

## Article

# Addressing the European Green Deal with Smart Specialization Strategies in the Baltic Sea Region

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**Abstract:** Despite the extent and importance of the Smart Specialization strategies, achieved in a short cohesion policy period from 2014 to 2020, the evidence on the assessment of their actual effect on the economic development and the mobilization via the Smart Specialization implementation of the regions is still pending. In light of green transformation, accelerated by the European Green Deal, the heart of Smart Specialization strategies of EU regions is to avoid fragmentation and to reach a complementary in reaching the joint EU ambition of climate neutrality by 2050. This article aims to demonstrate how to identify the region-specific (place-based and bottom-up) pathways for green transformation and align them with the European Green Deal-focused Smart Specialization strategies in regions, using moderated co-creation in DPSIR analysis and policy modeling. The findings of this article are based on the moderated experimental experience from the two interconnected projects in the area, i.e., “LARS” and “GRETA”, implemented in the Baltic Sea Region (October 2017 to September 2021). The research proposes how moderated learning and knowledge transfer between matured innovators and young innovators embodies the identification of place-based pathways and help develop political course recommendations for green transformation, thus solving the homogeneity issues of the Smart Specialization strategies.

**Keywords:** sustainability; European Green Deal; smart specialization; green transformation; DPSIR analysis; policy recommendations; Baltic Sea region



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## 1. Introduction

The first two decades of the 21st century have provided numerous pieces of evidence of how dramatically the environment, in its broadest sense, keeps changing around the world. Next to the sustainability concerns and crises in the fields of human wellbeing, health, and safety, the list of rising new challenges keeps increasing. In the face of climate change and many other disasters, numerous sustainability initiatives worldwide take the responsibility of proposing various solutions at different political as well as managerial levels to deal with occurring challenges. However, among many propositions, only a few suggest matured approaches in the possible ways forward, or pathways, in terms of operationalization of particular sustainability issues.

Among those multiple initiatives, as stated by Kougiass et al. [1], the biggest EU plan to reach climate neutrality was recently embodied in the European Green Deal. Thus, the continuity of the ambitious growth strategy of Europe 2020 has been assured, with leading legal acts and prescriptions from the EU. European Green Deal (2019) as a conceptual EU roadmap toward climate neutrality calls for concrete place-based actions from European regions [2]. These actions are recently referred to as Smart Specialization (also known as “S3”) strategies in scientific and political discussions [3–6], which reformed the EU cohesion policy by making a significant change in strategic economic development of Europe in the period of 2014–2020 [7]. Smart Specialization (S3) was also titled “the most ambitious

regional innovation programme ever to be launched in the European Union” [8] (p. 569). At the heart of the S3 strategy is the idea that the regions in the EU should be more specialized rather than diversified, and thus use their hidden opportunities through empowered collaborative knowledge–business–society–government (also known as Quadruple Helix innovation approach, see further Section 3.1) networks when building novel sustainable future economies [9,10]. At the same time, as highlighted by Santos et al. [11], S3 relies on the concentration of priorities for knowledge-based investments, as well as diversification within priorities, with the final aim of using a diversity of capabilities of a particular territory to develop more complex knowledge or technology. Thus, S3 strategies embody the place-based approach which works for bottom-up mobilization of the economic potential of a particular country and/or region.

This article aims to demonstrate how to identify the region-specific (place-based and bottom-up) pathways for green transformation and align them with S3 strategies for green transformation in regions. The process is grounded in moderated learning among regions and knowledge transferring and embedding from matured innovators (i.e., Finland with a rich scientific and practical background; Sweden—matured S3 practices), to young innovators (i.e., Latvia and Lithuania). In this research, aiming to better correspond to the context of studied regions and the timeline of this research, we use slightly different wording as of European Innovation Scoreboard (2021) [12]: in this research “matured innovators” means “innovation leaders” [12], and “young innovators” entails “emerging and moderate innovators” [12].

The findings of this article are based on the original moderated experimental experience from the two interconnected projects in the area of S3 and green transformation, implemented in the Baltic Sea Region under the Interreg Baltic Sea Region program, i.e., “LARS—Learning Among Regions on Smart Specialization” (October 2017 to December 2020) and its continuation “GRETA—Green Transformation! A Policy Tool for Regional Smart Specialization” (January 2021 to September 2021). The novelty of implemented research is embedded from several points of view.

First, is the change in understanding, that the “regime” [13] is a cause of decentralized and centralized energy systems’ breaking down. In the conducted research this was interpreted as the “region” itself, which causes changes due to its capabilities. Moreover, this enabled quantifying quite an elusive concept of green transformation via Smart Specialization. Second, this article operationally presents, how transnational learning and moderated modeling embody the identification of place-based S3 pathways for green transformation, thus suggesting how to solve the observed and further presented homogeneity issues of S3 in the scientific literature. Finally, this article presents the original application of a methodological DPSIR (Drivers–Pressures–States–Impacts–Responses) framework in the new context. It is a reactive framework that can be hard to accept on a regional political level, but it is also a coordinating framework. If we accept the same “landscape”. Drivers as a starting point we work with the same challenge on different levels and this solves a concern of policy fragmentation in the selected intervention area.

## 2. Literature Review

Among the actual scientific debate concerning the European Green Deal and S3, several highlights of recent scientific findings are worth examining in more detail as background for this research. It mainly concerns the weaknesses and the missing links in the S3 framework and its implementation; hence, this article appeals to closing some of the referred gaps in the literature and regional policy planning practice.

Despite the extent and importance of the S3 in development strategies, achieved in a relatively short period, the assessment of its actual effect on the economic development characteristics, as well as mobilized potential via the S3 implementation of the regions is still fragmented, often concerned with solely country or region, its economic development (e.g., [11,14–18]). It is stressed in recent research [19] that for successful innovation policy design and evaluation processes, it is crucially important to understand the economic

effects of S3 since S3 is focused on industrial restructuring and growth. Understanding the effects of implemented policy by ex post impact evaluations is at the heart of political learning. However, economic impact assessment is not yet a part of the policy framework for S3 [20]. In addition, especially this shortage appears in the S3 of regions with less developed innovation systems, i.e., so-called young innovators, when setting the priorities for S3 strategy, best contributing to their actual economic potential [21].

Among the already existing S3 evaluations at the European level, one of the recent studies [7] was devoted to examining the defined characteristics of S3 across Europe, focusing on S3 axes, economic or scientific domains, and policy priorities. The key findings highlight the increasing proliferation of objectives in the areas with less developed governance skills and more likely imitation of neighboring region activities with minor changes rather than prospective region-specific (i.e., place-based) S3 strategies. Other scientific studies also stress the homogeneity of applied S3 frameworks, despite the different economic and innovation potential of the regions [22].

Another important scientific concern is the limitations of S3 for radical and breakthrough innovations [23]. This is related to the specifics of S3, i.e., its focus on the selected area of the region's economic development (i.e., the "must" to specialize). By valuing the two separated technological and evolutionary pathways, a decision to be made is the purpose of specialization: technological advancement versus knowledge advancement. Following the core of S3, the combination of it is unavailable, otherwise, there is no specialization. Thus, focusing more on one of the selected economic development directions of the region, possibly another potential with currently weaker achievements, but huge potential, is dismissed. This is known as the "exaptation" of technological evolutionary development, which, as suggested by recent findings [23], might play a complementary role in the S3. Recently gathered scientific evidence suggests that technological relatedness in combination with knowledge complexity might accelerate the regional exaptation opportunities. Thus, on one hand, the early restricted strategic specialization of a region might cause the loss of such complementarity opportunity of technological relatedness and knowledge complexity as a natural evolutionary result in future development; on the other, in the long-run knowledge complexity increment might compensate the decreasing technological relatedness.

Further, serious concerns in the scientific debate are found concerning the effectiveness of S3 as a political experiment, since it may fail due to the lack of appropriate and timely evaluation of evidence on the effects and success of it as a pathway for Europe's economic development [7]. The most recent scientific study [24] highlights, that most of the examined regions in Europe have approved limiting S3 strategies for growth, by prioritizing different combinations of unspecialized or unrelated sectors. As of today, there is no clear answer, as to which of the outlined pathways is best for the development of regions in the EU. Based on various collected scientific evidence, scientists agree with the fact, that a huge difference exists concerning the S3 and innovation potential among matured, moderate, and young innovators, i.e., the Northern and Western parts of Europe and the regions in the Southern and Eastern parts of Europe [19,25].

Despite the outlined imperfections of S3 in scientific and political debate, recent EU regulations tightly interconnect the implementation of the European Green Deal with S3 strategies to act for climate neutrality in Europe. Since there is an agreement both at the scientific and political levels concerning the different capabilities of regions due to different advancements in the field of technology and knowledge basis for innovations, the success of Europe becoming climate-neutral by 2050 will necessarily depend on the selected development pathways for green transformation.

In light of the green transformation, accelerated by the European Green Deal, at the heart of S3 strategies for green transformation in regions is a need to avoid the already identified and above-listed problems with S3. The core outlined issue is the homogeneity of S3 strategies, which elucidates the lack of capabilities of the region to identify specific place-based opportunities for further development. It was outlined above, that there exist mature,

moderate, and young innovators in Europe, so there is a sense of developing effective S3 for green transformation by improving the knowledge complexity through transnational learning from advanced innovators. Learning in this research means gathering knowledge on scientific evidence-based methodology for identifying the place-based opportunities for S3 green transformation strategy and modeling the possible pathways for green transformation in the selected area of intervention. For doing so, the methodological framework titled DPSIR (Drivers–Pressures–States–Impacts–Responses) is originally applied in terms of context. This was carried out since DPSIR’s multiple successful application was observed in dealing with sustainability policy [26,27], which is tightly related to the respective concerns of the European Green Deal and climate/environmental issues as well.

### 3. Materials and Methods

The research, carried out during the above-mentioned GRETA project, covered 4 Baltic Sea Region countries (according to the Interreg Baltic Sea Region Strategy and programme regulation, for details please see: <https://interreg-baltic.eu/>, accessed on 5 September 2022), involving 6 regions and 6 different sectors: circular economy and green energy technologies in the Ostrobothnia region (Finland); circular economy and more precisely beverage and food industry concerning the green transformation in Päijät-Häme region (Finland); industry and mechanical engineering regarding smart materials, smart technologies, and engineering systems in Latgale region (Latvia); circular bioeconomy and biogas production from agro wastes in Lithuania; Food and Beverage industry in Klaipėda region (Lithuania); sustainable energy with a focus on hydrogen in Västerbotten (Sweden). Six regions from four BSR countries were chosen to analyze the stakeholders’ commitment and mobilization power towards the green transformation (hereinafter—GT). The chosen regions both as young and matured innovators not only implement S3 strategies but are expected to enhance their commitment toward S3 strategies, aligning them with the ambitious selected targets of the European Green Deal. Each partner of the project had conducted their own research on stakeholders and levels, as well pathways on how the GT is seen in their analyzed regions and sectors. The overall research process was coordinated by the project leader under a common research guideline. The lead partner methodologically supported the separate tasks together with task leaders. The project leader conducted comparative research (Mariussen et al., 2021 [25]) covering the partners’ research.

#### 3.1. The Commitment of Stakeholders towards the Green Transformation in the Baltic Sea Region

The Quadruple Helix innovation approach [28] was used to identify four key groups of stakeholders in six cases and five countries in BSR. In total, 113 stakeholders represent four key groups: private organizations (companies, producers, distributors, etc.), governmental organizations (ministries, municipalities, and other local, regional, or national state bodies), research organizations (universities, research institutes, and research hubs) and non-governmental organizations (NGOs) (communities, customers, associations, etc.).

The aim of stakeholder analysis was to identify the role of different stakeholders in the process of GT and mobilize them to support GT of society and economy as a part of S3 regional strategies in ways that are aligned with the European Green Deal.

Mariussen et al. [25] looked at the role of stakeholders in GT through the following main dimensions [29]:

- The urgency. Does the stakeholder call for immediate attention or press the action and to what extent (great/moderate/none)?
- The legitimacy. Has the stakeholder legitimacy to influence GT and to what extent (great/moderate/none)?
- The power. Has the stakeholder the power to influence GT and to what extent (great/moderate/none)?

To measure the urgency, legitimacy, and power of the stakeholder a scale 2-1-0 was used: “2” corresponds to “great”, “1” corresponds to “moderate”, and “0” corresponds to “none”. These figures were added together to form stakeholder analysis, which shows the

progress of individual stakeholders and lets to look at different helices and their progress toward GT (see Table 1).

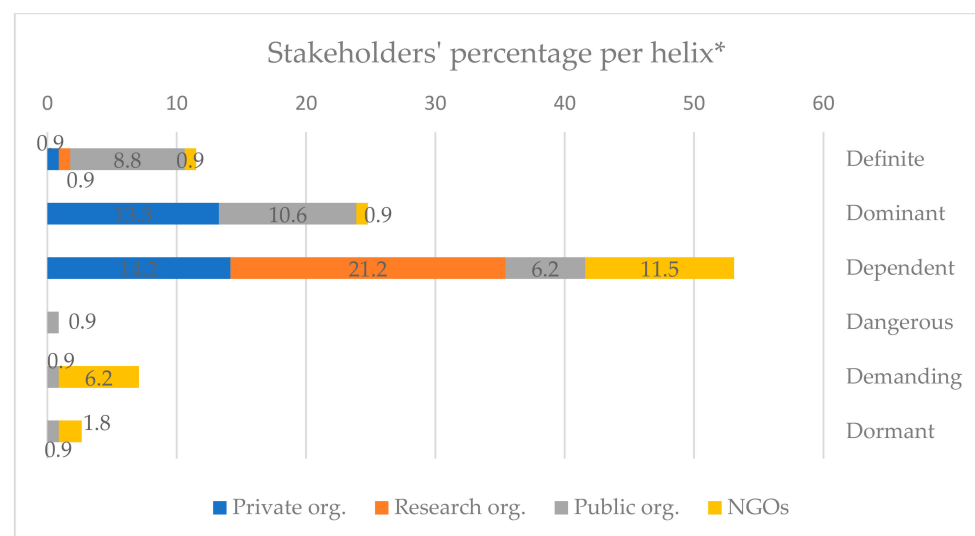
**Table 1.** Strength of stakeholders of Baltic Sea regions towards GT per helix.

Helix of Stakeholders	Period of Time	Finland (Ostrobothnia)	Finland (Päijät-Häme)	Sweden (Västerbotten)	Latvia (Latgale)	Lithuania (Klaipėda)	Lithuania (Biogas Sector)	Avg.
Private org.	5 years ago	4.0	3.8	3.0	2.7	4.7	4.3	3.8
	now	4.8	4.8	5.1	3.7	4.9	4.0	4.6
	in 5 years	5.0	5.5	5.7	5.3	5.0	4.3	5.1
Research org.	5 years ago	3.5	3.4	2.1	4.0	4.5	4.5	3.7
	now	4.3	4.4	2.2	5.0	4.3	5.3	4.3
	in 5 years	5.0	5.6	2.2	6.0	4.8	6.0	4.9
Governmental org.	5 years ago	3.6	4.9	3.8	2.2	4.7	5.0	4.0
	now	5.1	5.3	5.8	4.8	5.0	5.8	5.3
	in 5 years	5.3	5.7	6.0	5.7	5.3	6.0	5.7
NGOs	5 years ago	4.0	3.0	3.5	2.6	4.6	4.0	3.6
	now	4.0	3.8	5.0	4.0	4.4	4.0	5.0
	in 5 years	4.0	4.6	5.8	4.4	4.6	5.7	5.8

Source: created by authors according to Mariussen et al., 2021 [25].

Analysis of Mariussen et al. [25] revealed that all helices will increase their power, legitimacy and urgency, i.e., the strength towards GT. However, out of all helices, public organizations seem to be most eager to act towards GT in BSR, as they are the only ones, which must implement the European Green Deal and environmental issues. Analysis revealed that private organizations are in favor of GT and their commitment toward GT is growing to a great extent. It is also interesting that Latgale region in Latvia is very rapidly changing in almost all helices. Lithuanian biogas sector is also following a similar process. In general, all regions are showing great progress and stakeholders are strong in implementing GT in BSR.

Based on the Stakeholder Salience Model [29], each stakeholder corresponds to one of seven types of stakeholders: dormant, discretionary, demanding, dangerous, dependent and definitive. This typology allowed to classify stakeholders into latent (weak), expectant (moderate) and definitive (strong) (Figure 1) categories which helped to understand how stakeholders can be mobilized to move from a latent position into a more moderate, supporting, and then into a core supporter of GT, i.e., a definitive position.



**Figure 1.** The percentage of stakeholders by helix. \* Each analyzed stakeholder belongs to a particular helix, or sector (i.e., private organizations, research organizations, public organizations or NGOs) and corresponds to one of 7 possible stakeholder types, according to its measured role: dormant, discretionary, demanding, dangerous, dependent, and definitive. Source: Created by authors according to Mariussen et al. [25].



Analysis carried out by Mariussen et al. [25], revealed that dependent, as well as dominant stakeholders, were most typical among all cases. Research organizations were often dependent on GT, whereas private organizations were quite evenly shared between dependent and dominant actors. Definite stakeholders were most often public organizations, which would indicate that they are following GT goals.

In many countries and sectors the most important player—the definite one—is public institutions. It is the case of Latvia, Sweden, Finland and Lithuania (biogas sector), another helix part—companies are a definite actor in Lithuania (Klaipėda region). Moreover, private and public organizations are dominant players in all analyzed sectors. So, in a near future, it should be seen not only public institutions, but the private sector should grow into definite stakeholders as well to take a more significant role in the implementation of GT-focused S3 strategies in regions.

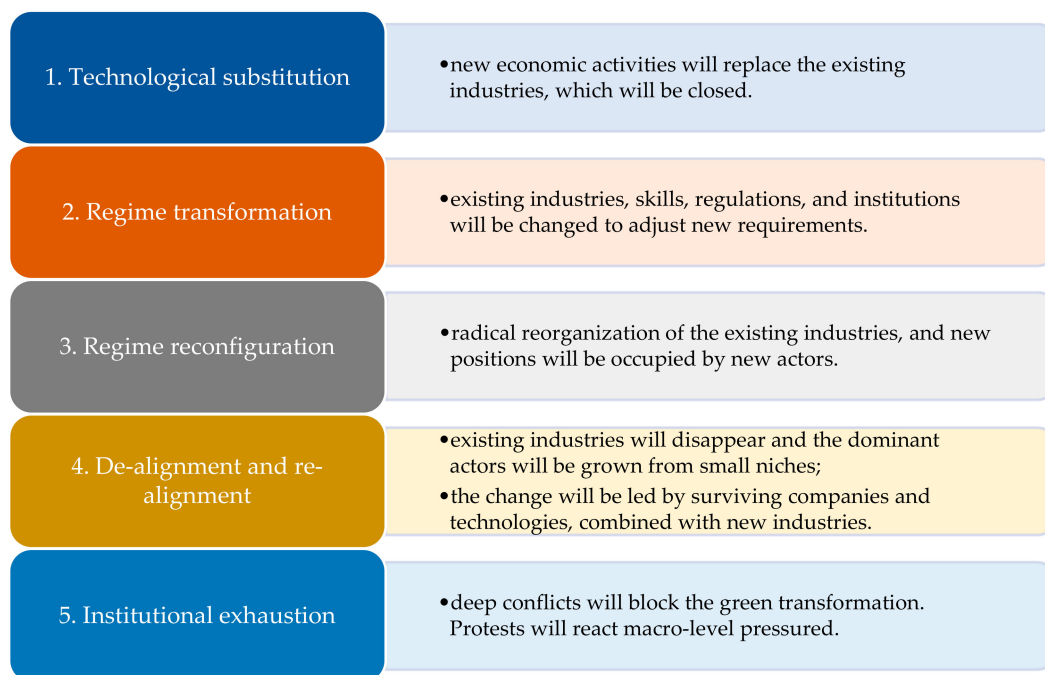
### 3.2. Driving Levels and Paths towards the Green Transformation

There are many different ways and categories to measure the transition from one path to another. Among the most recent research, a huge study had been carried out to conduct territorial reviews of industrial transition by experts and policymakers with the aim of operationalizing transformative industrial innovation [30]. The POINT methodology had been developed, tested, and presented in steps aiming at wider framing of production and consumption system application for transformative industrial innovation. Another developed framework is the Partnerships for Regional Innovation (PRI), which will probably become “a strategic framework for innovation-driven territorial transformation, linking EU priorities with national plans and place-based opportunities and challenges” [31] (p. 1).

However, the multi-level perspective [13,32] considers the evolutionary path of radical innovation as the starting point and puts its transformative path on scale and time dimensions. The transitions come over time through the interplay between processes on different scales or levels of society—niches, regimes, and landscapes. The first level emphasizes the emergence of small-scale and local-level—niche innovations. The second level corresponds to a regime, a particular state of the socio-economic system, in which the innovation needs to survive, considering the steering, promotion, as well as limitations for behavior. The third level represents the context and landscape of radical innovations, a broad scale on which the developments occur. Such an approach creates five possible pathways toward green transformation (see Figure 2).

In Mariussen et al.’s [25] research, the respondents pointed to different pathways on GT (see Table 2) but the most often mentioned pathway was a regime transformation, which means that existing industries, skills, regulations, and institutions will be changed to adjust the new requirements.

That is why there is a need for a common understanding, as well as transparent and just S3 strategies and partnerships connecting different stakeholders of the region in seeking the cooperation of Quadruple Helix actors towards GT. Analysis carried out by Mariussen et al. [25] revealed that the pathway towards GT is based on both top–down and bottom–up approaches. Regulations guide development toward GT, and top–down guidance is necessary since GT is a systemic change at all levels. Legislation, policy, and finances come top–down and make a framework (incentive) for companies and their long-term investments. Technological and niche-based change is more bottom–up but needs a broad perspective and guidance. New niches are often developed in the supply chain when important actors find new solutions, but this needs support from a more local/regional actor. Innovations in companies emerge by pressure which is coming up from the landscape level and the consumers.



**Figure 2.** Five possible pathways toward green transformation. Source: Created by authors according to Mariussen et al. [25].

**Table 2.** Paths toward green transformation across selected regions in BSR.

Regions of BSR	Technological Substitution	Regime Transformation	Regime Reconfiguration	Dealignment and Realignment	Instit. Exhaust
Finland (Ostrobothnia) energy technology, circular economy (CE)	Belong to the main combination already in effect		Mentioned		-
Finland (Päijät-Häme) grain cluster	-	Belong to the main combination			-
Sweden (Västerbotten) hydrogen	-	Main path	-	Mentioned	-
Latvia (Latgale) metal and mechanical engineering	-	Main path	Mentioned		-
Lithuania (Klaipėda region) food and beverage	-	Main path	-	-	-
Lithuania (whole country) biogas-sector	-	Main path	Mentioned, important in 2030s	Mentioned, important in 2050s	-

Source: Mariussen et al., 2021 [25].

### 3.3. Research Design—Prospects of EGD through Smart Specialization Strategies in BSR

Conducted research was carried out in several stages to reveal how different Baltic Sea regions will implement EGD-focused green transformation through their S3 regional strategies. At each stage, different methods were applied to obtain and validate the results of carried research:

1. DPSIR analysis;
2. Policy recommendations.

#### 3.3.1. DPSIR Analysis

The multi-faceted nature, the essence, and the transformational process of sustainable development had been examined from multiple perspectives, using different methodologies and frameworks. Among the multiple frameworks, as stated above, the DPSIR (Drivers–Pressures–States–Impacts–Responses) analysis has been successfully applied in sustainability research (e.g., [26,27,33–36]), by providing an evidence-based pathway in the

issue-specific context for political and/or other transformational response, based on the chain of causal links among driving forces, pressures, states and impacts.

As the DPSIR model developed by the European Environmental Agency (EEA) [37] is specially designed to show the relation between societal changes and their impact on the environment, as well as actions to help the situation, it is an ideal tool for addressing the regional environmental challenges, to form a bottom-up and place-based the European Green Deal-focused S3 regional strategies for GT.

DPSIR framework is seen as giving a structure within which to present the indicators needed to enable feedback to policymakers on environmental quality and the resulting impact of the political choices made or to be made in the future. According to the DPSIR framework, there is a chain of causal links starting with 'driving forces' or drivers through 'pressures' to 'states' and 'impacts' on ecosystems, human health, and functions, eventually leading to political 'responses' (prioritization, target setting, indicators).

Describing the causal chain from driving forces to impacts and responses is a complex task, and tends to be broken down into sub-tasks, e.g., by considering the pressure-state relationship [38]. The biggest gaps can be seen as drivers for change, thus the DPSIR framework was developed based on the previously implemented gap analysis in each researched region/country, carried out during the previously implemented LARS project (October 2017–December 2020). The main aim of the developed DPSIR in this research is, based on GRETA project results, to provide at least one place-based environmental issue and the bottom-up possible solutions to this focusing on the European Green Deal goals via the S3 strategy in each partner region/country.

DPSIR analysis in project partner countries was carried out in March–June 2021.

### 3.3.2. Policy Recommendations

Intelligence and co-creation had been recognized as the next stage in S3 strategies [39]. Considering the difficulties observed in “translating” the concepts of S3 and “Entrepreneurial Discovery Process” into policy practices [40], it is proposed in this research, that co-creation requires a format, reflection, and repetition. Since the DPSIR as a method itself help identify place-based issues using a bottom-up approach, it might be further translated into the political agenda for the European Green Deal-focused green transformation via S3 in regions. In this research entrepreneurial discovery process was used to elaborate policy recommendations, which are used to translate the bottom-up identified place-based issues into concrete action to be taken by the key players in GT in every researched region of the Baltic Sea. Policy recommendations are developed by GRETA partners via entrepreneurial discovery process for the policy-makers to make the unique GT pathways functional and implementable in regions.

In this research, every GRETA partner elaborated policy recommendations concerning the European Green Deal-focused actions for green transformation to be taken in their regional S3, and also composed propositions concerning the implementation of GT at the EU level. Ideas for policy recommendations were elaborated during the co-creation at round table discussions (May–July 2021) in each partner region. The results from DPSIR in each region (The main policy pathways) were used as a place-based starting point for starting the co-creation at round table discussions with stakeholders to identify concrete actions for the selected intervention area (see Table 2), as well as policy brief writing by each partner.

Policy recommendations by each project partner country were developed in July–October 2021.

## 4. Results

The results revealing the potentiality of the implementation of the European Green Deal through S3 strategies in the Baltic Sea Region using the proposed co-creation method for DPSIR and bottom-up policy recommendations in the field are presented in this section.



The results are described in 2 sections based on the logic of research that was explained in the Materials and Methods Section.

#### 4.1. DPSIR Framework in Reaching GT

It is commonly understood that a ‘driving force’ is seen as a need and drivers are the changes in the social, economic and institutional system that directly and indirectly trigger pressures on the environmental state. The European EEA [37] defines them as ‘the social, demographic and economic developments in societies and the corresponding changes in lifestyles, overall levels of consumption and production patterns’. A classification of four non-hierarchical but interacting levels of driving forces influencing the structure and relation between the social, economic, political and environmental systems has been proposed [41].

Cases from the Baltic Sea regions show that the main drivers in changing GT are external EU and national level policies and regulations, such as SDGs, EGD, climate policies, cooperation, transparency and new technologies (see Table 3).

Driving forces lead to human activities which result in meeting a need. These human activities exert ‘pressures’ on the environment, as a result of production or consumption processes, which can be divided into three main types: (i) excessive use of environmental resources, (ii) changes in land use and (iii) emissions (of chemicals, waste, radiation, noise) to air, water and soil [38]. Pressures are the anthropogenic factors inducing environmental change, i.e., impacts. They are defined by the EEA as ‘developments in the release of substances (emissions), physical and biological agents, the use of resources and the use of land by human activities, although different approaches to its definition can be found in the literature [42,43]. In GT pressures should be seen as long-term and more general aspects of DPSIR.

A carried analysis shows that in GT the main pressures are changing markets, increasing importance of the circular economy, sustainable and climate neutral economy, resource consumption, and expansion of environmental footprint (see Table 3). So it is clear that even though the regions and their specialization are different they are experiencing the same long-term pressures.

As a result of pressures, the ‘state’ of the environment is affected. That is the quality of the various environmental compartments in relation to the functions that these compartments fulfill. The ‘state of the environment is thus the combination of the physical, chemical, and biological conditions [38]. A state may refer to a natural system alone or both a natural and socioeconomic system in a short term and is more specific.

DPSIR framework revealed that the main states in analyzed BSR regions are both directly environmental and social. The first aspect covers such environmental short-term challenges as air, soil, water pollution, global warming, high energy consumption, and increased waste. However, nonetheless, social challenges such as public concerns, human wellbeing, unemployment, and widening social gaps are also met concerning short-term challenges in aiming for GT in BSR.

The changes in the physical, chemical or biological state of the environment determine the quality of ecosystems and the welfare of human beings, human health, and functions. In other words, changes in the state may have environmental or economic ‘impacts’ on the functioning of ecosystems, their life-supporting abilities, and ultimately on human health and the economic and social performance of society [38]. Impacts are changes in environmental functions affecting social, economic and environmental dimensions, which are caused by changes in the State of the system. Impacts can include changes in environmental functions such as resource access, water and air quality, soil fertility, health or social cohesion [44]. These Impacts trigger Responses [42].

**Table 3.** DPSIR framework towards GT in BSR.

	Drivers	Pressures	States	Impacts	Responses
Finland (Ostrobothnia) energy technology, CE	SDGs, EGD, Climate awareness.	Changing markets. GT for sustainable energy solutions. Increase for CE demand.	More public actions and predictable regulations to show the way	Become globally more relevant regarding future energy solutions. Possible lack of experts/multiple solutions for energy systems. Potential opportunity for “green cash” and new global markets. Undermining importance of CE role in future markets.	Public-private partnerships, new products, services and projects, circular economy roadmaps.
Finland (Päijät-Häme) grain cluster	CE, SDG’s, Climate Policy.	EGD, Climate goals, CAP.	National and Regional Climate goals, road maps (CE and Climate)	Regulations, legislation, internationalization, market demands.	Cluster strategies, RDI-projects.
Sweden (Västerbotten) hydrogen	SDG, Agenda 2030, EGD, Industry, Investments.	Changing markets because of green economy. Bigger role for CE. New technologies. Need of new skills.	“Not doing nothing (threats)”. Unemployment. Increased CO <sub>2</sub> emissions. Less opportunity for investments. Widening social gaps. Increased use of natural resources.	Opportunity to be global leader for energy solutions. Sustainable use of natural resources.	More experimental projects. Platforms to develop partnership. International cooperation. EU-projects. Long-term policy and finance.
Latvia (Latgale) metal and mechanical engineering	EU and EGD, National government, sectoral ministries responsible for GT.	Sustainable and climate neutral economy. Increase the economic competitiveness while limiting and reducing climate change. Safe living environment. Reducing resource consumption.	Air pollution and global warming (CO <sub>2</sub> emissions). High energy consumption and low added value (including low productivity).	Developed public infrastructure for business towards climate neutrality. Implemented business greening and product development activities. Developed skills, improved and retrained personnel for the transition to climate neutrality. Created added value/increased productivity. Introduced innovations in production process.	Environmental strategies and support mechanisms to introduce innovative solutions and promote RES; Changes in mindset of society in general/improved knowledge for companies about GT; Just Transition Fund as an instrument for green transformation
Lithuania (Klaipėda region) food and beverage	Manufacturing industry activities. Export. Demand driven price. Low environmental awareness. Technologies.	Unsustainable production of raw materials. Increasing municipal waste flow. Unsustainable waste treatment. Lack of proper infrastructure.	Polluted water and soil. Food losses. Excessive plastic packaging.	Soil deterioration. Downgrading rural economy. Change in marine ecosystem. Impeded tourism decrease in competitiveness.	Attraction of FDI of sustainability-oriented firms. Support to product design. Support to industrial symbiosis. Focused R&D activities on waste management and reusability, waste treatment infrastructure. Combination of traditional BM and ICT solutions. Short supply chains. Marketing innovations.
Lithuania (whole country) biogas sector	Collaboration, transparency, financial resources, state loans, strategic planning, EGD.	Expansion of environmental footprint, production of waste, control of smells, application of new technology	Air quality, soil quality, humans’ well-being, life quality, soil use, increased generation of waste flows, missing CE	Deteriorated water, soil, air quality, deteriorated human’s life quality, increased amount of waste, increased CO <sub>2</sub> emissions, increased consumption of non-renewable energy sources.	Macroeconomic EU and national policy measures. Setting environmental policies and sector-specific policies. Setting targets and prioritizing. Education, cooperation, public awareness raising.

Source: based on Reports on DPSIR models following order—Ostrobothnia (FI) energy technology, circular economy [45], Päijät-Häme (FI) grain cluster [46], Västerbotten (SE) (hydrogen) [47], Latgale (LV) metal and mechanical engineering [48], Klaipėda (LT) food and beverage [49], Biogas sector (LT) [50]. Reports can be found at [www.lars-project.eu](http://www.lars-project.eu) [51,52] (accessed on 8 August 2022).

DPSIR framework revealed that the main impacts in analyzed BSR regions are twofold, i.e., seen as an opportunity, and as a threat. The main possibilities are related to the growing role of BSR countries and regions in the circular economy, showing the way towards a greener economy and development, as well as improving the skills toward climate neutrality. Impacts that could become threats are mostly seen as environmental ones in deteriorating the soil, water, air, negative changes in a marine ecosystem or increased consumption of non-renewable energy sources.

A ‘response’ by society or policymakers is the result of an undesired impact and can affect any part of the chain between driving forces and impacts. An example of a response related to driving forces is a policy to change the mode of transportation, e.g., from private (cars) to public (trains), while an example of a response related to pressures is a regulation concerning permissible SO<sub>2</sub> levels in flue gases [38].

Responses are the policy actions that are directly or indirectly triggered by the perception of Impacts and which attempt to prevent, eliminate, compensate or reduce their consequences. Responses can come from different levels of society, such as groups of individuals, governments or non-governmental sectors. These Responses can in turn influence trends in the Driving Forces, Pressures, States and Impacts.

DPSIR framework revealed that the main responses in analyzed BSR regions are policy actions aiming for public-private partnerships, cluster strategies, experimental projects, environmental strategies, and mainly EU and national level policies and policy measures (see Table 3). Such measures are expected to help to reach environmental targets and to change the public mindset toward greener living. Therefore education, cooperation and public awareness raising are as important aspects of GT as the environmental targets and policies.

DPSIR framework revealed that as environmental issues go beyond the borders of states, the green transformation has to go beyond borders as well. DPSIR models on different analyzed intervention areas revealed certain unique and also common place-based drivers, pressures, states, impacts and responses to them, hence, these might be modeled and applied in other sectors or other regions as well. That is why collaboration between countries and knowledge sharing among regions is essential.

DPSIR model also shows common challenges which are faced by similar countries and regions. DPSIR framework also confirmed that there are common issues and challenges such as lack of collaboration, transparency, financial resources and strategic planning, as well as not enough planning on environmental measures, targets and priorities that might be relevant in other Baltic Sea Region countries.

Learning and cooperation within regions are essential to reach environmental goals as set in the European Green Deal and to push green transformation even further, as partners can share a good experience, and knowledge to learn from each other and raise public awareness for their citizens.

#### 4.2. Political Recommendations

The overall co-creation process among stakeholders during the GRETA project came to summarizing GT results at the round tables in all examined regions. Using the input from DPSIR, both matured and young innovators identified the European Green Deal-focused green transformation policy pathways for their regions in the selected S3 area, and also defined the key players and demanded policy actions. The summarized co-creation results in partner regions are explored in Table 4.

**Table 4.** Political recommendations for the European Green Deal-focused green transformation via S3 strategies in the Baltic Sea Region.

Examined Region and S3 Area	Advancement in Innovativeness Level	Identified GT Policy Pathway	Key Stakeholders for GT	Demanded Policy Actions in the Analyzed Areas
Finland (Ostrobothnia) energy technology, circular economy	Matured innovator	(1) Technological substitution (2) Regime transformation	<ul style="list-style-type: none"> <li>Definite and dominant stakeholders—public organizations;</li> <li>Dominant stakeholders—business organizations.</li> </ul>	<ul style="list-style-type: none"> <li>Applying different kinds of GT-focused protocols and certificates;</li> <li>measuring GHG;</li> <li>re-clarifying and reformulating the circular economy definition and spreading knowledge in the area;</li> <li>establishing regulation in the area of innovation rising from the landscape and the niche level;</li> <li>setting the circular economy mind in the product design phase;</li> <li>scaling the application of the 3D-printing.</li> </ul>

Table 4. Cont.

Examined Region and S3 Area	Advancement in Innovativeness Level	Identified GT Policy Pathway	Key Stakeholders for GT	Demanded Policy Actions in the Analyzed Areas
Finland (Päijät-Häme) grain cluster	Matured innovator	(2) Regime transformation (3) Regime reconfiguration	<ul style="list-style-type: none"> <li>Definite and dominant stakeholders—public organizations;</li> <li>Dominant stakeholders—business and research organizations.</li> </ul>	<ul style="list-style-type: none"> <li>Creating sufficient political guidance at the EU and national levels;</li> <li>considering sustainable development and climate change goals in strategies and action plans;</li> <li>creating sufficiently flexible conditions for supporting business investment and RDI projects;</li> <li>setting the national-level environmental policies and regulations for the industry;</li> <li>setting sectoral roadmaps, goals, and cooperation between the agriculture industry and research (preserving biodiversity);</li> <li>establishing financial support schemes (e.g., tax reliefs) and enabling risk funding for pilot actions;</li> <li>bridging the cooperation gaps between research institutions and business organizations;</li> <li>supporting universities to strengthen their role in GT;</li> <li>increasing skills in the area;</li> <li>linking individuals and retail in raising awareness of the GT.</li> </ul>
Sweden (Västerbotten) hydrogen	Matured innovator	(2) Regime transformation	<ul style="list-style-type: none"> <li>Definite stakeholders—public organizations;</li> <li>Dominant stakeholders—business organizations.</li> </ul>	<ul style="list-style-type: none"> <li>Building up test system/making test system available for companies;</li> <li>accelerating system thinking from policy to financing, innovation potential, and pilots;</li> <li>accelerating spread of knowledge and information;</li> <li>building networks for enhancing capacity for transformation;</li> <li>developing regional strategy with GT focus.</li> </ul>
Latvia (Latgale) metal and mechanical engineering	Young innovator	(2) Regime transformation	<ul style="list-style-type: none"> <li>Definite and dominant stakeholders—public organizations;</li> <li>Dominant stakeholders—business organizations</li> </ul>	<ul style="list-style-type: none"> <li>Spreading the examples about practical gains of GT;</li> <li>creating regional industrial waste collection and recycling points;</li> <li>establishing EU support programs for equipment replacement or modernization;</li> <li>starting with “basics”—changing old equipment first (specifically in Latgale region case);</li> <li>expanding cooperation to foster GT;</li> <li>broadening application of Horizon 2020 as an instrument for companies to be used to GT.</li> </ul>
Lithuania (Klaipėda region) food and beverage	Young innovator	(2) Regime transformation	<ul style="list-style-type: none"> <li>Definite and dominant stakeholders—business organizations;</li> <li>Dominant stakeholders—public organizations.</li> </ul>	<ul style="list-style-type: none"> <li>Supporting technological renewal;</li> <li>targeting GT-focused research promotion;</li> <li>strengthening competencies and knowledge in the field of circular economy;</li> <li>accelerating internationalization;</li> <li>stimulating the demand for GT-focussed products and processes.</li> </ul>
Lithuania (whole country) biogas sector	Young innovator	(2) Regime transformation	<ul style="list-style-type: none"> <li>Definite and dominant stakeholders—public organizations;</li> <li>Definite stakeholders—research organizations and NGOs.</li> </ul>	<ul style="list-style-type: none"> <li>Establishing new or updating existing regulation on eco-innovations and tax policy;</li> <li>raising awareness in the field of research and systemic thinking at state-level;</li> <li>setting new long-term strategic measures for GT;</li> <li>developing experimental culture;</li> <li>creating incentives and motivational measures for GT;</li> <li>defining GT measures in the field of public administration and for companies;</li> <li>raising awareness on GT through education, learning, bench-marking;</li> <li>mobilizing stakeholders and cooperating for GT;</li> <li>expanding information and communication channels and tools concerning the GT.</li> </ul>

Sources: Elaborated by authors according to the GRETA project results: Policy Brief FI Ostrobothnia (2021) [45]; Policy Brief FI Päijät-Häme (2021) [46]; Policy Brief SE Västerbotten (2021) [47]; Policy Brief LV Latgale (2021) [48]; Policy Brief LT Klaipėda Region (2021) [49]; Policy Briefs LT Biogas sector (2021) [50]. Reports can be found at [www.lars-project.eu](http://www.lars-project.eu) [51,52] (accessed on 8 August 2022).

It is important to highlight that summary results lead to several interesting findings. Both matured and young innovators commonly identified the GT policy pathway in their regions as “(2) Regime transformation”. Hence, the matured innovators from Finland had identified more than one possible GT pathway: energy technology and circular economy area (Ostrobothnia) might complementary take the “(1) Technological substitution” path-

way, and the grain cluster (Päijät-Häme) see the possibility of “(3) Regime reconfiguration” pathway in line with regime transformation (2).

Another important observation is that the key role in GT among stakeholders, despite the S3 area and advancement in innovativeness, in all examined regions belongs to public organizations, which in all cases occupy the definite and/or dominant stakeholder’s role. Among other dominant stakeholders, business organizations and research institutions were most expected to take a role in future GT processes; NGOs only once appeared in the biogas sector in the young innovator’s case.

Finally, concerning the identified demanded actions for GT at various policy levels, findings are diverse. From one side, even matured innovators require more action in regulation, especially at supranational, as well as at the national and regional levels, starting from the clarification of the concepts used in the context of the GT (e.g., circular economy, FI), continuing with education and knowledge sharing in the field. On the other side, improvements at the core of the top-down level were broadly addressed both by matured and young innovators, mainly—by re-thinking the already developed strategies and their implementation action plans (e.g., definitions; measures; different kinds of GT-concerned protocols and certificates; measuring GHG; business support, investment, and tax relief policy). It is important to state that this greatly calls for urgent improvements both at regional, and national, but especially at the EU level, targeting the newly set ambition by the European Green Deal—climate neutrality by 2050.

## 5. Discussion

Based on the outlined recent scientific findings in the introductory part of the article [7,19–24], and taking into consideration the findings from this research, several insights are worth discussing concerning further investigations and policy action in the area of the European Green Deal-focused S3 strategies for GT. These are specifically concerned with co-creation and knowledge sharing among *matured innovators* (Finland and Sweden) and *young innovators* (Latvia and Lithuania) in the Baltic Sea Region, but also might be taken into consideration in a broader—EU context.

Going back to the highlights of Varga et al. [19,20], this research results demonstrate that industrial restructuring and growth are of special interest in the nearest GT pathways in the analyzed Baltic Sea regions. The results also prove the observations of Capello and Kroll [21], that there is a difference between young and matured innovators in taking their S3 pathway. This research, carried out in the Baltic Sea Region proves, that young innovators concentrate more on their GT pathways in one direction—regime transformation, which refers to industrial restructuring via changes within already existing industries, skills, regulations, and institutions, by adjusting to new requirements. Whereas already experienced matured innovators, based on their collected evidence on innovation implementation via S3, tend to build complementary GT pathways, by adding more radical innovations, i.e., (1) replacement via technological substitution, which calls for closing existing industries and starting new economic activities, and (3) regime reconfiguration with a radical reorganization of the existing industries, and new actors in new positions to make an actual change (e.g., Finland).

This research also partly proves and partly contradicts the findings of Cataldo et al. [7]. The proliferation of objectives, considering the regional S3 strategies in terms of S3 axes, economic or scientific domains, and policy priorities, was different in all six analyzed cases. It became evident that the general S3 issues appear in all regional strategies, however advanced innovators (Finland and Sweden) are very focused in their S3 strategies on particular place-based strengths in their regions. Whereas the cases from young innovators proved a huge proliferation of objectives, trying to find ‘something’ to innovate in many development areas. Therefore, their pathway towards the GT goes more horizontal via existing development strategies of different economic sectors and is not as radical as in matured innovators’ cases. However, Veugelers [22] findings had not been approved in this research, since the homogeneity of applied S3 frameworks, despite the different economic



and innovation potential, was not found among the studied Baltic Sea regions. The S3 frameworks in studied regions in selected areas were unique.

This research, carried out in the Baltic Sea Region, adds to the propositions of De Noni et al. [23] concerning the limitations of S3 for radical and breakthrough innovations. In researched cases, matured innovators (Finland and Sweden) truly demonstrate their specializations, and therefore—advancement in analyzed areas reached via focused S3 from the very beginning. Whereas the young innovators' cases (Latvia and Lithuania) demonstrated weaker innovation achievements and much less focus on a particularly unique and strong place-based area in their S3 strategies; the latter often lack continuity after the political cycle shift. Despite this research lacks evidence concerning the idea of “exaptation” [23], it is possible taking into consideration the complementarity opportunity of technological relatedness and knowledge complexity: in analyzed cases, matured innovators took the complementarity option in the GT pathways, by selecting two of them instead of one. In this context, collaboration for knowledge sharing gains importance. The performed experiment via co-creation in LARS and GRETA among matured and young innovators evidently demonstrates the protectiveness of international learning and co-creation in such important processes and the European Green Deal-focused GT using regional S3 potential.

Finally, concerning the effectiveness of S3 as a political experiment, this research confirms the findings of Cataldo [7], since in all cases the lack of comparable data and comparable evidence was observed in studied Baltic Sea regions when trying to define the grassroots for DPSIR, and GT pathways. The highlight by Marrocu et al. [24] is the truth in the studied young innovators' cases—different combinations are prioritized in unspecialized and unrelated sectors. In addition, this is specifically the case for young innovators. Hence, a clear top–down political process from the EU concerning the implementation of the European Green Deal-focused GT is demanded both in matured and young innovators' cases. The co-creation of political recommendations envisaged joint expectancies for a clear definition of circular economy and related terms, knowledge sharing, and set the mindset both in industry and services, as well as knowledge sharing with peripheral areas, which lack acceptable channels to reach them. Sectoral roadmaps are also found of high importance in making regime transformation, as well as more radical pathways—technical substitution and regime reconfiguration.

Finally, the defined importance of different stakeholders' roles in the European Green Deal-focused GT via S3 strategies, most often address public organizations, as definite and dominant stakeholders. Thus, the bottom–up and place-based acceleration, considering the other important stakeholders—business and research organizations, and NGOs—cannot be successfully carried out without political intervention at all levels: regional, national, and EU. This was commonly identified both by matured and young innovators, thus to reach climate neutrality, the biggest role, on the joint belief of quadruple helix stakeholders, belongs to governments and political processes in collaboration with science, business, and NGOs.

## 6. Conclusions

Despite quite a long period of EU cohesion policy reform, which was based on the Smart Specialization course, plenty of scientific evidence is provided to demonstrate its imperfections. The collected evidence highlights the lack of assessment of taken course on actual effects on economic development characteristics across Europe not only at separate country/region-level. The proliferation of objectives in countries with less developed governance skills, and the increasing gap between young and matured innovators are signaling the already existing troubles with taking political experiments under the EU Smart Specialization course.

The new ambition of the EU to reach climate neutrality by 2050, set in the European Green Deal—the new course for Europe, which should necessarily deal with the already observed issues with Smart Specialization strategies in regions. Scientific research gives more and more evidence of how the quickly changing environment worldwide echoes continuously raising new challenges, which become possible to fight in the 21st century,

only in collaboration of political power (public institutions), science (research organization), business and civil society, which is better known as Quadruple Helix innovation approach.

The moderated experimental experience gathered over 5 years and explained in this article demonstrates how the knowledge, generated and systematized by matured innovators with the help of science, by incorporating appropriate tools, such as DPSIR analysis, enables to transfer the skills to young innovators and create the unique place-based and European Green Deal-focused pathways for green transformation via already acting Smart Specializations in regions.

The developed pathways represent the bottom-up co-creation approach since the identification of European Green Deal-focused Smart Specialization pathways for green transformation in studied regions were identified via co-creation process, with joint efforts of stakeholders from all four helixes: public organizations (government institutions), research organizations (universities and other science representatives), business organizations (actual innovation implementers), and civil society (NGOs and other society representatives). Thus, every case demonstrates the uniqueness and the actual demands of everyone in the region to empower joint efforts to reach the climate neutrality goals.

Thus, the tested DPSIR methodology is very useful when fighting the homogeneity issues of Smart Specialization strategies across Europe, especially in the light of green transformation, focusing on the targets of the European Green Deal, since it helps empowering the place-based strengths of regions. Further, the DPSIR composes a strong background for developing bottom-up policy recommendations to guide the green transformation pathways. Therefore, the proposed DPSIR framework might work well as a tool for re-defining the regional innovation and economic development strategies in the regions of the EU.

This research of course has limitations due to its coverage: four countries of the Baltic Sea Region and six areas of Smart Specialization. At the same time, these limitations call for further research in the field—to broaden the area and apply already developed tools and techniques (LARS and GRETA project results [51,52]), including the DPSIR analysis with guidance. All developed tools are useful for developing policy pathways for green transformation, focusing on the European Green Deal in the whole EU. The developed toolbox might be also applied for the comparison between the young and matured innovators, or other scientific developments in the fields of Smart Specialization and green transformation.

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