fossil fuel and renewable offshore energy production. Accordingly, we include energy-related RIS3 priorities based not only on R&I capabilities but also on business areas and target markets. Due to our regional focus, we have excluded both 'EU country' and 'non-EU country' entries in the EYE@RIS database from our mapping. Figure 1 shows the extent of RIS3 strategies across Europe in which energy is explicitly prioritised as an R&I capability and/or business area or target market.

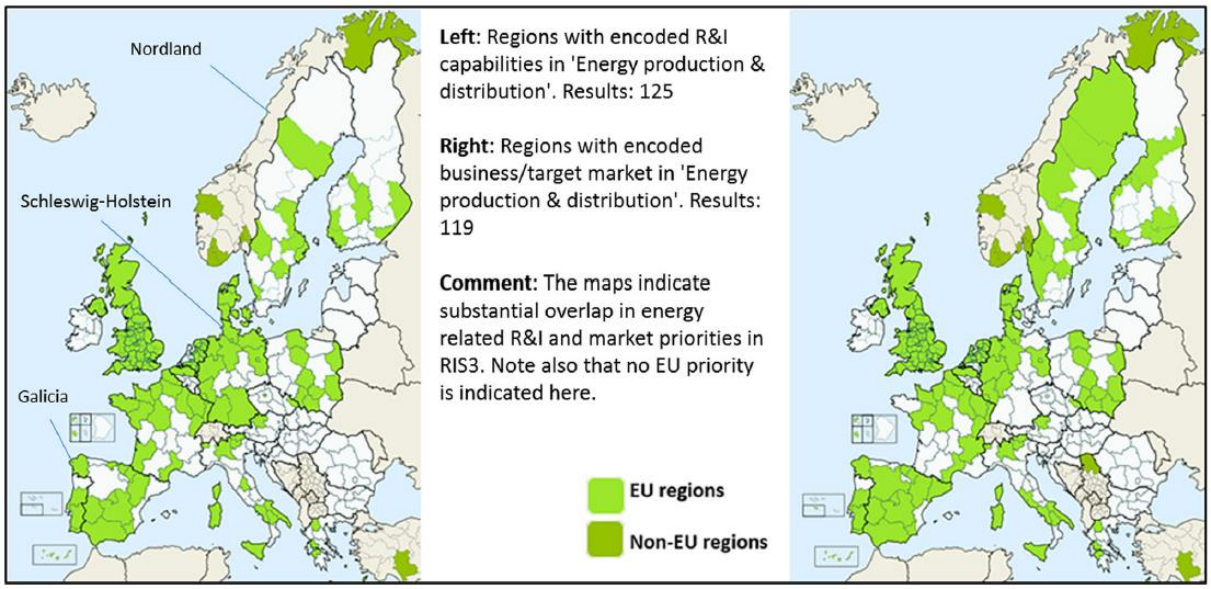

Fig. 1. Overview of energy-related RIS3 strategies based upon R&I capabilities or business area/target market (Source: EYE@RIS, European Commission. n.d.b)

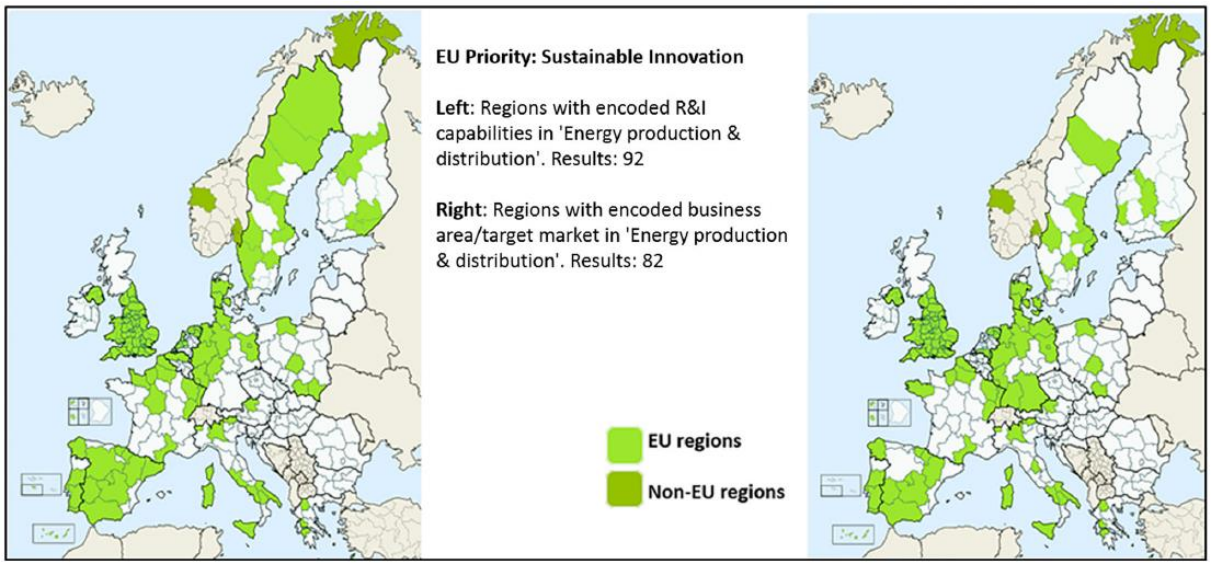

Fig. 2. Energy in RIS3 strategies (regions) with EU priority area 'Sustainable Innovation' (Source: EYE@RIS, European Commission. n.d.b)

Renewable energy is one of eight subcategories under Blue Growth, which the EU has defined as the long-term strategy to support sustainable growth in marine and maritime sectors (de Vet et al. 2016). Figure 3 shows that mainly western EU countries focus on renewable energy and Blue Growth, notably in the UK, where offshore wind and tidal power are focus areas in the national RIS3 strategies of England and Scotland. Compared with Sustainable Innovation, energy-related RIS3 strategies with this EU priority area are linked to far fewer technologies and business areas. Our case study region Galicia is part of this group of regions.

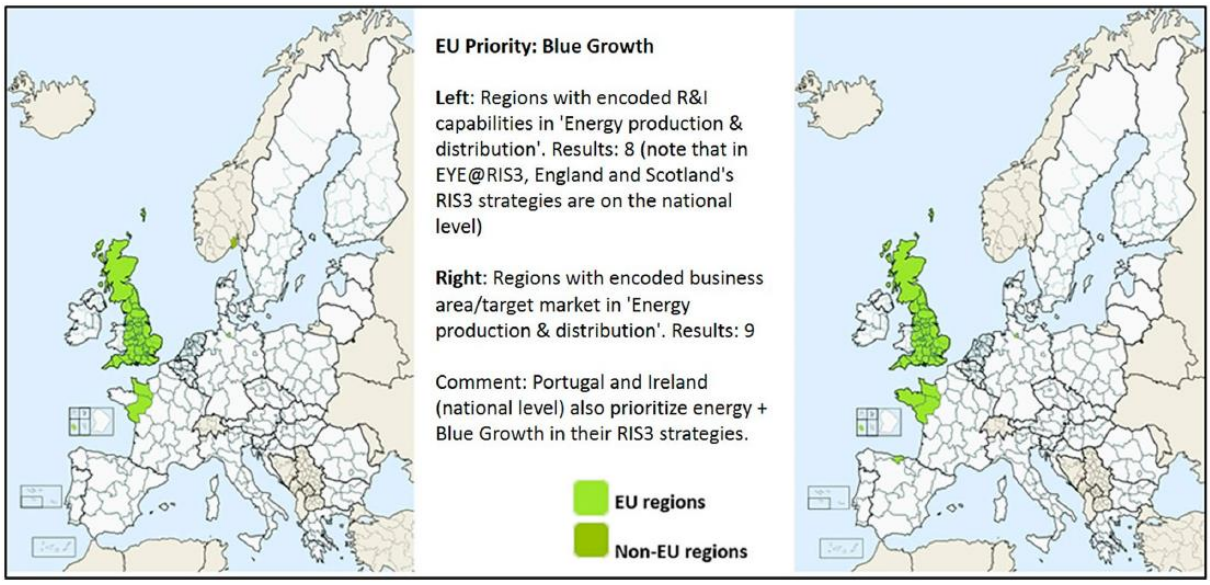

Fig. 3. Energy in RIS3 strategies (regions) with EU priority area 'Blue Growth' (Source: EYE@RIS, European Commission. n.d.b)

The priority area Digital Agenda (Fig. 4) is seen as important to RIS3 strategies because 'information and communication technologies are a powerful driver for economic growth, innovation and increased productivity' (Foray et al. 2012, 82). The typical energy R&I capabilities for Digital Agenda are linked to more efficient energy infrastructure and smart grid technologies.

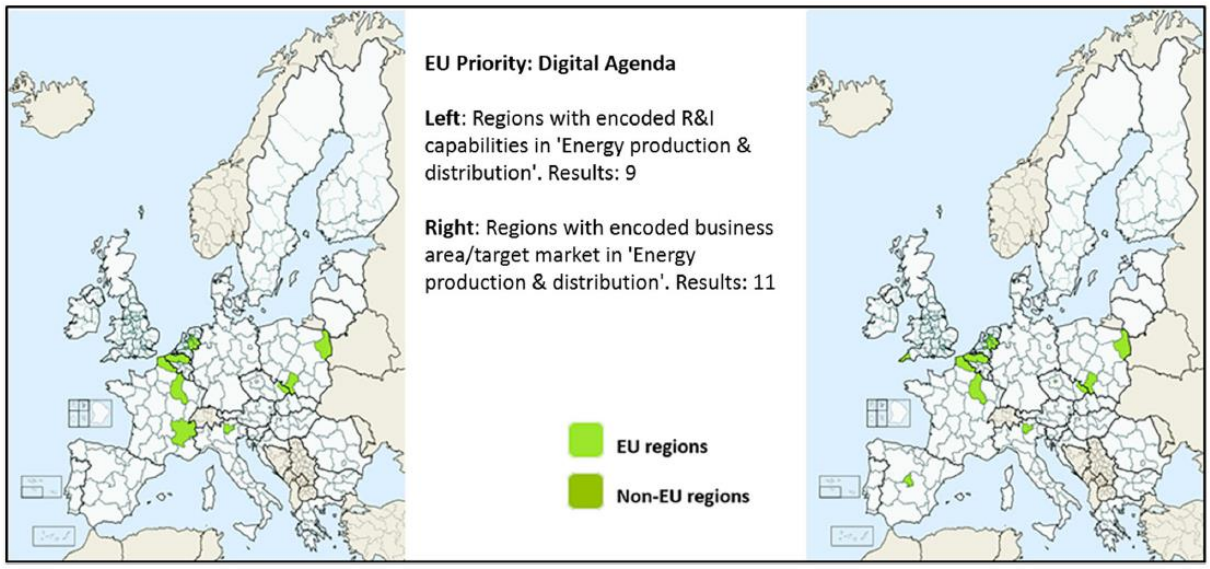

Fig. 4. Energy in RIS3 strategies (regions) with EU priority area 'Digital Agenda' (Source: EYE&RIS, European Commission. n.d.b)

Key Enabling Technologies in RIS3 comprises micro- and nanoelectronics, photonics, nanotechnology, industrial biotechnology, advanced materials, and advanced manufacturing (Foray et al. 2012). Such technologies are seen as crucial to 'smart growth' because they contribute to the modernisation and upgrading of existing industries, but also potentially form the basis for entirely new areas of economic activity. Given their multi-industry nature, the technologies are relevant for energy production and distribution in many ways. Our case study region Nordland links its energy-related RIS3 strategy to Key Enabling Technologies, but this is not apparent from Figure 5, which shows that relatively few regions prioritize KETs and renewable energy in RIS3, and is therefore elaborated upon in the case study section.

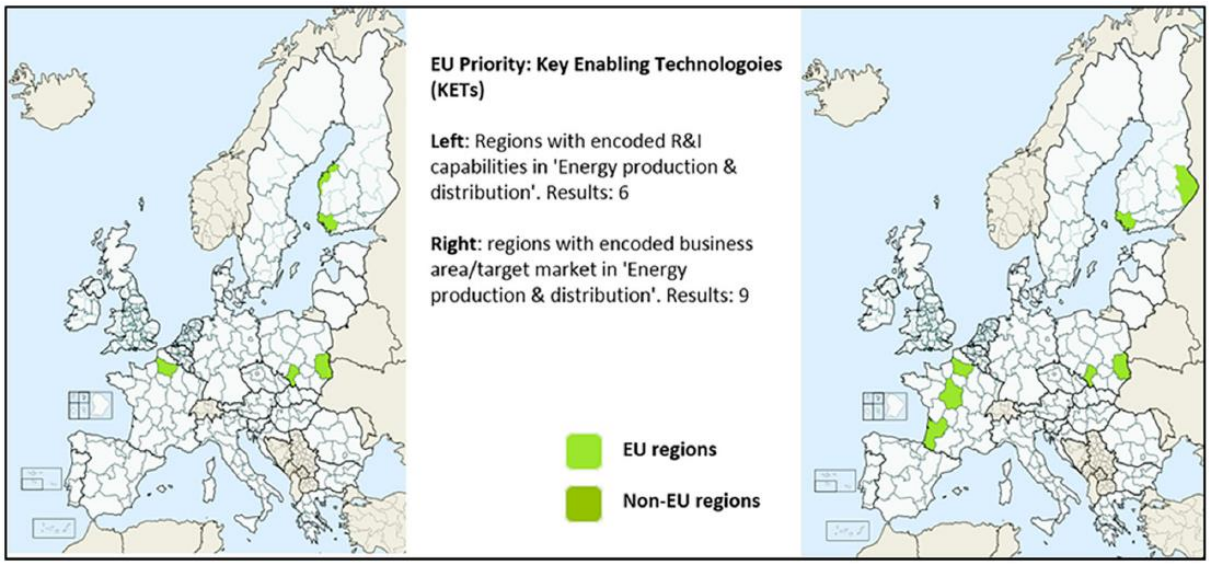

Fig. 5. Energy in RIS3 strategies (regions) with EU priority area 'Key Enabling Technologies' (Source: EYE@RIS, European Commission. n.d.b)

For our remaining secondary research question – *Does a supranational strategy, such as RIS3, lead to a regional convergence around a limited set of technologies or industries or does it lead to variety in terms of what regions identify as key areas for resource allocation for innovation?* – our descriptive mapping reflects the significance of energy-related priority areas in RIS3 strategies. Whereas RIS3 strategies related to the EU priority Sustainable Innovation far outnumber the other priority areas, closer inspection of the contents of these RIS3 strategies (based on strategy documents available from the EYE@RIS database) reveals that they are highly diverse, ranging from novel use of traditional natural resources (e.g. biomass from forestry and/or agriculture) to energy efficiency in manufacturing or construction sectors. The important general finding is that there is considerable variety amongst EU regions, suggesting that the priority areas mirror different endogenous preconditions, knowledge capabilities, and resource bases, as well as different views on opportunities and challenges across regions. This also suggests that energy-related strategies appear to have been chosen according to the RIS3 priority setting rationales.

The descriptive analysis further reveals that R&I capabilities and business areas and/or target markets tend to overlap, but there are numerous exceptions. A random case-by-case investigation of entries in the EYE@RIS database shows that many regions use 'energy' in their descriptions without linking them specifically to capabilities or markets, and hence they are not shown in Figs. 1-5. One such example is our case study region Nordland. Another example is Castilla y Leon (Spain), which links its R&I capabilities in 'agriculture, forestry and fishing' to the 'manufacturing and industry' market and the EU priority area Sustainable

Innovation. In its description in the EYE@RIS database, the emphasis is on 'agri-food and sustainable use of natural resources', with bioenergy as one of the topics listed. Such qualitative descriptions of RIS3 priorities strengthen our impression, too, that there is considerable variety in energy-related RIS3 strategies at the regional level. In turn, this highlights the importance of closer scrutiny of the actual contents of RIS3 strategies.

RIS3 energy case studies

The following analysis of three regional case studies sheds light on the role of regional capacities, the entrepreneurial discovery process, and the links between RIS3 rationales and regional ambitions on the one hand, and key national energy policy targets on the other hand. We first introduce the cases and then compare them in the subsequent discussion section.

Nordland

Norway's economy is in many ways built on energy resources: Norway is a major exporter of oil and gas and has an electricity system based almost entirely on hydropower (Ministry of Petroleum and Energy 2015). The near-term future target is for 67.5% of all energy consumption to come from renewable energy by 2020, the highest percentage of renewables in Europe. Although Norway is not an EU member, some Norwegian county municipalities (*fylkeskommuner*) have chosen to follow a RIS3 approach in their regional innovation strategies. Nordland was the first region to join the S3P platform, with the launch of its RIS3 strategy 'Innovative Nordland' in 2014.

Nordland is rich in natural resources, has considerable power production capacity and considerable untapped renewable energy potential, especially from hydropower and wind energy (Sweco 2014). The region aims to reduce its GHG emissions with 20% by 2020 compared with 1991, and to expand its renewable energy production by 5.7 TWh (50% wind energy, 25% hydropower, 25% energy efficiency) by the year 2025 (Nordland Fylkeskommune 2013). However, low prices in the Norwegian electricity market and corresponding limited investment capacity in the power industry have resulted in few new renewable energy projects being developed in recent years. On the demand side, metal processing and other energy-intensive industries consume more than 60% of total primary energy production in the region. Future regional energy demands will largely depend on the development of these industries as well as the potential for energy exports.

Nordland's RIS3 strategy is based on an analysis of regional core strengths in renewable energy, including recommendations for how RIS3 can contribute to increasing renewable energy deployment. It addresses in particular how Nordland can use its competitive advantage in renewable energy and natural resources (materials), with one pillar emphasising entrepreneurial opportunities associated with renewable energy. The strategy points to Nordland's limited endogenous R&I capabilities in renewable energy, highlights the fact that the traditional strategic planning process and national incentive schemes for renewable energy hamper deployment of renewable energy in the region, and proclaims the additional need for further development of the regional renewable energy knowledge base (Mariussen et al. 2014).

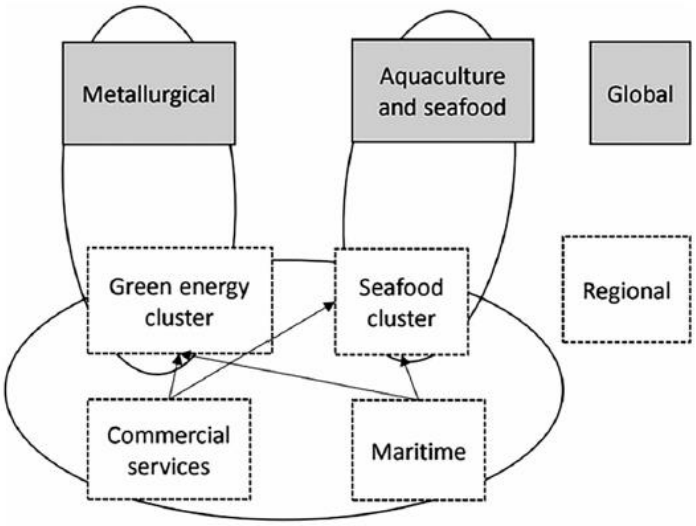

Fig. 6. The green energy cluster in Nordland's RIS3 network (Source: Nordland Fylkeskommune 2014, 11)

However, regional strategies related to renewable energy cannot be read from Nordland's entries in the EYE@RIS database, of which there are three: 'experience economy', 'suppliers to seafood', and 'industry processes, services and products'. The former relates to energy and is based on R&I capabilities in 'manufacturing & industry' linked to key enabling technology (KET). In 2013, following the RIS3 principles, the Nordland Research Institute conducted an analysis of the region's strengths (Mariussen et al. 2013). Together with more than 600 regional stakeholders, the Nordland Research Institute participated in the preparation and development of the strategy. During that process, regional actors identified the need to develop firm networks in order to exploit the potential for increasing green energy production. They identified a 'green energy cluster' (Fig. 6) as a key instrument, for which the metal processing industry and its electrotechnical supplier base was considered fundamental.

Schleswig-Holstein

In 2011, the German Federal Government officially announced energy transition as a key priority for future national development. Crucial political decisions in that direction were ambitious renewable energy targets, the nuclear power phase-out until 2022, the end of coal subventions by 2018, and various measures for promoting renewable energy (e.g. feed-in tariffs) and energy efficiency (e.g. National Action Plan on Energy Efficiency, NAPE). The result has been strong growth of renewable energy in Germany in recent years.

Schleswig-Holstein is one of Germany's leading renewable energy regions. In 2016, 127.9% of the state's final electricity consumption and 14.3% of its heat consumption were covered by regionally produced renewable energy ((Ministerium für Energiewende, Landwirtschaft, Umwelt, Natur und Digitalisierung Schleswig-Holstein 2016)), which is set to expand. The bulk of deployment has been in onshore and offshore wind energy, but also solar PV and biomass contribute to the renewable energy mix, which in 2015 covered 75% of regional gross electricity consumption. In total, c.18,400 people are employed directly or indirectly in Schleswig-Holstein's renewable energy industry (Ulreich & Kirrmann 2017). Additionally, industrial activities, universities and vocational training institutions offer renewable energy-specific study programmes, and political agenda-setting on renewable energy emerged in Schleswig-Holstein from 2005 onwards (Fornahl et al. 2012). Diekmann et al. (2014) identify Schleswig-Holstein as the leading German federal state regarding the output of renewable energy strategy documents and statistics, and political engagement in the renewable energy sector locally, as well as in attempts to influence national renewable energy policy.

The status of renewable energy is mirrored in Schleswig-Holstein's RIS3 strategy (Ministerium für Wirtschaft, Verkehr und Technologie des Landes Schleswig-Holstein 2014), in which two out of six thematic chapters address energy, especially renewable energy. For developing RIS3, the place-based approach and broad stakeholder involvement were crucial. The starting point was to define a regional innovation system (RIS) comprising five elements and eight influencing forces (Fig. 7), as well as consideration of regional development paths, regional assets, and global market developments. For all five system elements, renewable energy was seen as a strength with potential for future regional development. A six-step consultation process with multiple stakeholders from Schleswig-Holstein's administration, policy, and industry followed. This led to the identification of 20 potential priority areas and c.100 action recommendations, whereupon workshops and consultation with selected participants from Schleswig-Holstein deepened the understanding of regional potentials and

led to a prioritisation of areas and actions. Finally, state leaders defined five priority areas, one of which was renewable energy.

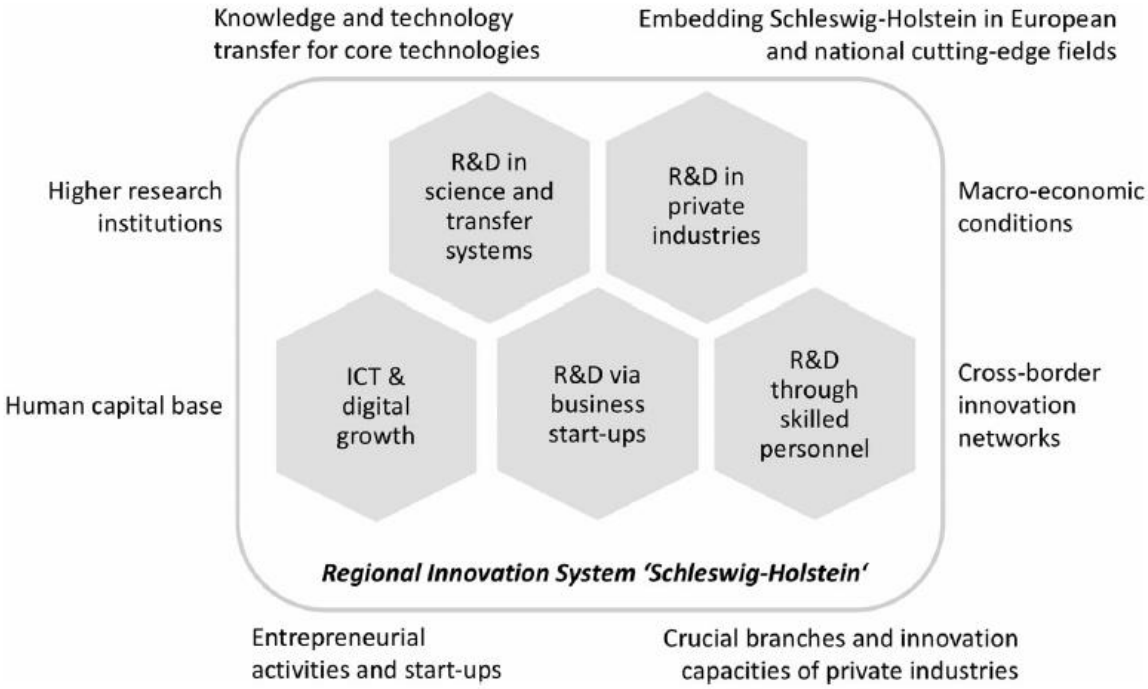

Fig. 7. The regional innovation system in Schleswig-Holstein (abbreviated as SH in the image) and its most influential forces (Based on Ministerium für Wirtschaft, Verkehr und Technologie des Landes Schleswig-Holstein 2014, 14–49)

Each priority area features 3–5 specific innovation potentials; for renewable energy, these are energy/drive technologies, environmental technologies, and renewable energy software. Besides priority areas, Schleswig-Holstein also set nine strategic action fields for smart specialisation, putting knowledge and innovation at the core of the strategy. Energy is an important aspect that is embedded in most categories and seen as a field in which various regional actors share interests and knowledge that build on existing competences and that offer the potential to develop a regional competitive advantage.

Galicia

Spain was a pioneer in introducing support schemes to spur investments into the deployment of renewable energy, since feed-in premiums were introduced already in 1998. Generous financial support led to rapid growth in renewable energy deployment in the 2000s. The economic downturn following the 2007–2008 financial crisis, with decreasing economic output, was accompanied by a c.10% reduced electricity demand from 2008 to 2012 (European Commission 2014). Additionally, the energy tariff deficit amounted to EUR 25.5 billion by 2013. As a consequence, the energy transition in Spain has come under increasing

stress. In February 2013, all incentives for renewable energy deployment were abolished, leading to a collapse in the domestic market. Whereas 16.2% of Spain's energy need was supplied by renewable energy in 2014 (Eurostat n.d.a), it is uncertain whether Spain will reach its target of 20% share of renewable energy in gross final energy consumption by 2020 (set in 2009). Within Spain, Galicia is one of the leading regions of renewable energy production alongside Castile y León. The region is also home to many pioneers in Spain's wind energy industry, making the region both a strong innovator and historically a site of renewable energy deployment (Matti et al. 2017).The development of Galicia's RIS3 strategy, implemented in 2015, was led and administered by the Galician Innovation Agency (GAIN), which was purposefully set up in 2012 to function 'as a fundamental element for establishing an open and plural Governance framework' (Xunta de Galicia 2014, 11) for the regional innovation system. Galicia has 11 entries in the EYE@RIS database. These span from introducing KETs (especially information and communications technology, ICT) in public administration through modernisation of traditional primary sectors to diversification of key industrial sectors such as the automotive sector. Key strategies are to enhance the use of new technology, and many strategies are linked to the EU priorities of KETs and Sustainable Innovation.

The diagnosis of Galicia's regional context and specialisation potential was made by GAIN and regional government departments together with the three regional universities, with support from the affiliated Galician Innovation Observatory (responsible for evaluation and monitoring of public innovation policy), and with data from the Galician Innovation Platform.[2]

Following a series of workshops (two general and five thematic), broader forums, and citizen consultation, 30 'future potential niches' were identified in a process of entrepreneurial discovery (Fig. 8). On this basis, 10 priorities were chosen, and these were in turn linked to three main challenges wherein energy was a fundamental element of both a 'new model for innovative management of natural and cultural resources based on innovation' and a 'new industrial model based on competitiveness and knowledge'. Regarding the former model, Galicia aims to develop energy generation from renewable resources, particularly biomass from the agriculture and livestock subsectors. A second prioritisation is marine renewable energy (wave energy, offshore wind power, algae for biofuels), which is considered an opportunity for renewable energy deployment as well as technological and industrial development, especially for Galicia's industrial infrastructure linked to naval technologies and shipbuilding capabilities.

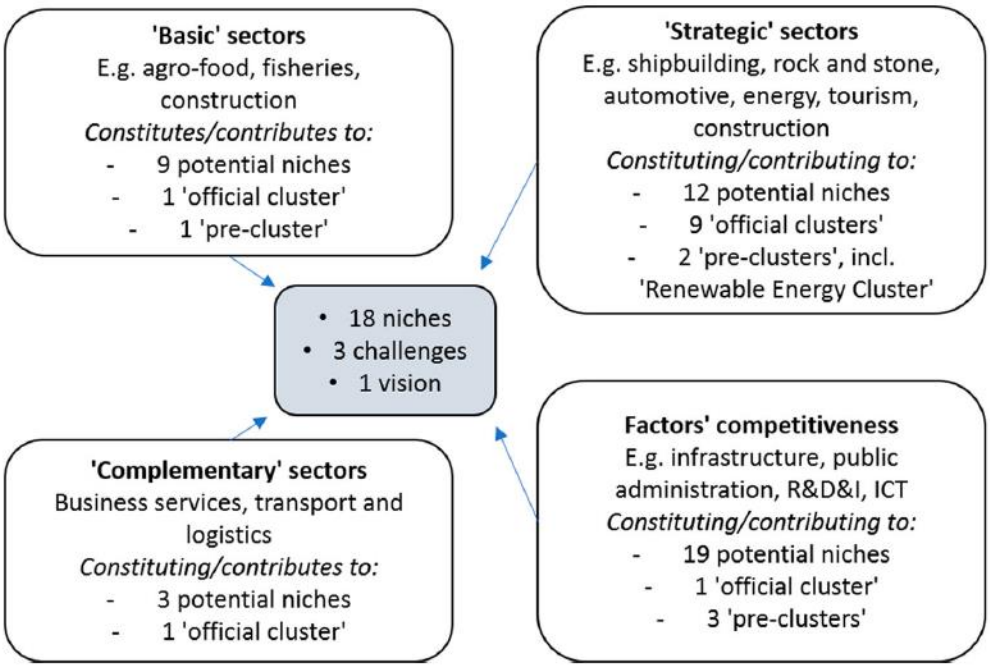

Fig. 8. Galicia's RIS3 strategy process and outcome (Source: Xunta de Galicia 2014, 63)

Discussion

Our empirical investigation has shed light on the extent and role of energy in RIS3 strategies, and how particular energy-linked target areas in RIS3 strategies relate to priority-setting rationales. In this section, we discuss our findings and reflect on the potentials of RIS3 strategies to foster renewable energy, thereby contributing to broader EU energy policy targets.

Our extensive mapping has revealed that energy is the most widely used target in RIS3 strategies, as two-thirds of all European regions have an energy-related priority. Many of these strategies are linked to the EU priority area 'Sustainable Innovation'. Although a comprehensive content analysis of all entries in the EYE@RIS database was beyond the scope of this article, closer inspection of entries revealed considerable variation in the R&I capabilities underlying energy-related RIS3 priorities. This suggests that priorities are based on place-based resources and capabilities rather than on different regional strategies converging around a few technologies, and on differences in demand-side conditions for renewable energy (and other energy-related) technologies. Furthermore, our examination of EYE@RIS data suggests that energy-related priorities are based on a broad understanding of innovation. Thus, some regions aim to upgrade and modernise existing sectors, or support diversification into new energy-related business and market activities, whereas others target niche-type segments in the energy system and associated value chains.

The above-provided interpretation of regional innovation strategy variety is supported by our three case studies, which show substantial differences in energy-related priorities as well as strategy-setting rationales. Priority areas in all three cases explicitly relate to pre-existing industrial structures and natural resources available in the region. Furthermore, alignment with broad EU energy-related policy targets (multilevel policy), a strong focus on pre-existing activities (place-based approach), and inclusion of many different stakeholder groups during the strategy development entrepreneurial discovery process (EDP) are core characteristics of RIS3 in the three regions. The latter is regarded as the most fundamental change accompanying RIS3 (Foray et al. 2012) and appears to have been followed in the case regions.

Our empirical investigation suggests that there are close interrelations between RIS3 strategies and broader EU energy policy targets for energy efficiency and increasing renewable energy shares. Achieving targets both at EU and national/regional governance levels will require substantial technological progress and investments in new or upgraded infrastructure in many sectors. Regions that aim to develop capabilities in, for example, more energy-efficient construction or waste management, or that aim to reduce energy consumption in agriculture, manufacturing, or processing industries, may thus make important contributions to overall EU targets, alongside those regions that have RIS3 strategies that are more directly linked to renewable energy technologies. We have observed that many regions aspire to develop technology and solutions for smart grid infrastructure, which is a prerequisite for a well-functioning energy market with substantial levels of intermittent energy production from renewable energy sources.

Furthermore, regions such as Nordland can use RIS3 as an upgrading strategy for their innovative capacities and thus move beyond being sites of energy deployment to sites that foster technological innovation. However, the lack of endogenous R&I capabilities in renewable energy technology appears to be an issue that has not been adequately addressed in Nordland's RIS3 strategy. For leading regions such as Galicia or Schleswig-Holstein, RIS3 can contribute to strengthening their position in a technology field.

A major concern for all case study regions, and one that we assume also applies to many other regions across Europe, is that innovation and development strategies may be hampered by a lack of energy policy instruments that stimulate market demand and formation. The fate of Galicia's and Nordland's energy-related priorities will largely depend on national energy policy frameworks, which currently are not very favourable to expanding renewable energy deployment. Recently implemented changes at the national level in Germany

regarding tendering procedures for renewable energy project development similarly and negatively influence energy-related developments in Schleswig-Holstein. Although RIS3 can contribute positively to EU energy targets by fostering renewable energy innovation and deployment at regional levels, this potential may therefore be undermined by a lack of conducive framework conditions that are largely a result of national-level policies.

We also note that cluster-type approaches are central to development ambitions. However, it appears that these cluster strategies are multisectoral in that they aim either to diversify existing clusters or to develop new ones based on capabilities in different sectors. As such, RIS3 strategies reflect the important idea of nurturing innovation by exploring potential for knowledge spillovers and knowledge recombinations between 'related' sectors (Iacobucci & Guzzini 2016). Nonetheless, this raises the question of whether vested interests have triumphed over the interests of more marginal actors in strategy development processes, and how far political decision-making remains path-dependent despite newly developed approaches such as RIS3. Consequently, future research on RIS3 strategy-making should seek to shed further light on how particular priorities are set, and on underlying assumptions held by regional authorities and other stakeholders regarding regional strengths or comparative advantages vis-à-vis other regions.

In the context of rigid sectors such as energy, where there are often strong vested interests tied to sunk costs in extant production and distribution infrastructure, institutional entrepreneurs (Sotarauta & Pulkkinen 2011) who strive to change or modify 'the rules of the game' may play particularly important roles. It is often assumed that energy sector incumbents are defenders of the status quo, that they can block the rise of entrants with new technologies, or that they can influence policymaking in ways that are advantageous to them (Steen & Weaver 2017). This is also debated in the sustainability transitions literature, where regimes encompassing incumbents and vested interests are set in a multilevel relation to niches as incubation spaces for innovation, and broader macro-trend landscapes, such as global GHG emission agreements. This literature also identifies the need to have a better understanding of the role of RIS3 in supporting the growth of new clean-tech 'niche' sectors, which is crucial for energy system transformation (Hansen & Coenen 2015).

A clearer understanding of the role of vested interests in RIS3 strategy-making will require qualitative research that carefully disentangles the institutional work of powerful actors such as the incumbent firms in energy sectors. Additionally, focusing on individual agents, for example in place-based leadership, and taking into account their stakeholder's

salience (power, legitimacy and urgency) (Neville et al. 2011) might account for potentially harmful as well as supportive elements of vested interests.

Conclusions

In this article we set out to explore the role of regions in fostering renewable energy through RIS3 strategies, and thereby contribute to achieving key EU energy policy targets. The article contributes important insights into how a multilevel policy challenge (i.e. transforming the energy system) is dealt with at the regional level through regional research and innovation strategies. Given that energy system transformation and decarbonisation require the development and deployment of a broad range of different technologies, a key topic addressed in this article is variety in energy-related RIS3 strategies across European regions. Our analysis suggests that RIS3 strategies vary considerably, reflecting that the underlying logic behind these choices is the place-based approach of choosing priority areas for research on and innovation in endogenous resources and capabilities. From a regional innovation point of view, this strategy of departing from established capabilities, resources, and assets follows the 'RIS3 prescription'. However, on a critical note, this may result in insufficient attention and resource allocation to the more radical innovations needed to support the transition to a sustainable energy system.

Whether regions are successful in their attempts is an entirely different research question that deserves attention in further research. Our case studies highlighted several challenges facing regional actors in developing energy-related activities, notably whether or not national-level framework conditions are conducive to renewable energy deployment. This, we suggest, will be contingent upon whether domestic market opportunities are vital for innovation and knowledge development processes. Another open question is the extent to which RIS3 strategies mirror actual resource allocation, initiatives, and activities. It may well be, at least in some regions, that lip-service is being paid to the EU. However, our case studies suggest that these issues are high on regional policy agendas.

Notes

1. The five non-hierarchical, 'closely related and mutually reinforcing' dimensions are security of supply, a fully integrated energy market, energy efficiency, emission reduction, and R&I (supporting low-carbon technologies) (European Commission n.d.c).
2. The English names of the observatory and platform have been taken from Xunta de Galicia (2014).

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