Operationalizing Regional Mission-Oriented Innovation Policy

MSc Thesis Innovation Sciences

Abstract

Developments in the last decade of innovation policy show a trend that moves away from generic economic growth towards solving specific grand societal challenges as its rationale. On the other hand, there is increasing consensus that regional (or local) contexts should be taken into account when designing innovation policies. This presents a challenge, as regions do not know how they can contribute to societal challenges that transcend their own geographical scale. In this thesis a framework is developed that aims to identify regional strengths and weaknesses to contribute to larger scale mission-oriented innovation policy. This is done by bringing together two broad literature streams (MIP and RIS). A part of the framework is put to the test in three case studies. The Dutch NUTS2 regions of Noord-Brabant, Zuid-Holland and Friesland are investigated within the context of the Dutch mission of having a completely CO2-free electricity system by 2050. Based on these analyses, it becomes clear that regions can indeed be better informed on how they can contribute to large-scale missions with the developed framework. More extensive case-studies wil be needed to develop the framework and obtain more quantitative insight into the dynamics of regional mission-oriented innovation policy.

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1. Introduction

This research aims to better understand how regions can contribute to national mission-oriented innovation. Within the innovation studies literature, contributions in this area can be divided between those with a focus on innovation policies for missions (Mazzucato, 2016; MIPO, 2020; Wanzeböck et al. 2020; Wesseling & Meijerhof, 2020) ((as contrasted to more generic innovation policies (Mazzucato, 2016)), and those with a focus on regional innovation policies (RIP) (Balland et al., 2018; Boschma & Gianelle, 2014; Cortinovis et al., 2017; González-López et al. 2019; Lelio Iapadre, 2016; Uyarra, 2009). First, *Mission-oriented Innovation Policy* (MIP) addresses how innovation (policy) can help overcome grand societal challenges like climate change, poverty and public health. Outside academia, MIP has gained popularity with policy makers at various levels, notably the European Union and its member states such as the Netherlands. Second, another trend in innovation policy, especially at the European level, are region-specific policies that emphasize the geographical contexts in which regions are embedded. The most popular regional innovation policy paradigm is *smart specialization* (S3), which argues why certain regions are successful in branching out into new, high-tech scientific specializations and industries while others are not. S3 is largely aimed at economic development and entrepreneurial activities by focusing on a region's identified technological branching-opportunities. To branch-out into a new complex technological path requires a diversity of capabilities related to it.

In the last decades, regions are an increasing level of focus for (inter)national governing bodies and agencies. Especially in the European Union, regional economic policy is very popular. Regions, on the other hand, have difficulties to understand how they contribute to large scale societal challenges that transcend their regional boundaries. (Wanzenböck & Frenken, 2020) point towards the importance of regions for the implementation of MIP. However, while there have been valuable insights from both the MIP literature and S3 literature, they have not yet been combined. By bringing together the two literature streams, valuable insights regarding the role of regions in missions can be created. Combining the two is a challenge. That is, S3 policies seem to be implicitly aimed at achieving a strong regional economy. While MIPs do not disregard the fact that entrepreneurial activities play a vital role in achieving the mission (Wesseling & Meijerhof, 2020), it takes it more as a means-to-an-end (the end being the mission). It is as of yet unclear if and how MIP and regions are related, and unclear if every region can contribute to missions while also strengthening its economy and societal development goals. Another challenge arises from the scope of missions. While innovation policies are argued to be ideally implemented at the sub-national level due to the contextual nature of the policies (Wanzenböck & Frenken, 2020), the problems MIPs address can be national or even global. Moreover, missions are often formulated at national or supranational levels. A final challenge relates to the top-down versus bottom-up focus of both MIP and regional policies. The same policies will not be successful in every regional context. In contrast, one region often cannot solve a problem or mission that is set at national or even global level. Thus, I argue that region-specific mission-oriented innovation policies are important for successful MIPs, but there is currently no MIP-framework that focuses on regions and their role in, link to and value for missions. To address this gap, the current research will develop an analysis framework for identifying regional potential to contribute to MIP. The framework should help regions to identify their contribution to specific missions (ie. regional fingerprint), and should provide quantitative indicators to assess the relative weaknesses and strengths for a region to contribute mission(s). Vice versa, the framework should help national governments to identify the contributions various regions can make to achieving nationally-set mission goals. Such an approach can help regions in implementing more effective and efficient policies to address societal challenges. From this follows the research question:

“**How can a region's relative strengths to contribute to national mission-oriented innovation policy be quantitatively identified?”**

2. Regional vs. Mission-Oriented Innovation

Most missions and examples of MIPs are formulated at the national or supranational level. However, (Wanzenböck & Frenken, 2020), argue that *“innovation policies aimed to solve societal challenges [...] are best pursued at subnational levels given the contested nature of problem identification and the contextual nature of problem-solving”.* The current focus of the Dutch mission-oriented innovation policies is a top-down approach to setting goals. An example of this is the Dutch mission of transitioning to a completely CO2-free electricity system by 2050. It has two sub goals for 2030, one of which is that by 2030, 49TWh of electricity will be generated with off-shore wind power (EzK, 2019). It is unclear how various regions are expected to contribute to this goal. Regions would therefore benefit from having a specific regional contribution that together with other regions contributes to the national goal. Following (Wanzenböck & Frenken, 2020), I furthermore argue here that allowing regions to partly govern their own solutions, following the subsidiarity principle[1], has the potential to make monitoring easier on both national and regional levels. If region’s know what

[1] Oxford English Dictionary. https://en.oxforddictionaries.com/definition/subsidiarityDefinition: "[mass noun] (in politics) the principle that a central authority should have a subsidiary function, performing only those tasks which cannot be performed at a more local level:"

national missions they can prioritize on given their specific regional technological and economic specializations, wickedness may be reduced as responsibilities on a regional level can be divided in a more effective way.

This research will therefore build on two broad strands of literature, namely that of Mission-Oriented Innovation Policy (MIP) and Regional Innovation Systems (RIS). The MIP-literature explores how innovation policy can be used to help overcome societal challenges and RIS provides insights in more generic innovation for economic growth. Therefore, insights and concepts from both are used to build a framework that can be used to identify potential bottlenecks as well as opportunities for a specific region to contribute to national MIP-goals.

Regional Innovation Systems

The regional innovation systems (RIS) approach, consists of several interacting actors within a region that together shape learning processes and innovations. The RIS approach particularly puts emphasis on the path-dependency and geography of innovation systems. The idea of path-dependency is that not every region is equally suited to become specialized in specific fields of knowledge or technology (González-López et al., 2020).

Smart specialization, a particular popular paradigm for innovation policy (and an important aspect of the cohesion policy of the European Commission[2]), is an approach that is in a way an extension of RIS (González-López et al., 2020). It also puts emphasis on the idea that regions are not equally suited for the same innovative activities. Rather, regions should prioritize those activities that are aimed at diversification of the technological capabilities that are already embedded in the region. Furthermore, the prioritized activities should have a connection with other regions (Lelio Iapadre, 2016).

Conceptually related to S3 is the notion of ‘related variety’ or ‘related diversification’ (Frenken et al., 2007; Boschma & Iammarino, 2009), which comes from the school of economic geography. It explores the opportunities of a region based on its current local capabilities and connects its knowledge spillovers to new, related development paths and industries. This way, technologies or industries that have promising potential within a specific region can be identified. The potential of specific policies also depends on the present policy mixes as well as the region's history of (innovation) policies (Uyarra, 2009).

(Balland et al., 2018) designed a smart specialization policy framework around the concepts of knowledge complexity and relatedness density based on patents. They stress that knowledge bases of regions (and firms) differ in (technological) complexity and tacitness. The knowledge that is required for relatively simple technologies and that is easily codifiable is also easily transferred to

[2]https://s3platform.jrc.ec.europa.eu/what-is-smart-specialisation-#:~:text=Conceived%20within%20the%20reformed%20Cohesion,Entrepreneurial%20Discovery%20Process%20(EDP)%20with

other regions. This usually makes knowledge economically less valuable as it does not provide the region with a competitive advantage.
The European Commission's guide to research and innovation strategies (EC, 2012) presents a six-step approach to the design of S3 strategies. They are defined as follows:

" 1. Analysis of the regional context and potential for innovation,
2. Set up of a sound and inclusive governance structure,
3. Production of a shared vision about the future of the region,
4. Selection of a limited number of priorities for regional development,
5. Establishment of suitable policy mixes,
6. Integration of monitoring and evaluation mechanisms. "

Mission-oriented Innovation Policy

Innovation policy that is aimed at using innovation to address grand societal challenges gains increasing popularity among policymakers as well as researchers (Mazzucato, 2016). The UN sustainable development goals (SDG's) and the EU's Horizon Europe serve as an important inspiration for the goals prioritized in (supra)national or regional MIPs.

Right now, the literature mainly discusses how governmental bodies can provide *directionality* to science, technology and innovation (STI) activities (Mazzucato, 2016 ; Wesseling & Meijerhof, 2020). This directionality would have to steer a very broad range of stakeholders towards a particular goal. Missions linked to grand societal challenges are characterized by a high degree of 'wickedness' (Rittel & Webber, 1973) regarding *contestation, complexity* and *uncertainty* both of the problems and the solutions surrounding the challenge (Wanzebock et al., 2019). (Janssen, 2020) points out that literature on MIP often emphasizes one of three sources of change. They are first, *Scientific Research and challenge-led R&D polic*y, second, *entrepreneurial experimentation by firms and industrial policy,* and finally *changes stemming from societal stakeholders and transformative innovation*. The first of these refers to scientific knowledge production relevant for the mission. The second refers to the uptake of new technologies or business models that contribute to a mission. Finally, the last one concerns change that originates at a local level and organically emerges bottom-up (see for example (Loorbach et al., 2020)).

Criteria for Analyzing Regional Mission-oriented Innovation

Some of the main insights on both regional and mission-oriented innovation policy are discussed. The general lesson provided by S3 is that attention has to be paid to a region's technological and institutional context (Balland et al., 2019). It is mainly concerned with economic development and competitive strength of a region, but its insights will be relevant as well when designing MIPs. For example: A greater variety of capabilities leads to more opportunities for new complex technological specializations, each of which might be of relevance for missions (Uyarra, 2009).

A framework that helps regions identify their potential to contribute to specific national missions, should be based on the insights discussed so far. The listed S3 design steps already provide criteria for (economically) successful regional innovation policies in general. But in the context of MIPs, directionality towards the mission goal is added to these. For the sake of being pragmatic, the desired directionality is taken to be provided by official policy documents. The framework therefore, aims to be applicable to missions already documented in policy documents.

3. Operationalizing Regional Mission-Oriented Innovation Policy

The two literature streams are brought together in this section, resulting in a new analysis framework. The framework serves as a tool that provides regions with insight into how they can contribute to solving societal problems that transcend the regional level. The developed framework is based on an adoption and adjustment of the six steps from the European Commission's guide to research and innovation strategies (RIS3) (EC, 2012). As we are interested in the identification of regional opportunities rather than the actual design of a smart specialization strategy, the first three steps are taken over and adjusted. Steps 4 to 6 are more relevant to the actual policy design. A new first step is added as well as it is relevant to provide a mission-context that is the same for all other steps. This step serves as the basis on which the other regional analyses can then be mapped. This results in the following steps:

1. Schematic coding of the mission

2. Analysis of the regional context and potential for innovation

3. Identification of the governance structure

4. Identification of the production & communication of a shared vision

On the basis of these steps an overall analysis can be made that provides insightful input in the actual policymaking process. The different steps require different indicators. However, on an abstract level, the following steps are the same for 2-4

- Thematic coupling of (traditional) indicators to the mission
- Construction of the mission-related data-set
- Defining measurements

This process enables the operationalization of a region's position to contribute to mission-oriented innovation policy. In the following, the four steps will be further elaborated on.

1. Schematic coding of the mission

The first step requires a mission to be documented in policy documents. This is because before regions can be analysed, the national mission has to be 'coded' in order to provide the other steps with a thematic context in which the analyses can take place. With coding is meant that a conceptual labeling of the content of the mission can be done by analyzing and interpreting the official policy document describing the mission. This means that a more precise and unambiguous articulation of the mission in policy documents makes this framework more usable.

2. Analysis of the regional context and potential for innovation

The analysis of the regional context and potential for innovation provides insight into the regional knowledge base and economic specialization that provide opportunities to contribute to the mission. In order to identify the regional context and potential for innovation, there are two relevant methods taken from RIS3 that are quantitative in nature. These are analyses of a region's (a) scientific and technological specialization and (b) economic specialization.

Scientific and Technological specialization

Traditional indicators for technological innovative activities (for example patent indicators) should be linked to concepts abstracted from policy documents accompanying the mission. These indicators should be measured in comparison to the average of other regions. This average can be taken to be the average of all regions in a country or can encompass more regions, depending on the scope and aim of the research and characteristics of the region. Furthermore, measuring changes over time in S&T specializations can provide a better understanding of a region's perspective than static analysis.

economic specialization

This analysis questions whether some sectors are over represented in the regional economy. This can be measured with location quotients (EC, 2012). An analysis of changes over time in the region's specialization can be expected to provide more insights than static analyses.

3. Identification of the governance structure

Identification of the governance structure is aimed to provide insight into the extent to which a region has a proper governing structure to contribute to national mission-oriented innovation policy. The traditional triple-helix model is based on involving the public sector, industry as well as academia in the policy-making process (Etzkowitz & Leydesdorff, 1995). However, there is increasing consensus on the importance of innovations that are not science- and technology based and broadening of innovation policy to target other kinds of innovations (see for example (Antons et al., 2020)). RIS3 expands the governance structure to include both user-innovators, which represent the demand-side of innovation, and civic-society stakeholders. In this *quadruple helix* governance structure, there is less danger of lock-in caused by the interest of lobbies or incumbents.

Governance for MIP should be inclusive and requires representation of many stakeholders, including representatives of academia, business, municipalities, start-ups, ministries, societal stakeholders, financiers, and insurance companies. There are several advantages of such *inclusive mission governance*. First, Missions require an integral approach with collaboration because of the issue of directionality (MIPO, 2020). Second, the participation in designing policies and solutions from many stakeholders increases legitimacy and clarity for the missions. As such, A specific mission-governance platform that encompasses stakeholders from different sectors helps effective mission-governance (TNO, 2018). Besides inclusivity of stakeholders, missions require thematic, mission-oriented organizations. Types of governance that are in particular suitable for mission-governance are public-private partnerships and agencies (TNO, 2018).
In order to asses the inclusivity of the mission-governance, the following indicators can be used:

- Inclusivity of mission-design (authors of policy documents) regarding the mission: Universities, business, governing bodies, civil society stakeholders, Public-private partnerships.
- Inclusivity of execution (types of actors that commited in some way to collaborate on a mission): Universities, business, governing bodies, civil society stakeholders, Public-private partnerships.

4. Identification of the production & communication of a shared vision

In the RIS3 this step is about developing a general future scenario for the region. Within the context of the analysis-oriented framework, it is focused on identifying the communication that already takes place within the region. In the context of missions, the vision is to some extent already shaped by national mission-oriented policy goals. Therefore, in the context of an already formulated (national) mission, this step is about specifying the ‘how’ of the regional contribution. Text mining methods are already used in innovation research (Antons et al., 2020), and provide the potential to analyze a 'regional narrative' by analyzing regional policy documents and social media (among other bodies of unstructured text produced in the region). This provides insight in alignment between stakeholders within the region and between national, regional and local levels, which is needed to keep stakeholders involved on the long-term.

4. Method

Research Design

The research is designed as a quantitative case-study of the first framework analysis, namely *Analysis of the regional technological context and potential for innovation.* It is structured by the steps in the framework section, including:

- Thematic coupling of indicators to the mission
- Construction of the mission-related data-set
- Defining technological specialization
- Defining "Relative Technological Strength"

Three Dutch NUTS2 regions are compared based on the present regional technological capabilities in the context of mission-oriented innovation policy. The mission used for the case study is the Dutch mission to have a completely CO2-free electricity system by 2050. Three mission-driven innovation programs are designed to achieve this goal. For the scope of this research, it suffices to use one of the case study, namely MMIP2: Renewable electricity generation on land and the built environment. The three regions chosen for the case study are Noord-Brabant, Zuid-Holland and Friesland. The first two regions are chosen as they both have technical universities (among other universities and research institutes) and as such they are expected to have a strong localized knowledge base in at least some of the areas of interest for this research. The region of Friesland is chosen as it is a smaller region in terms of R&D intensity and high-tech industry (Topsector Energie, 2019), and it would be of interest for this research to see to what extent the developed method can provide meaningful results for NUTS2 regions that are smaller in terms of technological capabilities. In order to identify these relative technological strengths within Dutch regions, patent data is used as it is widely seen as an important indicator for technological capabilities of applicants (Rathenau, 2013). Patent data is also practical as it allows analysis on several levels of scale (in this case NUTS2). Data analysis is done in R.

Data collection

In order to determine a region's technological specialization within the context of a specific energy-related mission, patent data are used. The Y02 CPC-classification of the European Patent Office (EPO) is used. The Y tag labels cross-sectional technologies spanning over several domains of the IPC-classes. The Y02 classification symbol classifies technologies or applications for mitigation or adaptation against climate change. Using Y02-classified patents allows for thematic coupling to climate-related missions. Using Y02-labeled patents between 2004 and 2018 results in a database containing 393831 patents, divided between 635 NUTS2 regions.

The resulting raw data consists of data sets containing application id's and CPC-classifications (all within Y02), applicants, application dates, regional codes and regional- and applicant shares.

Thematic Coupling of indicators and mission

A conceptual labeling of the mission is done. This is done by analyzing and interpreting the official policy document describing the mission. Concepts are gathered based on text- in the several sub-programs described in the mission. Paragraphs within the several subprograms serve as a thematic subgroup. The different patent classifications, as specific as a string of length 9 containing 7 characters (for example Y02 B10/3*) based on the classifications of EPO's Espacenet[3], are subsequently coupled to these concepts in order to complete the thematic coupling. An overview of the complete thematic coupling of the schematized policy document to patent-classifications can be found in appendix A.

Constructing the mission-related data-set

The dataset contains application-id's of the patents, NUTS2 regions, applicants, application year, CPC-classification, regional shares and application shares. In order to construct the data-set that combines the analysis of the regional technological capabilities within the context of the mission, thematic coupling is used to filter the data set, which then contains Y02 classifications related to the mission only.

Data Analysis

The data-analysis of patent data is done with the Rstudio software.

The classifications are specified with 7 characters (See figure 1). For instance, within Y02, there is the sub-group of Y02E 10. This represents "Energy generation through renewable energy sources'. Within the classification Y02E 10, some but not all of the classifications may be assessed the same. For the MMIP2 mission, which is about renewable electricity generation, classifications that focus on the generation of thermal energy may be classified as potentially relevant, as there are for example

[3] https://worldwide.espacenet.com/patent/cpc-browser#!/CPC=Y02

solar thermal energy generators that are used to generate electricity for the grid. All of the interpretations of the most detailed classifications (for example Solar thermal energy (Y02E 10/40)) are interpreted. If some but not all of the more specific subclassifications are interpreted as not being relevant, the irrelevant sub-classifications are filtered out of the data. The resulting classification index for the mission is provided in appendix B.

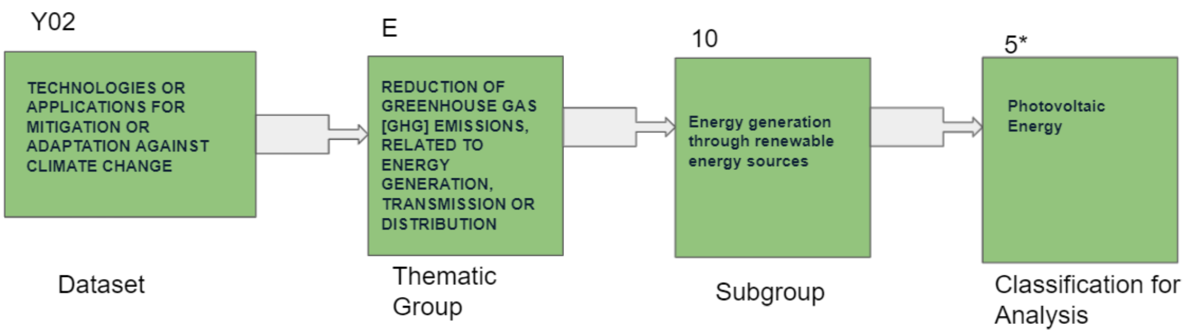

figure 1: Hierarchical structure of CPC classification Y02E 10/5*. The thematic coupling between classifications and MMIP2 is done with classifications of 7 characters.

In order to make a specialisation index for a NUTS2 level region within the context of one MMIP, the regional RSCA is calculated for all relevant and potentially/conditionally relevant patent classifications. The RSCA is the Relative Symmetric Comparative advantage. This measures a region's relative specialization within the selected classifications. It is defined as:

$$RSCA_i^{reg} = (RCA_i^{reg} - 1)/(RCA_i^{reg} + 1)$$

Where RCA is defined as:

$$RCA_i^{reg} = \frac{Y_i^{reg} / \sum Y_i^{reg}}{Y_i^{all} / \sum Y_i^{all}}$$

The region is said to specialize within a specific classification when RSCA >0**.** Some regions have a relative low number of total patents. This can result in very spiky specialization charts indicating a strong RSCA score in those patents that they have, as they will make up a relatively higher part of the total number of Y02 patents. Having only one patent in total would result in a RSCA score of 1 in the classification of that patent.. The RSCA charts are meaningful in that they provide insight into a region's specialization or priorities. Other indicators are needed to provide insight into a region's actual technological capabilities within a specific area, whether it specializes in this area or not. For this purpose, a new indicator is developed, namely the Symmetrical Interregional Average Compared score (SIAC score). It is defined as:

$$SIAC_i^{\text{reg}} = \frac{IAC_i^{\text{reg}}-1}{IAC_i^{\text{reg}}+1}$$

Where the IAC is defined as the number of patents of one region divided by the average number of those patents taken over all 635 NUTS2 regions in the database:

$$IAC_i^{\text{reg}} = \frac{Y_i^{\text{reg}}}{Y_i}$$

As the mission is a national one, and the aim is to find out how regions can contribute to this mission, their capabilities compared to other regions is analysed as well. To this end, for all the classifications the relative share of all Dutch regions is plotted.

Validity & Reliability

Mainly technology-driven missions can be assessed with patent indicators. For practical reasons, the charts show specializations on the scale shown in figure 1 (CPC8). However, the charts are only meaningful when compared to the filtering table in appendix B as some of the classifications are filtered internally. This may cause confusion of scope and content of the specializations. The thematic linking could be done on a more precise patent-classification level. However, subclassifications that fall under the same classification can be assumed to be technologically related to each other. In this way they do provide insight into a region's potential to develop into technological growth paths related to specific parts of the mission. Also, (Karki, 1997) already mentioned other forms of patent data (such as patent citations) that might better indicate technological strength. Furthermore, some thematic groups (figure 1) are not present in the Netherlands and are therefore left out of the analysis. The developed SIAC score provides insight into the international strength of a region, but they do not show how many patents there are in this classification. As such, a region could hypothetically be determined to have a "strong" position while having few patents (provided there are only a few other of those patents worldwide. This point is especially relevant for those classifications that have many subclassifications filtered out. Also, patents may be shared by regions. The patents are counted in such a way that they may be counted twice when they are shared by more than one region. Finally, more dynamic analyses could provide more insight into a region's technological context, as the current analysis does not provide insight into the distribution of regional patents in time.

Results

Figures 2-4 show the RSCA and SIAC scores of Noord-Brabant, Zuid-Holland and Friesland. Table 1 serves as a legend for all three radar charts.

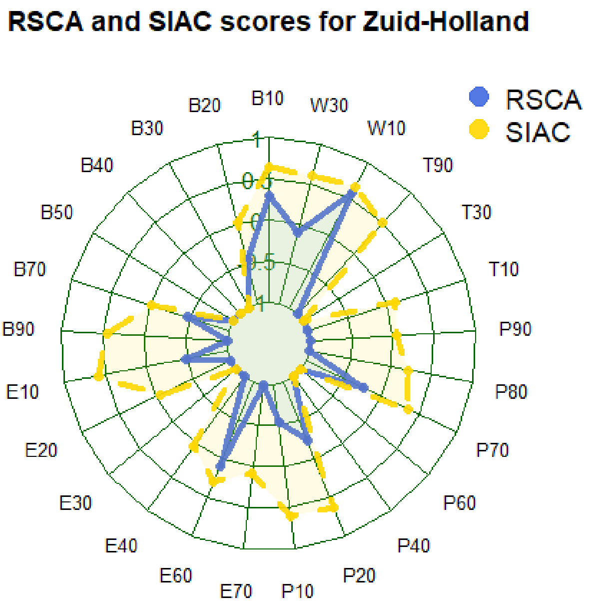

Figure 2: The RSCA- and SIAC Scores for Noord-Brabant

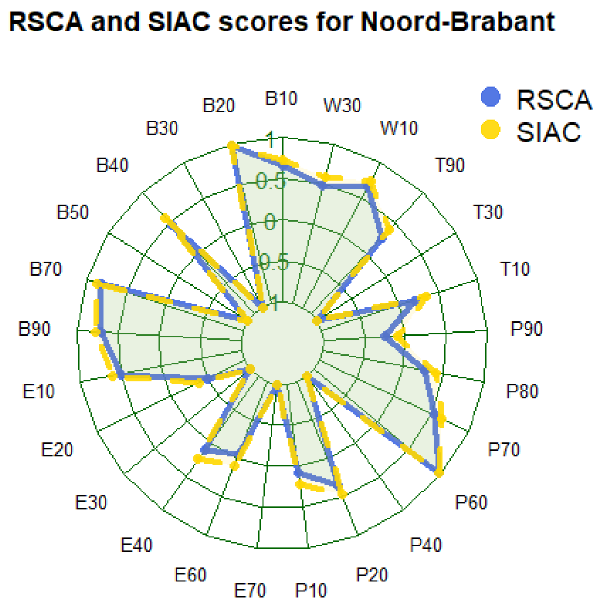

Figure 3: The RSCA- and SIAC Scores for Zuid-Holland

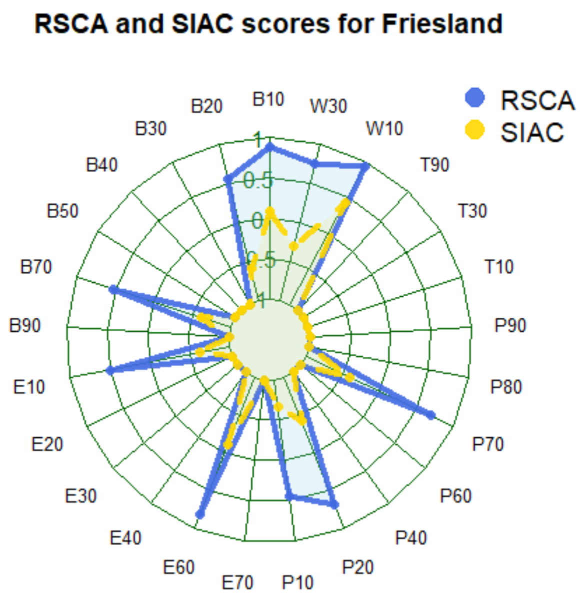

Figure 4: The RSCA- and SIAC Scores for Friesland

B10	Integration of renewable energy sources in buildings
B20	Energy efficient lighting technologies, e.g. halogen lamps or gas discharge lamps
B30	Energy efficient heating, ventilation or air conditioning [HVAC]
B40	Technologies aiming at improving the efficiency of home appliances, e.g. induction cooking or efficient technologies for refrigerators, freezers or dishwashers
B50	Energy efficient technologies in elevators, escalators and moving walkways, e.g. energy saving or recuperation technologies
B70	Technologies for an efficient end-user side electric power management and consumption
B90	Enabling technologies or technologies with a potential or indirect contribution to GHG emissions mitigation
E10	Energy generation through renewable energy sources
E20	Combustion technologies with mitigation potential
E30	Energy generation of nuclear origin
E40	Technologies for an efficient electrical power generation, transmission or distribution
E60	Enabling technologies; Technologies with a potential or indirect contribution to GHG emissions mitigation
E70	Other energy conversion or management systems reducing GHG emissions
P10	Technologies related to metal processing
P20	Technologies relating to chemical industry
P40	Technologies relating to the processing of minerals
P60	Technologies relating to agriculture, livestock or agroalimentary industries
P70	Climate change mitigation technologies in the production process for final industrial or consumer products
P80	Climate change mitigation technologies for sector-wide application
P90	Enabling technologies with a potential contribution to greenhouse gas [GHG] emissions mitigation
T10	Road transport of goods or passengers
T30	Transportation of goods or passengers via railways, e.g. energy recovery or reducing air resistance
T90	Enabling technologies or technologies with a potential or indirect contribution to GHG emissions mitigation
W10	Technologies for wastewater treatment
W30	Technologies for solid waste management

Table 1: description of CPC8 codes

Noord-Brabant

Noord-Brabant has 16 subjects that have a positive score for both the RSCA and SIAC measures. Table 2 shows the 10 highest scoring subjects ranked by their SIAC scores. Within the context of MMIP2, the region specializes (RSCA > 0) in the classifications B10, B20, B40, B70, B90, E10, E40, P10, P20, P60, P70, P80, T10, T90, W10 and W30. The SIAC scores show similar values, with a relative technological strength (SIAC >0) in the same subjects in which it specializes, with the addition of E60. There are two subjects that approach a score of 1 for both the RSCA and SIAC. These are B20 (Energy efficient lighting technologies) and P60 (Renewable energy and energy saving technologies relating to agriculture, livestock or agroalimentary industries). These two subjects both have an RSCA score of 0.97 and a SIAC score of 0.98.

Technological Subject	Associated Mission Concepts	RSCA	SIAC
Energy-efficient lighting technologies (B20)	- *Smart & Efficient electricity use in the Built environment* - *optimally gear the generation of wind and solar power to the demand for electricity, in time and place by smart lighting technologies (i.e. smart controller or presence detection)*	*0.97*	*0.98*
Renewable energy and energy saving technologies relating to agriculture, livestock or agroalimentary industries (P60)	- *Smart & Efficient electricity use in rural areas* - *integration of sustainable generation in the energy system and in products, homes and landscapes(i.e. solar water pumping in agriculture)*	*0.97*	*0.98*
Technologies for an efficient end-user side electric power management and consumption (B70)	- *optimally gear the generation of wind and solar power to the demand for electricity, in time and place* - *Contribution of Information technology to the upscaling and the ability to predict energy yield and energy demand* - *better integration of sustainable generation in the energy system and in products, homes and landscapes* - *new service and business models*	*0.82*	*0.86*
Building-related enabling technologies or technologies with a potential or indirect contribution to GHG emissions mitigation(B90)	- *optimally gear the generation of wind and solar power to the demand for electricity, in time and place* - *Smart & Efficient electricity use (in the build environment)*	*0.71*	*0.78*
Wastewater or sewage treatment systems using renewable energies(W10)	- *better integration of sustainable generation in the energy system and in products, homes and landscapes*	*0.66*	*0.74*
Integration of renewable energy sources in buildings(B10)	- *integration of solar generation technologies* - *Building-Integrated PV-systems* - *flexibility in* *shape, size, color and transparency of Solar in the built environment*	*0.65*	*0.73*

	- *better integration of sustainable generation in the energy system and in products, homes and landscapes for digitalisation* - *Local storage for system-integration* - *flexible electricity rates for system-integration* - *integration of generation systems in the future energy system for system integration* - *integration of solar-power technologies* - *improved integration into the environment for wind-power technologies*		
Climate change mitigation technologies in the production process for final industrial or consumer products(P70)	- *General advancements in wind-power innovations*	*0.54*	*0.64*
Energy generation through renewable energy sources(E10)	- *General advancements in solar-power technologies* - *Materials for solar-power generation* - *General advancements in wind-power innovations* - *Increased efficiency for wind-power* - *Robustness of wind-power technologies combining wind turbines and solar power systems* - *Other solutions for generating electricity from renewable sources on land* - *Thermoelectric conversion*	*0.51*	*0.61*
Technologies for solid waste management (W30)	- *design for sustainability/recycling of products and services adapted thereto*	*0.47*	*0.58*

Table 2: Noord-Brabant's technological profile in relation to MMIP2

Zuid-Holland

For Zuid-Holland, analysis shows the following specialization areas: B10, E60 and W10, P60, P70, P80, T10, T90, W10 and W30. Table 3 shows the 10 highest scoring subjects ranked by their SIAC scores. The SIAC scores for Zuid-Holland are higher than the RSCA scores for all subjects. The subjects that have (SIAC > 0) are B10, B20, B70, B90, E10, E40, E60, E70, P10, P20, P70, P80, P90, T10, T90, W10 & W30.

Technological Subject	Associated Mission Concepts	RSCA	SIAC
Wastewater or sewage treatment systems using renewable energies(W10)	- *better integration of sustainable generation in the energy system and in products, homes and landscapes*	*0.58*	*0.67*

Integration of renewable energy sources in buildings(B10)	- *integration of solar generation technologies* - *Building-Integrated PV-systems* - *flexibility in shape, size, color and transparency of Solar in the built environment* - *better integration of sustainable generation in the energy system and in products, homes and landscapes for digitalisation* - *Local storage for system-integration* - *flexible electricity rates for system-integration* - *integration of generation systems in the future energy system for system integration* - *integration of solar-power technologies* - *improved integration into the environment for wind-power technologies*	*0.29*	*0.64*
Technologies relating to chemical industry(P20)	- *production processes and systems for solar-power technologies* - *product design concepts and materials*	*-0.23*	*0.63*
Technologies related to metal processing(P10)	- *Circularity for solar-power technologies* - *Production processes and systems for solar-power technologies* - *Improved circularity of wind turbines* - *design for sustainability/recycling of products and services adapted thereto* - *Facilitation of recycling and reuse*	*-0.54*	*0.60*
Energy generation through renewable energy sources(E10)	- *General advancements in solar-power technologies* - *Materials for solar-power generation* - *General advancements in wind-power innovations* - *Increased efficiency for wind-power* - *Robustness of wind-power technologies* - *combining wind turbines and solar power systems* - *Other solutions for generating electricity from renewable sources on land* - *Thermoelectric conversion*	*-0.49*	*0.59*
Technologies for solid waste management (W30)	- *design for sustainability/recycling of products and services adapted thereto*	*-0.11*	*0.59*
Transport-related enabling technologies or technologies with a potential or indirect contribution to GHG emissions mitigation(T90)	- *integration for solar-power technologies* - *integration of generation systems in the future energy system* - *Optimally gear the generation of wind and solar power to the demand for electricity, in time and place* - *flexible electricity rates* - *Local storage* - *Contribution of Information technology to the upscaling and the ability to predict energy yield and energy demand* - *better integration of sustainable generation in the energy system and in products, homes and landscapes* - *new service and business models* - *Smart & Efficient electricity use*	*-1.00*	*0.51*

Building-related enabling technologies or technologies with a potential or indirect contribution to GHG emissions mitigation(B90)	- *optimally gear the generation of wind and solar power to the demand for electricity, in time and place* - *Smart & Efficient electricity use (in the build environment)*	*-1.00*	*0.45*
Climate change mitigation technologies in the production process for final industrial or consumer products(P70)	- *General advancements in wind-power innovations*	*-0.23*	*0.35*
Energy-related enabling technologies; Technologies with a potential or indirect contribution to GHG emissions mitigation (E60)	- *General advancements in solar-power technologies* - *General advancements in wind-power innovations* - *Increased efficiency for wind-power technologies* - *integration of generation systems in the future energy system* - *Local Storage* - *Conversion to another energy carrier (e.g. H2)* - *better integration of sustainable generation in the energy system and in products, homes and landscapes* - *Smart & Efficient electricity use* - *Other solutions for generating electricity from renewable sources on land*	*0.10*	*0.30*

Table 3: Zuid-Holland's technological profile in relation to MMIP2

Friesland

Friesland, the region with the lowest number of patents, specializes in B10, B20, B70, E10, E60, P10, P20, P70, W10 and W30. The SIAC scores for Friesland are lower than the RSCA scores for all subjects. The subjects that have SIAC > 0 are B10 and W10. B10 and W10 are the only subjects that both have a positive score, which are shown in table 4.

Technological Subject	Contribution to mission	RSCA	SIAC
Wastewater or sewage treatment systems using renewable energies(W10)	- *better integration of sustainable generation in the energy system and in products, homes and landscapes*	*0.94*	*0.43*
Integration of renewable energy sources in buildings(B10)	- *integration of solar generation technologies* - *Building-Integrated PV-systems* - *flexibility in shape, size, color and transparency of Solar in the built environment* - *better integration of sustainable generation in the energy system and in products, homes and landscapes for digitalisation*	*0.88*	*0.09*

	- *Local storage for system-integration* - *flexible electricity rates for system-integration* - *integration of generation systems in the future energy system for system integration* - *integration of solar-power technologies* - *improved integration into the environment for wind-power technologies*		

Table 4: Frieslands technological profile in relation to MMIP2

Distribution of relevant patents

In figures 5-9 the distribution of the relevant patents is shown per thematic group (buildings, energy, production/processing, transport and waste). Table 5 serves as a legend for all distributions.

Table 5: NUTS statistical regions of the Netherlands[4]

NL11	Groningen
NL12	**Friesland**
NL13	Drenthe
NL21	Overijssel
NL22	Gelderland
NL23	Flevoland
NL31	Utrecht
NL32	Noord-Holland
NL33	**Zuid-Holland**
NL34	Zeeland
NL41	**Noord-Brabant**
NL42	Limburg

[4] Regions in the European Union - Nomenclature of territorial units for statistics, 2018. https://ec.europa.eu/eurostat/documents/3859598/9397402/KS-GQ-18-007-EN-N.pdf/68c4a909-30b0-4a90-8851-eddc400a5faf

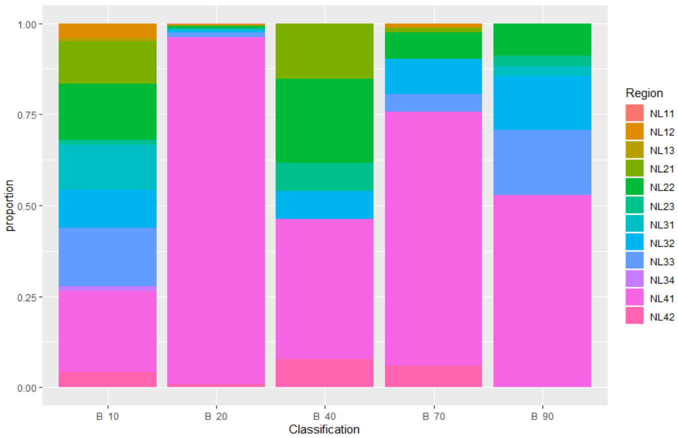

Figure 5: Distribution of relevant patents related to buildings

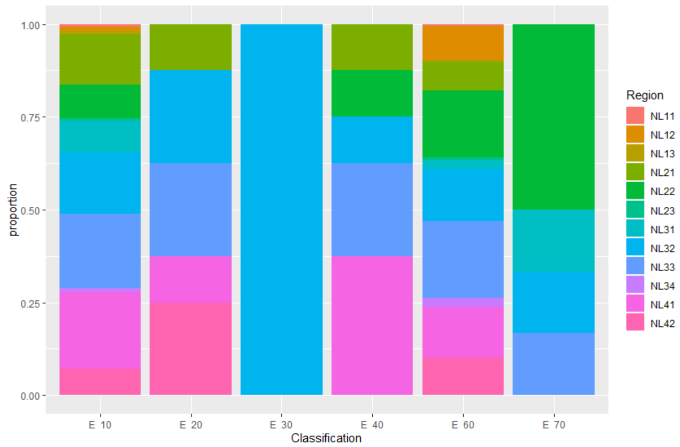

Figure 6: Distribution of relevant patents related to energy

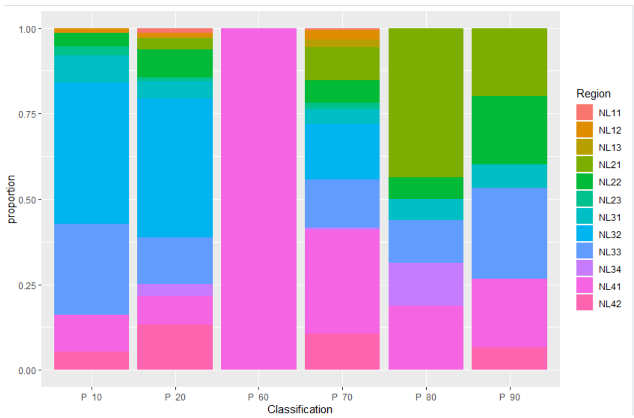

Figure 7: Distribution of relevant patents related to production/processing

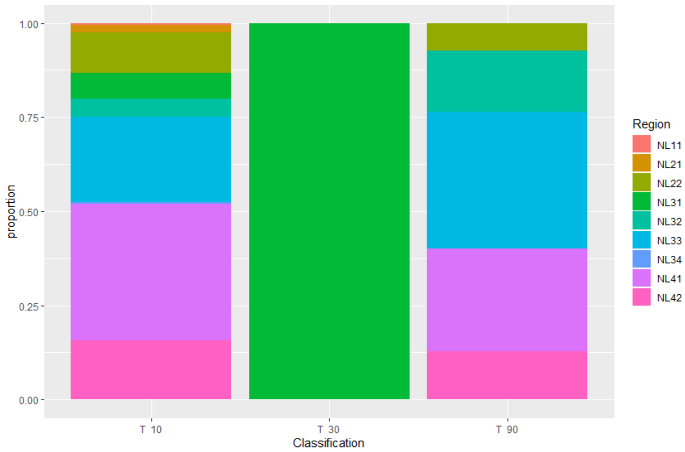

Figure 8: Distribution of relevant patents related to transport

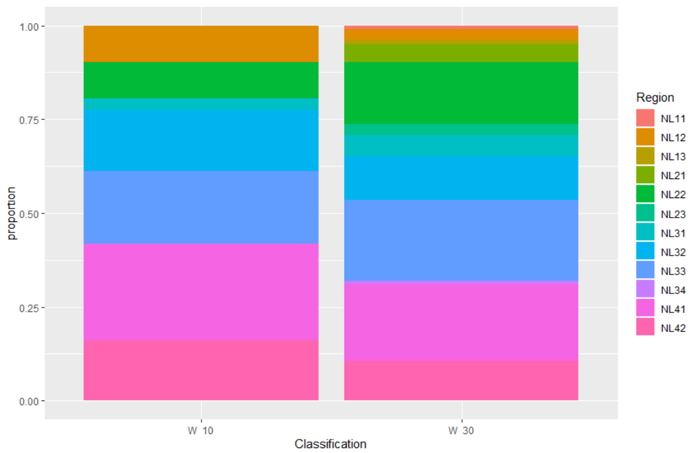

Figure 9: Distribution of relevant patents related to waste

Discussion

Noord-Brabant

In the case of Noord-Brabant, the RSCA and SIAC profiles in the context of MMP2 are very similar. This suggests that the region's RSCA profile is representative not only for the region's specialisation, but also for the strength of its technological knowledge base within the subjects. This is not controversial in the case of Noord-Brabant as it is the region with a relatively high number of patents within the analysed classifications compared to other regions in the database. When a relatively large share of that region's patents fall in a specific classification, it is likely that they have an above average number of patents within that classification.

The results suggest that Noord-Brabant has a strong technological knowledge base in areas relevant for MMIP2. The two classifications that stand out are *energy efficient lighting technologies* and *renewable energy and energy saving technologies relating to agriculture, livestock or agroalimentary industries*. Moreover, in the latter Noord-Brabant has all of the Dutch patents (see figure 7). This suggests, according to the thematic links to the mission, that the region has a good potential to contribute to Smart & Efficient electricity use in the Built environment, rural areas (more specifically in agriculture), and a better integration of sustainable generation in the energy system and in products, homes and landscapes. The rest of the region's capabilities can be linked to integration, efficiency and smart use of renewable electricity. Looking at the different groups of classifications, it has a strong position in the relevant technologies related to buildings (B), of which they also are the strongest region in the Netherlands (see figure 5).

In general, Noord-Brabant can be considered a high-tech region as they have relatively many patents in different areas. It has a relatively large share of patents in relevant technologies related to waste, transport and most of the production/process classifications. This suggests it has at least the technological capabilities to be a front-runner within the Netherlands and a region that can be an important broker within the network of Dutch regions. Less high-tech regions could then leverage their collaborations with Noord-Brabant in order to strengthen their own specializations. Future research that would provide more insight into this is a network analysis based on the co-ownership of patents between Dutch regions.

Zuid-Holland

In contrast to Noord-Brabant, Zuid-Holland's SIAC and RSCA profiles are not very similar. In general the region has low RSCA scores that do not show a relative comparative advantage. The SIAC scores, however, show that the region has an above-average number of patents in all classifications in which it has relevant patents. An explanation for this is that in these classifications, the average number of patents per region is relatively low. This relatively low number of patents can be distributed among many regions or there may be one or a couple of regions that are particularly strong in these areas. Further research into the '*spikyness'* of the patent distribution in these classifications could provide more insight in this, which may be relevant for Zuid-Holland in order to better assess its own position.

Within the relevant classifications, Zuid-Holland has a comparative advantage in *integration of renewable energy sources in buildings, technologies for wastewater treatment,* and *energy-related enabling technologies; Technologies with a potential or indirect contribution to GHG emissions mitigation.* It also has above-average patents within these classifications. This suggests that Zuid-Holland has the technological capabilities to contribute to MMIP2 by increasing renewable electricity generation in the built environment, and potentially in rural areas as well. Whether the latter is already the case cannot be concluded from the current analysis, as *better integration of sustainable generation in the energy system and in products, homes and landscapes* obviously does not indicate this. However, It is assumed here that the more precise classifications within those classifications used are technologically related to it. If Zuid-Holland would specialize in other parts of MMIP2, the current analysis suggests that it has the potential to do so, as it does have an above average number of patents in areas in which it does not specialize itself. It is noticeable that the region does not specialize itself in *energy generation through renewable energy sources* (which can be seen as the core technologies relevant to the mission), while it has the largest share of patents within this classification (see figure 6).

Looking at the distribution of MMIP2 patents in figures (5-9), shows that Zuid-Holland is a region that has a relatively large share of the patents within the Netherlands. As the scope of the mission is on a national scale, Zuid-Holland could to this end collaborate with smaller regions that do not have the capabilities to contribute to missions on every aspect, leveraging their capabilities within their specialisations. The region could become a front-runner in the already mentioned renewable energy generation (specifically electricity generation for the purpose of the mission). Another area in which zuid-holland has the largest share of patents is *transport-related enabling technologies or technologies with a potential or indirect contribution to GHG emissions mitigation*, which is mainly about technologies for smart and electric mobility.

Friesland

In contrast to the other two regions, Friesland has few areas in which they have an above-average number of patents. The region does have clear specialization areas, but as it has a relatively low number of total Y02 patents, these specializations are not as rigid as in the case of Noord-Brabant.

Friesland does have a strong position in technologies related to wastewater treatment. Within this classification, only those classified as ‘Wastewater or sewage treatment systems using renewable energies’ are taken as relevant for MMIP2, by contributing to a better integration of sustainable generation in the energy system and in products, homes and landscapes. However, the distribution of these patents among the Dutch regions show that some other regions have a larger share than Friesland. This suggests that Friesland should collaborate with other regions to strenghten their position in those areas in which they specialize.

General Reflection on the Case Studies

Some insights into the technological context of the three regions Zuid-Holland, Brabant and Friesland and how these are relevant for MMIP2 have been provided by the performed analyses. The RSCA and SIAC scores provide insight into the regions specialization and relative strength, and the relative shares of patents between the Dutch regions provides extra information on which regions can be seen as national leaders within the particular technological field and which regions have many or few mission-related patents in general. Comparing complete analyses of all Dutch regions can give insight into the less technology-related characteristics of regions. The scope of the case studies can become ambiguous as they can be seen from a national perspective as well. As mentioned in the method, patents may be co-owned by more than one region. In combination with the results from the case-studies this suggests that a fruitful direction for future research is the dynamics of competition and collaboration between regions in the context of national missions. This is because the regions are contributing to the same goal, but may act as competitors as well. A dynamic network analysis may provide insight in this.

Conclusion

In this thesis I developed a first analysis framework for identifying regional opportunities to contribute to larger-scale MIPs. Its applicability to the Dutch national mission-agenda is illustrated by three case studies of the analysis of the regional technological context and potential for innovation. The key idea of the framework is coding mission-policy documents and thematically linking (traditional) indicators to the coded mission.

I identified mission-related technological profiles of three Dutch regions. Coding the official policy document provided the mission-specific context and concepts to which traditional indicators can be linked and as such can be put to use to identify alignment between regional strengths and directionality of the mission. The results showed clear differences between the regions' technological position within the context of MMIP2. The other steps in the framework should be further investigated in a later stage. But as these follow the same principle of linking the indicators to the mission, the results of the first case studies suggest the rest of the framework is applicable to the mission as well. To assess whether the framework could address the three different sources of change generally discussed by literature on MIP more extensive case studies are needed. The analyses show that it can at least address change stemming from entrepreneurial experimentation by firms and industrial policy. Whether it can address more social change stemming from societal stakeholders remains to be seen, as data on the subject may be lacking.

The chosen mission is a relatively technology-driven one and the case studies are based on the Y02 patent data. It is likely that analyses of the technological background of regions in this particular way is more applicable for technology-intensive missions related to climate change. Furthermore, the analysis makes clear that, in line with other studies (TNO 2018), missions would benefit from clear and unambiguous goals articulated in their policy documents.

I conclude that the developed framework can indeed provide regions insight into how they can contribute to larger-scale MIPs. However, its applicability depends on the characteristics of the mission and the availability of data.

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APPENDICES

Appendix A: **Coding of MMIP2 and Thematic coupling of the MMIP2 mission with CPC patent codes**

Sub-program	**Sub-program paragraph**	**Concept**	***Relevant classifications***
Sub-program 1A: Enablers and broadly applicable innovations in the field of technology	*solar-power technologies*	*general advancements in solar-power technologies*	*Y02E10* *Y02E60* *Y02T10*
	solar-power technologies	*materials for solar-power generation*	*Y02E10* *Y02E40*
	solar-power technologies	*production processes and systems*	*Y02P10 - Y02P20* *Y02P80* *Y02P90*
	solar-power technologies	*integration*	*Y02B10* *Y02B30* *Y02E70* *Y02T10* *Y02T90*
	solar-power technologies	*circularity*	*Y02B50* *Y02P10* *Y02P80*
	solar-power technologies	*flexibility in shape, size, appearance, material, weight and light transmission*	*Y02B10* *Y02E10* *Y02P70*
	solar-power technologies	*new system configurations*	*Y02E40* *Y02E70* *Y02P80*

	wind-power technologies	*General advancements in wind-power innovations*	*Y02E10* *Y02E60* *Y02P70*
	wind-power technologies	*improved integration into the environment*	*Y02B10*
	wind-power technologies	*social acceptance*	
	wind-power technologies	*reduced noise production, reduced visibility*	
	wind-power technologies	*offshore wind power innovations applied in onshore technology*	
	wind-power technologies	*increased efficiency*	*Y02E10* *Y02E40* *Y02E60* *Y02P70*
	wind-power technologies	*size of the turbines*	
	wind-power technologies	*Robustness of wind-power technologies*	*Y02E10*
	wind-power technologies	*improved circularity of wind turbines*	*Y02P10*
	intersecting themes: system integration	*integration of generation systems in the future energy system*	*Y02B10* *Y02B30* *Y02E40* *Y02E60* *Y02P60* *Y02P80* *Y02T10* *Y02T90*
	intersecting themes: system integration	*Optimally gear the generation of wind and solar power to the demand for electricity, in time and place*	*Y02B20* *Y02B70* *Y02B90* *Y02E40* *Y02T90*
	intersecting themes:	*flexible electricity rates*	*Y02T90*

	system integration		*Y02B10*
	intersecting themes: system integration	*local storage*	*Y02B10* *Y02E40* *Y02E60* *Y02E70* *Y02T90*
	intersecting themes: system integration	*conversion to another energy carrier (e.g. H2)*	*Y02E60* *Y02E70* *Y02P80*
	intersecting themes: system integration	*combining wind turbines and solar power systems*	*Y02E10*
	intersecting themes: digitization	*security (cyber security, risks that arise in places where information exchange takes place between panels, inverters, turbines, e-network and the internet)*	
	intersecting themes: digitization	*Contribution of Information technology to the upscaling and the ability to predict energy yield and energy demand*	*Y02B70* *Y02P90* *Y02T90*
	intersecting themes: digitization	*better integration of sustainable generation in the energy system and in products, homes and landscapes*	*Y02B10* *Y02B40* *Y02B70* *Y02E40* *Y02E60* *Y02E70'* *Y02P60* *Y02P80* *Y02T10* *Y02T90* *Y02W10*
	intersecting themes: digitization	*measuring, for example, component and system performance or generated energy*	*Y02P90*
	intersecting themes: digitization	*visualisation en simulation software*	
	intersecting themes: circularity	*design for sustainability/recycling of products and services*	*Y02P10* *Y02P80* *Y02W30*

		adapted thereto	
	intersecting themes: circularity	*new service and business models*	*Y02B70* *Y02T90*
	intersecting themes: circularity	*product design concepts and materials*	*Y02E70* *Y02P20* *Y02P80* *Y02T10*
	intersecting themes: societal enthusiasm	*innovative participation models*	
	intersecting themes: societal enthusiasm	*Landscape integration*	
	intersecting themes	*market and policy innovations*	*Y02P90*
	intersecting themes	*valorisation and market creation*	*Y02P90*
	other technologies and enablers	*Other solutions for generating electricity from renewable sources on land*	Y02E10 Y02E20 Y02E30 Y02E60 Y02E70 Y02T10
	other technologies and enablers	*thermoelectric conversion*	Y02B30 Y02E10
	other technologies and enablers	*Smart & Efficient electricity use*	Y02B20 Y02B40 Y02B50 Y02B70 Y02B90 Y02E40 Y02E60 Y02E70 Y02P40 Y02P60 Y02P80 Y02P90 Y02T10

			Y02T90
	other technologies and enablers	blue energy (for example salinity gradient electricity generation)	Y02E10
Sub-program 1B: Enablers and broadly applicable innovations in the field of market and policy	*market and policy innovations*	*market and policy innovations*	*Y02P90*
	valorisation and market creation	*valorisation and market creation*	*Y02P90*
concepts from (overlapping) sub-program 2	*Solar in the Built Environment*	*flexibility in shape, size, color and transparency*	*Y02B10* *Y02E10* *Y02P70*
	solar in rural areas	*solar power innovations in the field of spatial integration and multiple use of space.*	
	solar in rural areas	*ecologically optimal fit*	
	solar in rural areas	*solar on water*	
	solar in rural areas	*solar on infrastructure*	*Y02T10?*
	wind in rural areas	*general*	*Y02E10*
	wind in rural areas	*more efficient maintenance*	
	wind in rural areas	*red night lighting leads to resistance in the environment in many places*	
	wind in rural areas	*facilitation of recycling and reuse*	*Y02P10* *Y02P80*

	wind in rural areas	*life extension*	*Y02E10* *Y02E40*
	wind in rural areas	*monitoring technology (for ageing)*	
	Overige technologieën en enablers	other solutions for generating electricity from renewable sources on land	Y02E10 Y02E20 Y02E30 Y02E60 Y02E70 Y02T10
	other technologies and enablers	thermoelectric conversion	Y02B30 Y02E10
	other technologies and enablers	smart and efficient electricity use	Y02B20 Y02B40 Y02B50 Y02B70 Y02B90 Y02E40 Y02E60 Y02E70 Y02P40 Y02P60 Y02P80 Y02P90 Y02T10 Y02T90

Appendix B: Description of CPC patent codes and their filters applied in the case studies for MMIP2

CPC8 Code	*Description*	*Filters for MMIP2*
Y02B10	*Integration of renewable energy sources in buildings*	*No Y02B10/40 (Geothermal Heat Pumps)*
Y02B20	*Energy efficient lighting technologies, e.g. halogen lamps or gas discharge lamps*	*No filters*
Y02B30	*Energy efficient heating, ventilation or air conditioning [HVAC]*	*Only Y02B30/625 is used:* *Absorption based systems combined with heat or power generation (CHP)*
Y02B40	*Technologies aiming at improving the efficiency of home appliances, e.g. induction cooking or efficient technologies for refrigerators, freezers or dishwashers*	*No filters*
Y02B50	*Energy efficient technologies in elevators, escalators and moving walkways, e.g. energy saving or recuperation technologies*	*No filters*
Y02B60	*NO description*	*Not used*
Y02B70	*Technologies for an efficient end-user side electric power management and consumption*	*No filters*
Y02B80	*Architectural or constructional elements improving the thermal performance of buildings*	*Not used*
Y02B90	*Enabling technologies or technologies with a potential or indirect contribution to GHG emissions mitigation*	*No filters*
Y02C20	*Capture or disposal of greenhouse gases*	*Not used*
Y02E10	*Energy generation through renewable energy sources*	- *No Y02ER 10/10 (Geothermal Energy)* - *No Y02E 10/40 (Solar Thermal Power)*
Y02E20	*Combustion technologies with mitigation potential*	- *Only Y02E20 14 Combined heat and power generation & Y02E20 16* *Combined cycle power plant [CCPP]*
Y02E30	*Energy generation of nuclear origin*	*No filters*
Y02E40	*Technologies for an efficient electrical power generation, transmission or distribution*	*No filters*

Y02E50	*Technologies for the production of fuel of non-fossil origin*	*Not Used*
Y02E60	*Enabling technologies; Technologies with a potential or indirect contribution to GHG emissions mitigation*	*No Y02E60/14 (Thermal Energy Storage)*
Y02E70	*Other energy conversion or management systems reducing GHG emissions*	*No filters*
Y02P10	*Technologies related to metal processing*	*No filters*
Y02P20	*Technologies relating to chemical industry*	*No filters*
Y02P30	*Technologies relating to oil refining and petrochemical industry*	*not used*
Y02P40	*Technologies relating to the processing of minerals*	*Only Y02P40/121 (energy efficiency measures)*
Y02P60	*Technologies relating to agriculture, livestock or agroalimentary industries*	*Only Y02P 60/12 & 60/52 (Using renewables) and 60/14 (measures for saving energy)*
Y02P70	*Climate change mitigation technologies in the production process for final industrial or consumer products*	*No filters*
Y02P80	*Climate change mitigation technologies for sector-wide applications*	*No Filters*
Y02P90	*Enabling technologies with a potential contribution to greenhouse gas [GHG] emissions mitigation*	*Not YO2P 90/70 (Combining sequestration of CO2 and exploitation of hydrocarbons by injecting CO2 or carbonated water in oil wells)*
Y02T10	*Road transport of goods or passengers*	*not Y02T10 10/10, 12, 30, 40* *(Not electricity related)*
Y02T30	*Transportation of goods or passengers via railways, e.g. energy recovery or reducing air resistance*	*Not Used*
Y02T50	*Aeronautics or air transport*	*Not used*
Y02T70	*Maritime or waterways transport*	*Not used*
Y02T90	*Enabling technologies or technologies with a potential or indirect contribution to GHG emissions mitigation*	*No filters*
Y02W10	*Technologies for wastewater treatment*	*only Y02W 10/3** *Wastewater or sewage treatment systems using renewable energies*
Y02W30	*Technologies for solid waste management*	*Not Y02W 30/30, 40*
Y02W90	*Enabling technologies or technologies with a potential or indirectcontribution to greenhouse gas [GHG] emissions mitigation*	*Not used*

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