

Sustainability integration in Innovation strategies

An analysis of sustainability aspects in Swedish innovation strategies
and in Swedish healthcare sector innovation activities

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Abstract

The healthcare sector, currently accounting for about seven percent of global GDP expenditure, faces growing demand pressures driven by factors such as ageing populations and growing prevalence of chronic diseases. Consequently, the sector is increasingly looking for innovations that can simultaneously improve the efficiency and quality of care. Healthcare innovations could in turn make large contributions to sustainable economic, social and environmental development.

This thesis therefore investigates whether and how sustainability principles are integrated with innovation policies and innovation practices of the healthcare sector, using Sweden as the case study. Data were collected by a combination of qualitative and quantitative text analyses, surveys and semi-structured interviews with key stakeholders. Four key topics were analyzed: *integration*, *interpretation* and *operationalization* of sustainability principles in innovation policies and *barriers* to sustainability integration in healthcare innovation organizations.

The findings and analysis indicate that sustainability challenges function as drivers, rather than objectives, in Swedish innovation strategies. Findings interestingly also suggest that the innovation strategies that are integrated with the regional development plans not only propose a more integrated approach to sustainability and innovation, they also display stronger interpretations of sustainability and develop more specific objectives, targets and indicators for sustainable development to which innovation shall contribute. A correlation between implementation and operationalization of sustainability suggested by the environmental policy integration literature is confirmed. The findings finally reveal that sustainability principles are poorly integrated in the analyzed healthcare innovation organizations' practices. These organizations would benefit from clear and operational sustainability objectives, increased cross-administrative collaboration along with resources to improve organizational innovation capacity.

Keywords: Innovation, Sustainability, Healthcare, Environmental policy integration, Transition management

Executive Summary

Accounting for about seven percent of GDP globally and nine percent of GDP in the OECD countries, the healthcare sector has large environmental impacts by the sheer size of its operations alone. Facing a growing global demand for healthcare services driven by factors such as ageing populations and increasing prevalence of chronic diseases, the sector is now looking for innovations to simultaneously increase efficiency and quality of care.

In this regard, theories of transition management and sustainable innovation note that innovation systems can indeed be geared in a direction towards sustainable development. Such an orientation could lead to large improvements in all aspects of sustainable development: economic, social and environmental. Stakeholders have however pointed out that such a holistic approach is missing in healthcare sector. Improvement and innovation processes give a primary priority to economic efficiency and care quality aspects, while environmental aspects are typically given last priority or are considered an issue separate from the healthcare system at large. Further, it is uncertain whether and how sustainability dimensions are taken into consideration in the healthcare sector's innovation projects. As innovation strategies and projects guide the development of future care systems, taking into account all three aspects of sustainable development in healthcare innovation strategies could largely impact the sustainability performance of the healthcare system.

This thesis therefore analyzes the implementation of sustainability principles in the innovation policies and practices of the Swedish healthcare sector. The analysis includes the national innovation strategy and regional innovation strategies, as well as practices in local healthcare innovation projects, so called Innovation Gateways. The thesis further put a special focus on two case regions considered innovation and sustainability front-runner regions: Region Skåne and Västra Götalandsregionen. The thesis also aims to describe barriers to the implementation of sustainability aspects in healthcare sector innovations.

Analysis of four key topics - method

The thesis's analysis is organized into four topics, each contributing to an overall diagnosis of sustainability aspects in innovation policies and innovation practices of the healthcare sector. The overarching topic of the study, *integration of sustainability*, was analyzed using a combination of qualitative, quantitative and survey methods. A quantitative content analysis was conducted to categorize and determine the frequency of the main themes in national and regional innovation strategies. The qualitative analysis considered the centrality of different sustainability arguments in the innovation policies and a survey sought to capture non-formalized implementation of sustainability aspects at regional innovation administrations. The *operationalization of sustainability* in innovation policies was analyzed using a framework for sustainable innovation policies, including elements from the entire span of the policy cycle. The literature analysis suggested that the normative interpretation of sustainability was strongly linked to the actual implementation. An analysis of the *interpretation of sustainability* in the innovation policies was therefore conducted in order to determine a possible correlation between the interpretation and implementation dimensions. The thesis finally sought to describe the perceived *barriers to integration of sustainability principles*. This data was collected in a set of semi-structured interviews with stakeholders from the different levels of analysis.

Presented below are the main findings, conclusions and suggestions for policy-makers derived from the analysis of the four topics.

Integration of sustainability aspects

The national and regional innovation strategies (not including regional development plans or -strategies) heavily emphasize two primary objectives: to improve the capacity of the innovation system and to generate national and regional economic growth. Social and environmental aspects are less frequent, propose less central arguments and rather function as drivers behind the two primary objectives. The content analysis identified that the social and environmental categories used a slightly more varied vocabulary at the regional level, indicating that sustainability challenges are described in *more detail* at the regional level. The survey similarly indicated a *clearer connection* between innovation and sustainability at the regional level. Here, almost all regional administrations indicated a clear connection between the regional sustainability and innovation policies and 70% had defined sustainability objectives for the innovation activities.

The survey results further suggested a *more integrated approach to sustainability aspects among the regions where the innovation policy was integrated with the regional development plan or strategy*. The regional development plan analyzed in the case study used sustainability arguments more frequently and had a more even balance between the different sustainability aspects than did the analyzed stand-alone innovation strategy. There is currently a growing development of regional innovation strategies in Sweden. These findings suggest that the fruitfulness of developing separate innovation strategies (in their current format) is questionable, should regions wish to use innovation policies to promote sustainable regional development.

Policymakers that wish to connect innovation and sustainability strategies are recommended to consider options to create synergies between the two policy areas. The findings of this thesis indicate that there is a need for increased collaboration between these departments. The findings from the analysis also suggest that in order to reconcile sustainability and innovation strategies, the (seemingly more integrated) regional development plans may propose a better option. However, further research is needed to develop the understanding of how sustainability aspects are integrated within different types of innovation strategies and the determinants of such integration. A suggested topic for a future research is therefore to further investigate the connections between different types of innovation strategies, the importance of organizational characteristics and how this affects the integration and operationalization of sustainability principles.

Interpretation of sustainability principles

Literature suggests that the normative interpretation of sustainable development constitute a determinant to integration and operationalization of sustainability principles. A framework of normative interpretations of sustainable development was therefore used to categorize the interpretations made in the national innovation strategy and the innovation strategies of the case study regions. The analysis suggests that the national innovation strategy and the regional stand-alone innovation strategy had an overall 'weak sustainability' interpretation while the integrated regional strategy had a 'strong sustainability' interpretation. As was previously noted, the integrated regional strategy also had a stronger implementation of sustainability aspects. Thus, these findings *confirm the correlation between interpretation and implementation suggested by literature* on environmental policy integration. Policy makers are suggested to engage sustainability expertise (e.g. from environmental or sustainability administrations) in the development of innovation strategies, should they wish to further align these policy areas.

Operationalization of sustainability

A framework for sustainable innovation policies, including elements from the whole policy cycle, was used to analyze the operationalization of sustainability. The analysis suggests that while all innovation strategies recognize sustainability challenges and link them to innovation strategies, it is only the 'integrated strategy' (the regional development plan analyzed in the case study) that has defined targets and performance indicators for sustainability challenges. The integrated strategy continuously blends different sustainability aspects in describing the activities' objectives. This differentiates it from the national and regional stand-alone innovation strategies, where the primary orientation is economic growth and where targets and performance indicators are missing. The integrated strategy thus fulfills more of the criteria set out by the framework, proposing a closer take on a strategic framework for sustainable innovations. The literature analysis indicates that the priority given to sustainability risks being watered down when there is a lack of targets, indicators and evaluation criteria. This suggests that there is a risk that the more process-oriented, stand-alone innovation policies achieve less positive contributions to sustainability.

Evaluating process-oriented policies is of course difficult, not least in lack of targets or performance indicators. While the innovation system literature highlights the need to improve innovation processes, the sustainable innovations literature suggests that linking processes to targets and indicator is important for organizations that wish to use innovation as a tool to transition to more sustainable societies. Policy-makers that wish to do so are encouraged to define clear sustainability objectives, targets and performance indicators in innovation strategies. This possibility to evaluate innovation administrations' activities could also improve their transparency and legitimacy. Further research is needed to develop appropriate sustainability objectives and indicators for innovation policies. Unlike short to mid-term development targets, technological transitions constitute long-term processes, why objectives, targets and indicators on different time scales may be needed.

Barriers to sustainability integration

The thesis identified three main barriers to integration of sustainability principles in the healthcare sector's innovation practices, combining findings from interviews with respondents from the different levels of analysis.

- **Agenda setting** was highlighted as a highly important element; Innovation gateways and other innovation projects that did not have specific sustainability objectives did not work with these aspects. Respondents also highlighted the importance of clearly communicating regional sustainability policies and targets and importantly, the need to make these objectives and targets operational at the local administrative level (e.g. introduced into balanced scorecards). This failure to operationalize regional targets at the local level calls for more cross-administrative collaboration. Policy-makers are therefore recommended to promote this type of collaboration to enhance the operationalization of sustainability objectives.
- **Lack of capacity** to work with sustainability was commonly identified as a barrier. This was observed both as a lack of internal competence to work with sustainability aspects in the innovation gateways, and an external lack of capacity in healthcare to understand the interlinkages between sustainability issues. The capacity to attach a monetary value to social and environmental benefits was highlighted as especially important. Policymakers are especially recommended to introduce tools for valuation of social and environmental impacts of purchases and innovations.
- **Lack of resources** to address the previously mentioned barriers was finally highlighted as a barrier; healthcare organizations' focus on economic efficiency has slimmed down

organizations to a point where there are not enough resources or maneuvering space to generate the much asked-for ‘needs-driven’ process, service and product innovation. Policy-makers are encouraged to consider long-term impacts to economic, social and environmental sustainability when establishing innovation organizations and structures for the healthcare sector. This entails both setting aside resources to improve the sustainability awareness and innovation capacity of healthcare staff and promoting better social and environmental valuation of services and products.

Final remarks

The analysis indicate that sustainability challenges are drivers in Swedish innovation strategies. The research also suggest that the innovation strategies that are integrated with the regional development plans not only propose a more integrated approach to sustainability and innovation, but also display stronger interpretations of sustainability and develop more specific objectives, targets and indicators for sustainable development to which innovation shall contribute. While the methodology has included both interviews, surveys and different text analyses, the results are considered preliminary as a qualitative comparison between the integrated and stand-alone regional innovation strategies was only possible on the case study regional level. Further research is needed to confirm these initial findings.

Going back to move forward

Today, sustainability challenges function as a driver behind innovation strategies. As policy-makers increasingly realize the magnitude of sustainability challenges, such as those caused by resource depletion, fossil fuel dependency, ageing populations and diseases caused by increasing levels of air pollution, the principle of environmental policy integration is making its way into innovation policies. Will innovation policies of the future be less focused on innovation system *processes* and more focused on its *objectives*, the characteristics of innovations? Considering the purpose of an innovation strategy, and innovations in general, through the prism of global sustainability challenges may be a next step for policy makers. The results of this thesis suggest that innovation policies that are more integrated with development policies set out more defined objectives and have a deeper understanding of the sustainability dimensions interconnectedness. They also suggest that a healthcare sector that wishes to generate sustainable innovations needs to not to only define, communicate and operationalize sustainability objectives. It also needs to set aside resources for innovation in healthcare. Respondents and healthcare innovation expertise have suggested that healthcare may need to ‘act more like Google’ – in order to create sustainable healthcare systems, we need to set aside resources for healthcare staff to be creative, to innovate and to continuously improve care systems. While such investments may be perceived as too costly from a short-term economic efficiency point of view, they might be necessary in order to make the transition towards sustainable healthcare systems.

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Abbreviations

ALMI	ALMI Business partner AB
EM	Ecological Modernization
EPI	Environmental Policy Integration
KK	Kammarkollegiet
MEPIN	Measuring Public Innovation
NCM	Nordic Council of Ministers
NIVO	Network for Innovations in Healthcare
OECD	Organisation for Economic Co-operation and Development
PRV	Swedish Patent and Registration Office
RIS	Regional Innovation Strategies
RISE	Research Institutes of Sweden
RS	Region Skåne
RUP	Regional Development Plan
RUS	Regional Development Strategy
SAERG	Swedish Agency for Economic and Regional Growth
SAGPA	Swedish Agency for Growth Policy Analysis
SALAR	Swedish Association of Local Authorities and Regions
SCA	Swedish Competition Authority
SEA	Swedish Energy Agency
SEMC	Swedish Environmental Management Council
SEPA	Swedish Environmental Protection Agency
SMT	Swedish Medtech
SI	Sustainable Innovation
SNIS	Swedish National Innovation Strategy
VINNOVA	Swedish Governmental Agency for Innovation Systems
VGR	Region of Västra Götaland

1 Introduction

1.1 Healthcare and sustainability

By the sheer size of its operations alone, the healthcare sector has large environmental impacts. On average, the healthcare sector on average accounts for seven percent of global GDP (World Health Organization, 2010b) and about nine percent of GDP in the OECD countries (OECD, 2013b). The expenditure and environmental performance of the sector however varies significantly between countries. The Scandinavian countries, known for their generous welfare systems, spend a fairly average share of GDP on healthcare (ranging from 9% to 11.2%), while the USA is the biggest healthcare spender internationally with 17.9 % of its GDP spent on healthcare in 2012 (World Bank, 2014). Through product purchases, the energy and water consumption required to run operations 24 hours a day and its large and complex generation of waste, the healthcare sector has very large environmental impacts. Environmental management is an especially salient issue in the healthcare sector in many ways. Firstly, typical environmental aspects (e.g. waste generation, raw material and energy use and chemical emissions) have large impacts in healthcare operations as they are used in large volumes, something that is also often unavoidable to uphold patient security requirements.

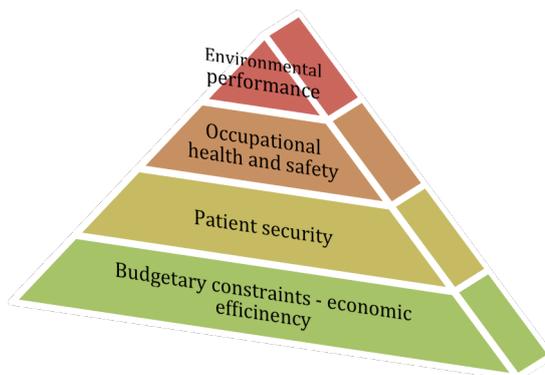


Figure 1. Hierarchy of objectives in healthcare (Eriksson, 2014).

Secondly, impacts from several less common materials and processes are found in the healthcare sector. These include pharmaceuticals, effects of radiation, hazardous and non-hazardous clinical waste (e.g. sharps, infectious waste and cytotoxic waste), PVC, phthalates, analogue x-rays, silver in bandages, disinfection and sterilization products, nitrous oxide, mercury, chemicals, xylene, formalin, isocyanides in gypsum, the 24 hour operation of buildings, utilities and appliances and the large amount of single use products (Eriksson, 2014). In total, the healthcare sector has been estimated to

account for five percent of the EU's and eight percent of USA's annual greenhouse gas (GHG) emissions (LCG-Healthcare, 2011, p. 10, World Health Organization, 2010, p. 2). However, its environmental impacts have received relatively little attention. In comparison, the aviation industry's direct emissions are estimated to account for three percent of EU's annual GHG emissions (European commission, 2014), but receive far more media coverage. A part of the explanation to the lower notice granted to the healthcare sector's environmental impact may be the complexity to communicate solutions for a diverse mix of emission sources (e.g. buildings, pharmaceuticals, products, transports etc.) in healthcare. The healthcare sector also provides societal services essential to human health and survival, which are typically publicly funded, why the focus of performance evaluations is usually put on aspects relating to this; patient security and economic efficiency. In addition to this, the sector has strong values in the occupational health and safety (OHS) areas. This already large amount of operational objectives has sometimes been seen to lead to a lower prioritization given to improving the environmental performance of the organization for evaluation (Karlsson & Pigretti Öhman 2005, Eriksson, 2014), see figure 1. However, due to increasing demand and supply of healthcare services, the healthcare sector's expenditure is expected to grow dramatically over the coming years. While the demand increase is caused by *inter alia* an increasingly ageing population and increased prevalence of chronic diseases, the supply side offers more advanced and more costly treatment methods. The growth rate of healthcare services during the coming

years has been predicted at around 5.35% globally (Deloitte, 2013). In order to meet this demand, the public sector is looking towards healthcare innovations and efficiency improvements in all areas and increasingly realize the connection between different operational objectives (Karlsson & Pigretti Öhman, 2005); efficiency improvements and innovation can lead not only to reduced costs, but also decreased environmental impacts by e.g. minimizing energy, water, chemicals and raw material use and patient flows in general.

1.1.1 Healthcare and sustainability in Sweden

Sweden, the country studied in this thesis, has a decentralized healthcare system, where care is financed and organized by the first level of political and administrative subdivision (under the national level). This is divided into seventeen (17) county councils and four (4) regions¹ (SALAR, 2014b). The regions Skåne and Västra Götaland are given a special focus in the analysis of this thesis. These regions differ from the county councils in that they enjoy increased regional self-governance, including greater responsibility for regional development. Sweden is often considered to be one of the front-runner countries concerning sustainability in healthcare (Personal communication, Eriksson, 2014), with a strong emphasis on limiting environmental impacts that dates back to the country's environmental legislation of 1969, setting comprehensive environmental requirements for both industry and the healthcare sector. This led to the development of systematic environmental management in the healthcare sector. The strong tradition in Swedish healthcare to work systematically to limit environmental impacts was thus historically driven by legal requirements. Today, Swedish hospitals increasingly applying a more holistic approach to sustainability issues, motivated by increasingly ambitious regional environmental policies (Personal communication, Eriksson, 2014), risk management and resource efficiency needs and a corresponding growing public awareness about sustainability issues (Karlsson & Pigretti Öhman, 2005). This is also demonstrated by the fact that healthcare units are increasingly looking to develop sustainability reports for their operations (Pettersson, 2013).

Sustainability trends in Swedish regions

Social sustainability is making its way into the Swedish healthcare sector's purchasing practices; an ethical code of conduct has been developed in collaboration between Swedish regions. The code of conduct is also supported by a national network (hallbarupphandling.se) including a financing scheme, a national coordinator and a managing group, as well as a joint auditing scheme (uppfoljningsportalen.se). Some regions (including the case study regions) apply the Ethical code of conduct in all procurement processes (Personal communication, Region Skåne 3, 2014)

Some of the current sustainability trends among Swedish regions are compiled in a cross-regional performance data report for key regional environmental impacts (Swedish Association of Local Authorities and regions, 2013). The Swedish regions currently identify three main focal areas for environmental challenges, namely *reduced climate impact* (transport, energy use, medical gases), *toxic-free environment* (pharmaceuticals, chemical use, chemicals in goods) and *resource efficiency* (waste, purchasing, streamlining practices). However comparable performance indicators are only available on topics related to air emissions², antibiotics use and purchases of organic food. There are thus no comparable data for a range of sustainability topics, such as material use, waste generation or use of innovation and ethical code of conducts in procurement practices. Some common success factors to achieve reduced

¹ The municipality Gotland is counted as a region. In 2015, another six counties will be reorganized into regions. Three further counties have also applied to the parliament for regional restructuring.

² Energy use and mix, medical gases and share of renewable fuels.

environmental impacts were identified for the regions on the five topics. Clear political targets constitutes a key factor here; national targets were in place for four out of five indicators; and several regions had made it halfway to the of the national 2020 target set for two of the indicators. Political targets at the regional level, engaged staff and managers with an integrated perspective on environmental performance are also highlighted as a success factor.

1.2 Healthcare and innovation

The concept of ecological modernization, seeking to illustrate a simultaneous potential to meet both ecological and economical needs, dates back to the late 1980s (Carter, 2007). The basic assumption of this concept is that by industrial transformation to more environmentally friendly modes of production, encompassing a decoupling of economic growth and resource use, both economic growth and environmental protection can be achieved. This technology-oriented approach to environmental policy proposed an alternative to the previous focus on end-of-pipe solutions or the more radical call for a restructuring of the market economy (Carter, 2007; Jänicke, 2008). Several similar concepts, such as cleaner technologies, green product development or eco-efficient innovation (the latter being used by the EU in the Lisbon strategy for growth and employment) have been proposed, all entailing a similar focus; the development of new technologies to create more value with less environmental impact. The notion of ecological modernisation focuses heavily on combining resource efficiency and productivity, so as to increase competitiveness in a world of limited resources and increasingly tightened environmental regulations. In this way, the ecological modernization approach seeks to reconcile the capitalist liberal market's strive to modernize and innovate to improve competitiveness and the need to limit the environmental impact from production processes – in other words “to innovate and diffuse environmental technologies” (Jänicke, 2008). Critiques of the ecological modernization approach have argued that its proponents put too much faith in the development of new production technologies, forgetting that a more resource efficient production enables higher levels of consumption – creating a so-called rebound effect that marginalizes the benefits of pollution prevention, cleaner production and dematerialization.

The healthcare sector has large environmental impacts but also a strong mandate and unique opportunity to steer markets. Through its purchasing power, scale of operations, research-intensive nature and close connection to political targets, it has many possibilities to develop innovations to promote resource efficiency and sustainability. Procurement proposes one possible tool to promote innovation. Environmental and social purchasing criteria are increasingly being used to drive markets towards more sustainable practices (Swedish government, 2010 and 2013). Besides procurement practices, the healthcare sector can stimulate sustainable innovations for healthcare by organizing various collaborative activities. Test beds constitute one organizational form that has been used to provide access to healthcare for companies that need to perform clinical trials for the product development. Test beds can also be used to promote ‘intrapreneurship’ among healthcare staff by providing an organizational support system that encourages and guides staff into developing new innovative solutions to problems that they meet in the everyday operations. This needs-based approach has been supported by the Swedish innovation agency during the last years (Vinnova, 2014f).

1.2.1 Healthcare and innovation in Sweden

The Ministry of Enterprise, Energy and Communications governs Sweden's innovation policy (Swedish government 2014b). Among the overall objectives of the ministry, it is stated that “Sustainability, gender equality and fair competition are to be fundamental principles that underpin all our work” (Swedish government, 2014b). The ministry launched a national

innovation strategy in October 2012. Among its 23 agencies the Swedish Governmental Agency for Innovation Systems (VINNOVA) is responsible for supporting and developing the national innovation system with the mission to “promote sustainable growth by improving the conditions for innovations, as well as funding needs-driven research” (VINNOVA, 2014a). Each year, the agency invests 2,7 billion SEK in different initiatives. In addition to this, co-funding of at least the same amount from actors involved in projects is required (ibid.), collectively injecting substantial funds and exerting a large capacity to influence the innovation system.

VINNOVA has introduced a number of programs to strengthen the national innovation capacity. The agency’s programs are currently organized under three thematic areas. In the first thematic area, “Strategically important knowledge areas” (own translation), “*health*” and “*transport and environment*” constitute two strategic areas³. These programs finance knowledge and competency development within areas that are considered strategically important to Sweden. The second thematic area, “Innovation capacity of specific targets groups”, is intended to develop leadership, strategies and projects that are important for the innovation capacity of specific groups, including the *public sector*⁴. The third, most long-term thematic area is “Trans boundary collaborations”, which gathers actors from different around areas where societal challenges are the driving force for innovations.

Two projects are oriented towards cross-border collaboration (nationally and internationally) and a third project, “Challenge-driven innovation” focuses specifically on four areas characterized by both a societal challenge and a competitive advantage for Sweden, “*The health and healthcare of the future*” being one⁵. Healthcare and the public sector are thus an ingredient in all of the agency’s thematic areas. Healthcare is one of the four strategic sectors that the agency works with. While the healthcare sector holds a lot of innovation potential due to the well developed R&D in life science and other technologies, there is a need to develop the innovative capacity of the public sector and the infrastructure for knowledge transfer within the industry (VINNOVA 2014e).

In conclusion, the Swedish innovation agency has sought to meet the identified challenges in the healthcare sector in various ways such as strengthening public sector innovation capacity and the development of e-health services. A range of other actors have also implemented projects to enhance the innovation procurement capacity with regional innovation departments include the Nordic council of ministers, including the Swedish competition agency and the former Swedish environmental management council.

Previous studies have identified that the many innovation initiatives in the Swedish healthcare sector have had a primary orientation towards supporting and capturing primarily two types of innovation: supporting research oriented innovations (e.g. the life science industry) and generating innovations from healthcare employees. The sector is thought to have a relatively weak innovation system and innovation capacity (Swedish Government, 2010). Several barriers to innovations in the healthcare sector have been identified. One example is organizational ‘mental barriers’, indicating a need for managers to encourage innovation. It has also been suggested that quality- and process improvement activities should be better utilized

³ Other strategic areas are Services and ICT and Production and work life (own translation)

⁴ The other target groups are Innovative SMEs, Triple helix knowledge collaboration and Individuals and innovative environments (own translation)

⁵ The other strategic areas are “Information society 3.0”, “Sustainable attractive cities” and “Competitive production”.

to promote innovations, that reporting on innovation activities could be done and that there is a possibility to improve collaboration with the private sector (ibid).

Based on the fact that the healthcare sector is experiencing increasing resource pressures and that the environmental challenges, reconciling sustainability and innovation policies in healthcare should be relevant to promote the development of an economically, socially and environmentally sustainable healthcare system.

1.3 Problem definition: Sustainable Healthcare

Large potential: Having considered the substantial environmental and social impacts of healthcare sector and the potential of innovations to improve performance in all sustainability dimensions, we can conclude that systematically implementing sustainability criteria in product purchasing and innovation policies and practices may contribute to large scale sustainability improvements for the healthcare sector. Enabling the market actors to move towards more sustainable practices can have very direct and significant impacts to entire market, and this is not least true for industry frontrunners like the Nordic healthcare sector. As an example, a medical supply manufacturer has argued that if the Scandinavian and German markets set joint product criteria (e.g. phasing out PVC), the entire market would change towards this new solution (Personal communication, Eriksson 2014). However, coordinating different actors on an interregional or international level in sustainable and innovative procurement is a challenge for any given actor.

Uncertain what is done in Sweden: The Swedish innovation agency (VINNOVA) has provided funding for several projects to strengthen the innovation capacity in the healthcare sector. These projects have primarily been targeted at medical or clinical product development and have not had a strong emphasis on sustainability aspects (VINNOVA 2014b). Many projects have also been supported in the environmental domain, with the ambition to develop more resource efficient and fossil free solutions (VINNOVA 2014c). However, few of these projects have an application in the healthcare sector. Within VINNOVA's strategic research areas, several projects with potential bearing on the healthcare sector (e.g. innovative product development) have been funded (VINNOVA, 2014d), but it is unclear whether and how knowledge is transfer between these projects and the healthcare sector. Overall, it is thus unclear whether the innovation policies in the Swedish healthcare sector systematically take into account sustainability dimensions. Although the agency has a target to direct 80% of its grants to projects that contribute to a socially or environmentally sustainable society (in addition to economically sustainable), the implementation of this sustainability requirement is less clear. Considering ecological modernization rationale, this could lead to a loss of synergies between the innovation and sustainability policies.

Identified problems in healthcare innovation: Several actors have identified the need to improve the sustainability performance of innovation practices. One of the challenges that have been pointed out is a lack of connection between products' environmental performance indicators and the sustainability criteria applied by procurement practitioners, which may indicate a lack of product or market knowledge. Innovation procurement is seen to propose an even bigger challenge, related mainly to capacity of procurers and legal uncertainty (Personal communication, Hearing on sustainable healthcare, 2014). Test bed organizations are utilized in some hospitals, but *it is unclear whether these organizations, or innovation policies relevant to healthcare, systematically take into account sustainability dimensions*. Although test beds have been put in place in several regions, company representatives still report on a lack of access to hospital environments in the product testing and clinical trials phase (Personal communication, Hearing on sustainable healthcare, 2014, IVA 2014). Company representatives have also reported on a lack of communicative structures to systematically

identify needs, e.g. in procurement processes (Personal communication, Hearing on sustainable healthcare, 2014). Enabling innovation from within healthcare organizations is seen as an untapped potential, however the projects that have been launched in Sweden have so far not delivered innovation on a larger scale and it is uncertain how sustainability dimensions are integrated with these ‘intrapreneurial’ test beds (VINNOVA, 2013b).

As previously noted, the healthcare sector faces substantial challenges, posed by growing population numbers, new types of diseases and ageing populations. Citizens’ demands on the service delivery of the healthcare sector are also growing, and the healthcare sector is currently struggling with questions on how it can simultaneously deliver more value through a better care that has less negative impacts to the environment. Previous research has highlighted the importance of fostering innovations originating from the ‘micro-level’ healthcare practitioners in order to achieve sustainable transformation of the healthcare sector (Essén & Lindblad 2012). The ecological modernization literature clearly displays the potential benefits of steering innovation systems towards an integrated sustainability perspective. Several stakeholders have identified the need to better integrate sustainability objectives in the healthcare sectors’ innovation and procurement practices. Finding ways to support and promote sustainability perspectives in innovation practices has the potential not only to greatly improve the sustainability performance of the healthcare sector, but also open up the way to entirely new solutions to the healthcare sector. The aim of this thesis is therefore to evaluate whether and how sustainability criteria is applied in the innovation policies and practices of the Swedish healthcare sector.

1.4 Research objective and questions

While the Swedish healthcare sector in many cases has proved to implement innovative and environmentally friendly solutions, e.g. by its increasingly ambitious sustainable procurement practices, (SCA 2014, Swedish government, 2013), it is unclear whether and how sustainability principles/aspects are linked to innovation policies and activities in Swedish healthcare. The objective of this thesis is therefore to clarify whether and how sustainability principles/aspects are taken into account in relevant innovation policies and innovation organizations in the Swedish healthcare sector. This research objective relates to a larger research field of integration of sustainability principles (also referred to as Environmental policy integration, or Environmental mainstreaming), here applied to innovation policies.

The analysis will firstly consider policies on different levels of the innovation system that have an impact on the healthcare sector. Therefore, innovation policies on both national and regional are analyzed. Secondly, in order to determine whether and how sustainability aspects are taken into consideration in practice, healthcare innovation organizations will also be included in the analysis. See chapter two for further detail about the methodology.

The purpose of this master’s thesis is to determine whether, how and to what extent sustainability principles are integrated into Swedish innovation policies on a national and regional level and innovation practices in Swedish healthcare on a local level. The thesis also has the purpose of identifying the barriers for implementation of sustainability principles in innovation projects in the Swedish healthcare sector. The thesis will also seek to outline some recommendations for policy-makers on how to improve the integration of sustainability aspects in innovation policies and healthcare innovation organizations.

The research questions are therefore:

- 1) Are sustainability principles integrated with, and operationalized by, innovation policies at national and regional level and innovation practices at local (healthcare) level?

- 2) What interpretation of sustainability is represented in the innovation policies?
- 3) What are the main barriers for integration of sustainability principles in healthcare's innovation practices at local (healthcare) level?

Based on the findings, some conclusions can be drawn concerning if and how sustainability principles are integrated in innovation policies relevant to the Swedish healthcare sector, as well as what the main barriers are to implement such principles in innovation organizations in healthcare. Following these conclusions, this thesis discusses the potential reasons for the success or failure in implementing sustainability dimensions in innovation policies in the healthcare sector.

The findings of this thesis will also inform the analysis of an innovation agenda for Sustainable healthcare. The project is financed by Vinnova (the Swedish innovation agency), FORMAS (the Swedish research council) and Energimyndigheten (the Swedish energy agency) and carried out by TEM, Swecare, Lund University and Sustainable Business Hub. The findings and recommendations made in the thesis will be made available to the project partners and inform the identification of how the innovation system in Swedish healthcare can be developed. It should be noted that the thesis is produced independently from the innovation agenda project.

1.5 Outline of thesis

The first chapter (1) has outlined the background of the thesis: the need for societies to transition to more sustainable modes of production and consumption in the face of sustainability challenges such as resource depletion, climate change, environmental pollution, population growth and social sustainability. The first chapter has also provided an introduction to the concept of Ecological Modernization (EM). The central argument of EM is that innovation, when geared towards sustainable development, can provide an answer to the sustainability challenges. The first chapter has further provided an outline of innovation policies and how they are linked to sustainability policies. It has also defined the sustainability impacts of the healthcare sector and defined and motivated the purpose of the thesis: to determine whether sustainability aspects are integrated into innovation policies and practices in the healthcare sector.

The next chapter (2) will elaborate further on the methodology of this thesis. It will also provide a discussion on the selection of scope, possible limitations and validity and reliability considerations. After this, chapter three (3) provides the theoretical underpinnings of the thesis. Here, further detail on the principle of Environmental Policy Integration and Sustainable Innovation theory is provided. This creates the basis for a framework of evaluating implementation and operationalization of sustainability aspects in innovation policy (adopted to the healthcare sector).

Chapter four (4) presents the findings of the research, on the three levels of analysis and from the different data sources as explained in chapter two. Chapter five (5) presents the analysis, applying the theoretical frameworks identified in chapter three. A discussion of potential limitations and observations outside the scope of the thesis is provided in chapter six (6). Chapter seven (7) finally presents the conclusions of this thesis.

2 Methodology

The methodology section accounts for the ensemble of methodological choices that have been made in the thesis. These include research design, material, scope and limitations, validity and reliability, as well as definitions of key concepts (Beckman, Ludvig, 2005:11).

The objective of this thesis is to clarify whether and how sustainability principles are integrated in innovation policies and innovation organizations in the Swedish healthcare sector and to identify barriers to implement sustainability principles in healthcare innovation. Many different data sources and levels of analysis could be considered to provide answers to these questions. The methodological choices necessary to limit the scope of the thesis are further explained in this chapter. The epistemological perspective of this thesis is that the researcher cannot be fully detached from the objective of analysis, and the results are as such to some extent affected by the researcher's persona through the choices that are made. However, by a transparent approach, clarifying the reasoning behind and providing justifications for the choices that were made, clarity and intersubjectivity are sought out to render findings and conclusions more understandable to the reader.

2.1 Research process

The healthcare sector engages in different activities that promote innovation, such as procurement, innovation procurement and operating test bed organizations. Difficulties to promote sustainability aspects in these innovation activities were identified in the healthcare sector. This problem identification led to a research focus on how to promote sustainability principles in innovation. An initial literature review was carried out to probe the literature on integration of sustainability aspects in innovation activities. The most important literature was identified in the Environmental Policy Integration (EPI) and Transition Management literature. Introductory interviews were carried out to identify the most prominent issues in this area.

Västra Götalandsregionen and Region Skåne were chosen as case regions for a closer analysis of integration of sustainability principles in regional innovation strategies and in healthcare innovation organizations at the local level. These cases were chosen because they are considered to be public sector front-runners concerning sustainability policy, why they are likely to have implemented sustainability principles in innovation policy. If these regions have not implemented such principles, it is considered less likely that other regions would have, i.e. the 'most likely selection principle' (Teorell & Svensson, 2007). The regions are also considered comparable as they are fairly similar in size and population, and unlike the county councils both enjoy the enhanced regional governance, where regional development, innovation and sustainability administrations are part of the same organization, strengthening the "most likely" approach to find good practices of sustainability integration in innovation policy. While this regional organization has in both cases developed the innovation strategies, these differ both in character and responsible organization. In the case of Skåne, the business development administration has developed a separate innovation strategy, while in Västra Götalandsregionen; this strategy is integrated with the regional development plan. A comparison between a separate and an integrated innovation strategy is thus possible. There are different types of innovation organizations at the local level, however both these regions have an operational 'Innovation Gateway'⁶ (hereinafter IG), an organization that seeks to capture innovations from within the healthcare sector. The IG's are chosen as the local healthcare innovation organization studied in both the case regions and the survey. These

⁶ 'Innovationssluss' in Swedish.

organizations thus constitute the operational indicator for ‘practices at local (healthcare) level’. These organizations are different in character from many other innovation organizations (e.g. the research-oriented life science industry) and the validity of the findings is therefore limited to these organizations.

Innovation strategies greatly influence the innovation activities in a country or region (the latter being the governing level for healthcare sector in Sweden, see section 1.1.1.) and constitute the most apparent format for integrating sustainability principles into innovation policies. Innovation strategies were therefore analyzed to determine whether sustainability principles are integrated in innovation policies. It was also considered important to analyze whether sustainability principles were integrated at a local, more practical level (i.e. test bed organizations in healthcare). Here, introductory findings suggested that this integration might be missing, why it was considered important to determine the current status and to identify potential barriers to sustainability integration.

While the EPI literature provided a good analytical starting point, it did not include much detail about EPI in innovation policies. The analysis therefore turned to literature on transition management and sustainable innovations to identify potential frameworks for integration of sustainability principles to innovation policies. After supplementing this literature with the policy cycle analysis literature, a *framework for analysis of sustainable innovation policy* was developed (see section 3.5). The EPI literature also suggested that different normative interpretations of sustainable development could, at least partly, explain differences in implementation performance. The analysis therefore turned to sustainable development literature to identify a *framework for categorizing different interpretations of sustainability* in the innovation policies (see section 3.5 and appendix 4).

Equipped with these theoretical frameworks, the *analysis of sustainability integration in innovation policy* could be performed. The primary method was qualitative text analysis of the national innovation strategy and regional innovation policies of two regions chosen as regional case studies (Region Skåne and Västra Götalandsregionen). In order to improve the validity of the study, this method was supplemented with findings from a *quantitative content analysis* of the national innovation strategy and the fourteen existing regional innovation strategies, a *survey* sent to innovation administrations in all Swedish regions and *interviews* with stakeholders from national and regional level.

To inform the analysis of sustainability principles/aspects integration at the local level, interviews and a survey was used as the method for data collection. The survey was sent out to all innovation gateways (the studied case of healthcare innovation organization) and interviews were carried out with managers of innovation gateways in the case regions (Skåne and Västra Götaland). After the findings were compiled, the theoretical frameworks were applied to support the analysis and conclusions, see chapter five and seven. See section six for a discussion of the methodological limitations.

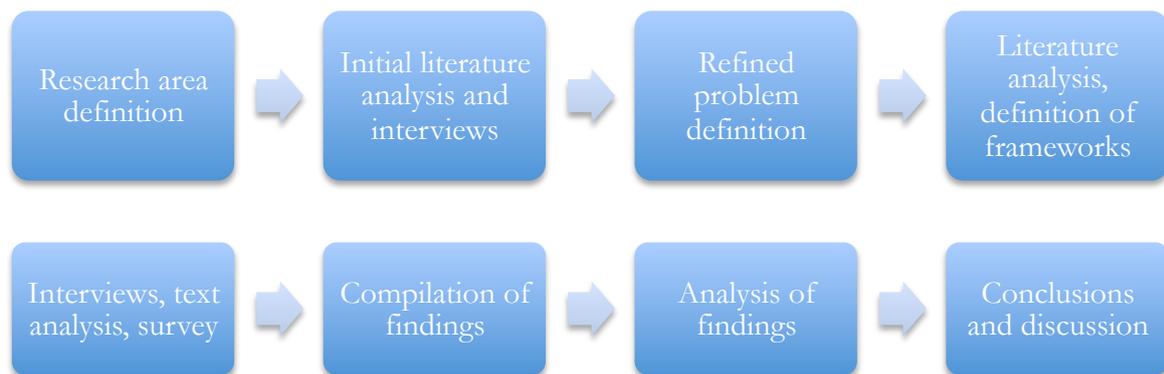


Figure 2. Research process.

2.2 Descriptive analysis

The research questions of this thesis are descriptive, aiming to determine whether and how sustainability principles are integrated in innovation policies and practices in the Swedish healthcare sector. To analyze this, a framework for sustainable innovations is provided in chapter three. The analysis takes a point of departure in an understanding of EPI that considers it to be an approach for integrating sustainability principles in other policy sectors. A second analytical framework is used to describe the different interpretations of sustainability present in the analyzed policies (see appendix four). This framework provides typical arguments as the operational indicators for the different interpretations of sustainability. These are used to determine what type of sustainability is reflected in the material. Descriptive analyses typically use such classification schedules to guide the analysis (Esaiasson et. al 2007:155).

2.2.1 Quantitative content analysis

The first text analysis is a *quantitative content analysis* of innovation policies as found in the healthcare sector. The quantitative text analysis is performed on national and all regional innovation strategy documents. This type of analysis is a common starting point for descriptive analyses (Esaiasson et. al 2007: 225). Here, the research is focused on the *frequency of* and *space granted to* the different text variables. The rationale is that the more frequent the word or argument, the greater is its *centrality* and the more space, which is granted to the issue, the larger is its *importance* (Esaiasson et. al 2007:223-233). The variables in this analysis are grouped into seven different categories in order to determine their centrality, signifying the weight given to different topics and aspects of sustainable development (see appendix 5).

2.2.2 Qualitative text analysis

The qualitative text analyses supplements the quantitative content analysis, seeking to better capture the meanings found in the material. While the quantitative analysis scans the material for key words and concepts, the qualitative analysis moves closer into analyzing the meaning of what is said. Qualitative text analysis is a method where the researcher seeks “to extract the essential content through a careful reading of the text parts, the text as a whole and the context in which it is embedded” (Esaiasson et al. 2007:237, own translation). The purpose of qualitative text analyses is to capture the essential meaning of a text by analyzing its argumentation. This is done by an analysis of how the different text parts relate to each other, what overarching objectives they are governed by and implicit arguments that are not uncovered by a mere word count. To perform such an analysis (and to achieve validity and reliability), the text has to be read several times, both quickly and more thoroughly (Esaiasson

2007:237). The qualitative text analysis is performed on national innovation strategy documents and the two case regions' innovation strategies, enabling us to understand the interpretation and integration of sustainability principles in these strategies (the first two research questions).

The third research question seeks to describe the main barriers for integration of sustainability principles in healthcare's innovation practices. While this analysis is of a more preliminary nature, the results should provide some preliminary suggestions for policy makers and suggest areas of interest for further research. This analysis focuses on extracting information about the arguments for obstacles and opportunities for sustainable innovations in the healthcare sector.

2.2.3 Surveys

Two surveys are used as a complement to the text analysis. The first survey is sent out to all regional innovation administrations with the purpose of capturing sustainability integration not reflected in the innovation strategies, e.g. if regional innovation strategies are coordinated with regional sustainability strategies or if there are specific sustainability objectives or targets set for the regional innovation projects. This survey also seeks to capture these administrations' views on innovation's potential to contribute to sustainable development, how they rank the different sustainability dimensions etc. The second survey seeks to determine if and how sustainability principles are integrated and reflected in the activities of the Innovation Gateways, determining whether regional sustainability policies influence the activities and what barriers the IG's see for integrating sustainability principles in their activities. Both surveys ask the respondents whether and how they collaborate with other regional administrations in innovation activities. The survey questions are found in appendix six and seven.

2.2.4 Semi-structured interviews

Semi-structured interviews were conducted with informants from all three levels of analysis. Interviews are chosen as a method to collect information that is less formalized (i.e. informal organizational or decision-making patterns, or key actors' perspectives and arguments). Interviews vary in the level of structure; ranging from the structured interview's closed questions to the unstructured interview's conversation-oriented approach (Teorell & Svensson 2007:89). The semi-structured type of interview is chosen to allow for more interaction and for unexpected answers to take the interview into new directions (Esaiasson et al. 2007:283f.). The qualitative analysis applied to the semi-structured interviews is focused on unveiling hidden phenomenon or arguments (ibid.) where after the different responses can be categorized. Generally, it is considered that more interviews are needed until it is determined that no new categories of responses appear. The number of interviews required to achieve this so called "theoretical saturation" is a debated issue, but an approximate number of ten interviews is considered typical in the methodological literature (Esaiasson 2007:260, 292). For the two regions studied, theoretical saturation has been considered to have been fulfilled. The interviewees have functioned both as informants (where the interviewee provides factual information, e.g. about how decision-making processes function) and as respondents (where the personal thoughts and perspectives of the interviewee are the central objects of study) (Esaiasson 2007:257f).

2.3 Validity & Reliability

The concept of validity depicts the congruence between what is analyzed on a theoretical level and what is actually measured. While the concepts of Environmental Policy Integration and sustainable innovation can be perceived as relatively abstract, the operational indicators provided in the frameworks (see section 3.5 and appendix four) are designed to be as

straightforward as possible while connecting to the theoretical notions of each category provided in the framework. By this overview of how the more theoretical concepts were operationalized into the text analysis, the ambition is to achieve as much transparency as possible regarding the interpretations of concepts that have been made. Reliability means the lack of unsystematic errors in the analysis, such as missing to count or reporting on results. The material is read several times to avoid these types of errors and the results section references the material frequently.

2.3.1 Analytical triangulation and limitations

The analysis strives to achieve analytical triangulation, including not only three different levels of analysis, but also several types of data sources. Triangulation is regarded important reduce the potential subjectivity of the chosen cases, collecting data from many different sources reduces the risk of bias or validity errors. This broad analytical approach has been considered essential in order to analyze the similarities and differences between different parts of the innovation system concerning sustainability integration. An overview of the different levels and types of analysis and of the analyzed data is provided in Table 1.

Data level	Quantitative analysis	Qualitative analysis
National	<ul style="list-style-type: none"> National innovation strategy, content analysis 	<ul style="list-style-type: none"> National innovation strategy Interviews
Regional	<ul style="list-style-type: none"> Regional innovation policies, content analysis Survey 	<ul style="list-style-type: none"> Regional innovation policies Interviews
Local	<ul style="list-style-type: none"> Survey (Innovation Gateways) 	<ul style="list-style-type: none"> Interviews (Innovation Gateways)

Table 1 – Data level and type of analysis.

2.4 Material

A literature review of relevant theories is performed. The conclusions that can be drawn from the literature review are compiled in chapter three, where the theoretical framework for the analysis is also found. The literature review is focused on environmental policy integration and sustainable innovations. Complementary theoretical fields include the innovation system approach and policy cycle analysis. The frameworks derived from the literature review are used to scan the data.

The thesis' primary data is collected through several semi-structured interviews with actors from the regions of Skåne and Västra Götaland. In the first stage (June-July) interviews were performed with actors from the two regions. Complementary interviews were performed during August. The interviewees are gathered from environmental managers in hospitals, environmental, innovation and procurement officials from the public sector and industry representatives (see bibliography for a list of respondents). Primary data was also collected through a survey, as described in section 2.2.3 above. National and regional innovation strategies constitute the secondary data.

2.5 Definitions of key concepts

As this thesis considers several contested concepts. This section provides definitions of the most central concepts in order to provide clarity to the reader.

Sustainability is based in the definition of sustainable development provided by the Brundtland commission’s report, a “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (WCED 1987:43), including economic, social and environmental aspects.

The **Healthcare sector** has been defined by the UN International Standard Industrial Classification (ISIC) as the three categories 1) hospital activities 2) medical and dental practices and 3) other human health activities. The definition used in this thesis is the one provided by the Industry Classification Benchmark that distinguishes two main groups in the industry: 1) health care equipment and services providers and 2) pharmaceuticals, biotechnology and related life sciences providers. The former group includes entities that provide medical equipment and supplies, health care service providers such as hospitals and home health care providers (ICB, 2014).

Sustainable healthcare is a contested concept as the healthcare system can promote a healthy society in many different ways. This thesis uses the definition limited to the hospital and care center level of healthcare provision, along with the definition of Sustainable healthcare provided in table 2 below.

Concept:	Sustainable Health	Sustainable Healthcare	Environmental Health
Focus:	Proactive focus, taking a holistic perspective on healthy societies. E.g. healthy diets, limiting tobacco use, encouraging physical activity	Reactive focus, limiting the sustainability impacts of the healthcare sector’s operations. E.g. energy efficient buildings, healthcare management and logistics systems that minimizes transports of patients, staff and goods, product purchasing requirements for low-carbon alternatives, ethical purchasing criteria.	Preventative focus; considering how environmental impacts affect health/ causes disease among the population.
Key issue:	Limiting the amount of patients /care to be provided	Limiting the sustainability impact once there is a patient that needs treatment	Limiting disease caused by environmental pollution

Table 2 – Definition of sustainable healthcare. Based on Eriksson (2014).

Innovation has been defined in many ways. The Australian economist Joseph Schumpeter suggested that innovations can be defined as; “ the commercial or industrial application of something new – a new product, process or method of production; a new market or source of supply; a new form of commercial, business or financial organization” (Schumpeter, 1934 in Vinnova 2001). Service innovations are also included in the definition used in this thesis. The word ‘new’ is interpreted as that the innovation brings something new to the economy and not just to a single organization, excluding the diffusion of technology from this definition. Further, innovations can be incremental or radical nature, where the incremental innovations contribute to smaller changes in the product’s or design whereas radical innovations bring

more drastically changes to society. Examples of radical innovations include the introduction of e-mail, to a large extent replacing the previously dominant postal system. This thesis uses Edquist's definition of innovation, where product innovations are defined as *new or improved goods and services* while process innovation are defined as *new (technological or organizational) ways of producing goods and services* (Edquist et al. 2001, cited in Edquist and Chaminade, 2006). See section 3.1 for further discussion of the innovation concept.

Sustainable healthcare innovations are consequently defined as *new or improved goods and services, and new technological or organizational ways of producing goods and services that limit the healthcare sector's operations' negative impacts to sustainable development*. Examples of sustainable healthcare innovation include new *e-health services* that allow patients to be treated in their home (thus limiting transports and material use, improving timely access to care for those that need treatment by physical visit, increasing patient convenience, reducing cost for healthcare and patient), the *development of single use products made from biopolymer plastic* rather than fossil plastics (reducing greenhouse gas emissions, indirectly contributing to reduced health and social impacts) and the introduction of *technology or treatment methods that limit emissions* of nitrous oxide, which has a global warming potential of 310 (IPCC 2007, EPA 2014).

Environmental innovations can be understood as those innovations that have an *intention* to have positive effects on the environment or those that have these positive environmental *effects* regardless of the intention (Vinnova 2001). The latter, effect-oriented perspective is the one taken in this thesis. Hemmelskamp defined environmental innovations as "innovation that serves to prevent or reduce anthropogenic burdens on the environment, clean up damage already caused or diagnose and monitor environmental problems" (ibid.). This is also the definition used by the Swedish innovation agency (ibid.).

2.6 Scope and limitations

The limitations needed in the selection of data sources are among the most important limitations of this thesis. When analyzing large and complex systems such as healthcare and innovation systems in a multi-level perspective, these limitations in scope are nonetheless needed to focus the orientation of the thesis. The macro level of analysis has been limited to the national level innovation strategy, evaluation reports from the Swedish innovation agency Vinnova and interviews with The Swedish Competition Agency.

The meso level of analysis considers the regional innovation strategies and primary data from the survey. This data is complemented by other documentation and interview data in the regional case studies. We cannot outrule the possibility of missing interesting data in focusing on this particular material, but as much validity as possible has been sought by a triangulation approach to the research. The thesis only considers innovations that have an application to the healthcare sector, meaning that the focus is thus limited to innovations that are dependent on communication and collaboration with the healthcare sector specifically. Rather than considering only the innovations that are technically specific to the healthcare sector, the general innovation policy and practices were studied. This wider focus is chosen because of the research objective; to consider the sustainability aspects in healthcare innovation policy in general.

The definition of sustainable healthcare that is found in Table 2 narrows the scope of the thesis to innovations taking place at the hospital or care center level – leaving out for example innovative preventative health strategies that are placed under the sustainable health category. The geographical scope is limited to Sweden and a particular focus is put on the two case regions. This may imply that we are missing out on data from other relevant Swedish regions and that the validity is limited mostly to Sweden. The pharmaceutical industry makes up a

large part of the innovations taking place in the healthcare sector. However, this is considered a separate sector in its own right and is therefore mainly left out of the analysis, apart from the fact that the general innovation policies also apply to this sector to some extent.

Limitations to this research design are that the findings from cases may not be exhaustive and thus not provide external validity for Swedish healthcare or healthcare in general. The contextuality of Sweden is an inherent limitation to choosing Sweden as the studied country. The validity of the findings at the local level is limited to the type of organization studied: Innovation Gateways.

3 Literature analysis and theoretical background

Several papers have evaluated the effects that stringent environmental laws and policies have on the innovation in society (N. A. Ashford, Ayers, & Stone, 1985; N. Ashford & Hall, 2011; Costantini & Mazzanti, 2012; Rexhäuser & Rammer, 2011; Tuncak, 2013). Such regulations were introduced by many governments in response to the growing environmental awareness of the 1960's (Pearce, 2002). This approach to greening the economy was based on the rationale that regulatory policy instruments could drive technological development towards more sustainable patterns of consumption and production. While the focus initially lay on end-of pipe solutions, rendering incremental technological change, the development gradually turned towards the aforementioned ecological modernization approach, more oriented towards pollution prevention and restructuring of production systems (Carter, 2007). Governments thus increasingly looked for policy instruments to drive innovation processes towards cleaner production and consumption. Innovations, especially radical innovations typically suffer from the dilemma that private costs exceed societal gains in the start-up phase, rendering it difficult for private firms alone to invest in radical innovations needed to transition to sustainable production systems. So how could these radical and transformative innovations be supported? How could radical change in industrial practices be induced? What could be done for innovations to be more effectively transferred and adopted between firms? In order to answer these questions, government looked to developing more general innovations support structures.

The literature analysis includes several different areas of academic research. The next section (3.1) introduces the system of innovation theory (relevant because it is especially influential in Sweden, the country of study in this case), exploring the mechanisms that affect the innovation systems' functioning. The systems of innovation seeks to capture the complexity of innovation processes, highlighting their nonlinear character and emphasizing the important process of interactions between many different actors. However, it is less certain whether and how sustainability dimensions are integrated in innovation systems and innovation policies. In order to analyze this, the following section (3.2) explores how sustainable innovation (an innovation policy that promotes sustainability) can be defined. A section on environmental policy integration (3.3) helps us to identify the typical barriers to integrate sustainability considerations with other sectorial policies. One of the identified barriers is differing interpretation of sustainable development, why this chapter also elaborates on different interpretations of sustainable development. The barriers to environmental policy integration are found at different points in the policy cycle. The next section (3.4) therefore recalls the policy cycle theory to further clarify the characteristics and determinants of the different points of the policy cycle. The concluding section (3.5) of the literature analysis summarizes the findings and provides two frameworks of analysis for sustainability in innovation policies. The first framework is a categorization of different interpretations of sustainability, proposed by Baker (2006). Drawing heavily on the sustainable innovation theory and applying a policy cycle and environmental policy integration approach the second framework is developed to analyze the integration/operationalization of sustainability in innovation policies.

3.1 Systems of innovation

The systems of innovations (SI) approach seeks to describe the complex environment in which innovations occur, emphasizing the importance of the context. Here, innovations are not considered an isolated phenomena originating from the firm alone but something which takes place within a system of other actors, e.g. universities, suppliers, firms, customers and government (Edquist, 2011). Unlike traditional approaches to innovations, the SI approach focuses on the nonlinearity and interdependence between between actors in the innovation system (Edquist and Chaminade, 2006). As we will see, the Swedish government was one of

the first to formally deploy the innovations systems perspective in the national innovation policies. The perspective thus allows us to better understand the design of the Swedish innovation policies and to contextualize the different levels of analysis (national, regional and local), corresponding to different systems in the SI literature (e.g. supranational, national, regional and sectorial and technological systems of innovations). The IS approach is used to explain the innovative activity level in these different levels and to understand success and failure of innovations. The characteristics of these systems are drawn out in order to understand the relevant actors at the three levels of analysis.

The definition of innovation applied in this thesis is broad, including both product and process innovations. Product innovations are defined as *new or improved goods and services* while process innovation are defined as *new (technological or organizational) ways of producing goods and services ways* (Edquist et al. 2001, cited in Edquist and Chaminade, 2006). Innovations systems can exist on a national, regional, sectorial and technological level (Edquist and Chaminade, 2006). A generic systems of innovation approach for all these levels is applied here, considering these different levels to be variations of the same general principle. When analyzing whether and how sustainability is integrated in the Swedish healthcare sector's innovation policies and practices, all of these innovation systems may be relevant. While there are several innovations systems within the healthcare sector in Sweden (e.g. regional, sectorial and technical), the national innovation system is considered to have an overarching function.

While there is no universally accepted definition of an innovation system, it is possible to distinguish a list of features upon which most of the academic world agree on. Freeman (1987) was the first to use the term national innovation systems in published form where after the theory was further developed during the 1990's. Prominent writers on national innovation systems include Nelson, with an empirical approach, and Lundvall, with a theoretically oriented approach that sought to put learning, interaction and innovation in the focus of the economics discourse (Edquist and Chaminade, 2006). These authors both point at organizations that support and create research and development; universities, public and private laboratories, as the main sources of innovation but also take into account the socio-economic, political, cultural and institutional context in which these organizations are embedded. (Freeman 2002, cited in Edquist and Chaminade, 2006). National systems of innovations have been identified as the structures that determine or influence the innovation processes in a country (Nelson and Lundvall in Edquist, 2011). SI definitions are generally kept very broad, recognizing the difficulty of determining specifically the determinants of an innovation.

The main components of a SI are typically considered a range of *organizations* (the players of the game) and *institutions* (the rules of the game) (North 1990 in Edquist and Chaminade 2006). Here, organizations are considered formal structures that have been created to serve an explicit purpose. Examples of organizations in a system of innovation are universities, public agencies that develop and implement innovation policy, laws and regulations, financial providers such as capital funds, firms and so on. Institutions are the rules of the game in a specific context, ranging from 'hard institutions' such as laws, to 'softer institutions' such as established practices and routines, norms and common habits. The institutions regulate relations and interactions of the different actors (individuals, groups, organizations) in the innovation system (Edquist 1997 in Edquist and Chaminade 2006). The role and importance of organizations and institutions vary between national SI's. For example, Swedish universities have a central role in R&D in Sweden, whereas independent public research institutes are much more important in Germany. Similarly, institutions such as patent laws vary greatly between countries.

The main function of an SI is to develop and diffuse innovation. *Activities* taking place in an SI are seeking to influence these processes. Research has focussed on different areas of activities within an innovation system (Edquist and Charminade 2006):

- 1) Activities that are done to move an idea into an actual product or process innovation.
- 2) Activities in knowledge processes; production and diffusion of knowledge
- 3) Organizations' activities to influence the innovation system
- 4) Innovation policy; public intervention that influences the SI

A *national innovation system* can be defined in several ways, for example “the elements and relationships that interact in the production, diffusion and use of new, and economically useful, knowledge”(Lundvall, 1992). The innovation system approach considers innovation processes to be non-linear, including communication and interaction between several different actors (R&D, market actors, policy makers, civil society etc.). This complexity also means that there are multiple feedbacks between the different actors that co-exist in the innovation system. It is such perceived as a dynamic, rather than static context, which inherently includes a high level of uncertainty (Foxon & Pearson, 2008a). The innovation system approach further acknowledges that since all actors have limited innovations, they are working in a situation of bounded rationality, where the modes of learning from (e.g. learning by doing, using and interacting) and communicating with each other becomes essential. The expectations that are shared among industry actors also shape trajectories of technology development.

Regional innovation systems are organized (often with support of regional governments) in recognition that they are needed to create lasting economic growth. One of the key motives of regional innovation systems are that regional growth is dependent on the regional actors' ability to exchange and adopt knowledge, in order to remain competitiveness in a constantly changing dynamic and globalized economic system. Regional innovation systems are as such characterized by an approach similar to the triple helix approach – emphasizing the importance of networks and relational factors in the innovation system (Martin, Moodysson, & Zukauskaitė, 2011). Regional policies often do not take into consideration the fact that firms' capacity to adopt knowledge differ depending on the industrial sector. In their 2011 study, Martin et al. analyzed the regional innovation policies for three industries in the Scania region in Sweden, among which life science was one.

Innovation systems serve several *functions*. Jacobsson and Johnson outline five of these functions: 1) creating and diffusing 'new' knowledge, 2) guiding the search process among users and suppliers of technology, 3) supplying resources, e.g. capital, competencies and other resources, 4) creating 'positive external economies' by exchanging information, knowledge and visions and 5) facilitating the formation of markets (Jacobsson and Johnson in Foxon and Pearson, 2008). Several aspects affect the functioning of innovation systems. Mechanisms that *promote* effective functions of technology systems include government policy (e.g. R&D funding, investment subsidies, tax incentives), ease of firm entry and feedback from market formation (ibid.). Other mechanisms *induce* effective functions of technology systems. These include uncertainty, poor connectivity of networks, lack of political support, established firms displaying opposing behavior and disincentives from other government policies (ibid.).

The main contender to the innovation system approach is the cluster concept, suggested by business economist Michael Porter in 1990. The cluster concept regards innovations as occurring in an environment where a network of companies within a particular sector interacts with suppliers, customers and other relevant organisations. This environment is generally expected to be geographically concentrated. In Sweden, the cluster approach is more used in regional politics, but overall less influential than the innovation system approach according to Eklund (Eklund, 2007).

Sweden receives top ranks in innovation indexes and reports (e.g the Innovation Union Scoreboard 2013, The Global Cleantech Innovation Index 2012) and the OECD has identified that Sweden has the possibility to become a “pioneer in policy development, notably in the areas of public service innovation and innovative procurement” (OECD 2013, p. 21) The main organization in Sweden’s national innovation system is the Swedish Governmental Agency for Innovation Systems (VINNOVA, 2014), run by the ministry of Enterprise, Energy and Communications and with a mission to “...promote sustainable growth by improving the conditions for innovations, as well as funding needs-driven research.” (VINNOVA, 2014). Each year, the agency invests about 2,7 billion SEK in various initiatives, supporting research and innovation milieus and developing catalytic meeting places (VINNOVA, 2014). When founded in 2001, it was the first innovation agency in the world to be named after the innovation systems approach (Eklund, 2007), suggesting a strong support for this approach (rather than the cluster or linear approaches to innovations as discussed above).

The innovation system approach is useful to understand the sometimes interrelationships between different actors in a given innovation milieu and the role of innovation policy in influencing the innovation system. However, it does not provide information about how innovation systems can be designed to promote innovations for sustainable development. The following sections expand on this issue. Firstly, theoretical approaches and principles for sustainable innovations policy are described in section 3.2. After this, the principle of environmental policy integration is described.

3.2 Sustainable innovations

The transition management approach is among the most famous theoretical frameworks to analyze societal transition to sustainable technologies. Developed in the Netherlands in the early 2000’s, the approach seeks to define a governance structure that gradually transforms socio-political and socio-technical landscapes towards sustainable development. It seeks to reduce uncertainties (inducing mechanism in innovation systems) by engaging and creating shared visions among stakeholders on many levels of the innovation system (Rotmans, Kemp, van Asselt, 2001). The rationale is that by focusing on collectively determining objectives of change, sustainable societal outcomes can be achieved. The transition management approach has a long time strategic perspective, considering a time span of at least one generation (Kemp, Loorbach, & Rotmans, 2007). Importantly for the analysis of innovation policies, the theory emphasizes the need of multi-level governance perspective to tackle the issue of ‘political myopia’ (short-term political changes caused by fluctuations in the political, legal and economic environment) (ibid.). Visions and long terms goals are developed at the *strategic level*, agendas, networks and coalitions are created and negotiations occur at the *tactical level* and projects and experiments are implemented at the *operational level*. Transition management relies on the functioning interaction and collaboration within and between these levels. Kemp et al further argues that the transition management approach offers an especially relevant framework for science, innovation and sector policies (ibid.). Transformative innovations are based in an analysis of needs and strive to make far-reaching improvements (i.e. factor five improvements). Examples include replacing physical meetings with virtual meetings, tablets rather than printed material, leasing rather than owning products etc. In order for the public sector to promote for transformative soluciotns, procurement and other actors need to be driven by a shared deeper analyses of societal needs (Swedish Government, 2010).

Foxon & Pearson (2008) have outlined the features and suggested principles of a Sustainable Innovations (SI) policy regime, that seeks to align environmental policies and innovation policies into an integrated policy design that promote the development of cleaner technologies and sustainable innovation in general (Foxon & Pearson, 2008a). Sustainable innovations are defined as “innovation towards more sustainable technological and institutional systems and

processes are broadly understood as systems for which resource use and waste production remain within appropriate environmental limits and socially acceptable levels of economic prosperity and social justice are achieved”, (Foxon & Pearson, 2008a). The authors argue that while environmental and innovation policy regimes have previously been treated as fairly separate units, recent research has sought to bring together these two policy units to generate “direct policy support for innovation to achieve environmental ends” (Foxon & Pearson, 2008a). The authors’ explain that the background to this is that the two policy units are built on two different problem identifications. Innovation policy is needed because the social returns of innovations exceeds the private and therefore the innovation system needs to provide support for innovations that may take too long to achieve profitability. This has been the case with several major innovations historically, such as the Internet, vaccines etc. In contrast, environmental policies are designed to internalize negative environmental externalities through the use of various policy instruments. Foxon and Pearson argue that while these policy units are kept separate, they will be unable to adequately support the transition to a sustainable system of consumption and production, similar to the strategic level network collaboration suggested by the transition management approach.

The reconciliation of innovation and sustainability policy areas is considered important to facilitate the transition to a more sustainable society, as innovations allows for the development of drastic and/or systemic changes to models of production and consumption. The sustainable innovation policy regime thus seeks to create an integrated policy design that promotes the development of cleaner technologies, along the lines of ecological modernization theory (e.g. Jänicke) but with a time span and governance approach similar to that of the transition management.

Both the sustainable innovation policy regime and the transition management approach discuss the necessity to overcome path dependency in technological development processes. Under such lock-ins, systemic factors, expectations and events determine whether and how a technology develops. Economics of scale, learning effects and adaptive expectations all contribute to the risk of technological lock-ins. Under this situation, the incumbent technology creates a barrier for new technologies to enter the market. Innovation supporting institutions also risk a range of lock-ins, caused by cognitive frameworks and fixed regulatory regimes (Foxon & Pearson, 2008b; Kemp et al., 2007). Traditional environmental innovation policy regimes have been based on a linear thinking, which has been largely criticized for not capturing the complete picture of the actual innovation structures. These traditional innovation policies led to the promotion of innovations that were financially viable on a short term and excluding more sustainable innovations that would take a longer time to reach market and achieve profitability.

Foxon and Kemp further suggest that “current policy-making processes often result in the ‘watering down’ of measures to promote sustainable innovation” – meaning that the actually implemented measures are significantly weaker than the stated policy design (Foxon and Kemp, 2004). This watering down of policy is considered to be a result of negotiation in the policy-making process. Three types of external pressures that negatively effect the policy making process are outlined: the *low priority* granted to long-term sustainability goals relatively to the more immediate policy pressures, the interrelated and therefore *complex nature* of the issues at hand and the contested nature of these issues and the *weak goal-setting capacity*.

The innovation system perspective takes into account a larger range of actors and considers more dynamics. However, the innovation system provides little guarantee for the inclusion of environmental considerations into policies and decision-making processes, as considered necessary in theories of transition management and sustainable innovations.

Foxon and Pearson have outlined the key guiding principles for a sustainable innovation policy regime. Firstly, there should be an “explicit objective of promoting sustainable innovation”. A “long-term, stable and consistent strategic framework to promote the transition to more sustainable systems” which should encourage investments in innovations that are sustainable in the long term should support this. The transition management approach is considered an example framework for sustainable innovation policy processes. Defining visions and strategic goals are considered essential to form the overall directions for the development of more sustainable technological alternatives.

The framework further stresses the need for systems thinking, enabling the innovation system to recognize system failures and techno-economic- or policy windows of opportunity. The processes for agenda setting should in in the sustainable innovation policy regime characterized by a multi-level governance perspective where public-private structures promote the interactions between the regulator and the regulated, enabling stakeholder participation.

Further, a mix of policy processes needs to include sustainability indicators and SI criteria that are balancing the three sustainability dimensions. Processes also need to assess these instruments as to the appropriateness to different stages of the innovation process. Finally, learning needs to be an integrated part of the processes. Monitoring and evaluation of policy implementation and a review of policies’ impacts on innovation systems enable learning processes. The full account of the guiding principles is provided in Appendix 3.

Implementing sustainability aspects into innovation policy is a relatively new topic. In order to better understand how sustainability principles can be integrated with different policy areas, we now turn to the literature on environmental policy integration (EPI), also known as environmental mainstreaming. The following section investigates the characteristics of the environmental policy integration (EPI) principle. EPI has typically been applied to ‘vertical’ policy sectors such as agriculture, energy or transport (Lenschow, 2002) but less so to other ‘horizontal’ policy sectors like innovation policy. The analysis of the EPI literature seeks to extract insights to from the EPI approach that may be relevant for analyzing how sustainability principles can be applied to innovation policies.

3.3 Environmental Policy Integration

Since the 1980’s bloom of the sustainable development discourse and the quest to reconcile is potential conflict with the industrial production system (illustrated in the ecological modernization approach) the principle of environmental policy integration (EPI) gained the attention of policy makers. This principle, also known as environmental mainstreaming, seeks to systematically integrate environmental policy with other policy areas. Environmental policy integration is here defined as *a principle that seeks to integrate environmental policies into all other societal sectors’ activities* (Jordan & Lenschow, 2010a; Nilsson & Persson, 2003; Storbjörk & Isaksson, 2013) The objective is for environmental aspects to be analyzed and taken into consideration by internal sectorial processes rather than by an external environment-specific policy body (such as an environmental department or ministry). The sustainable development approach, growing in importance since the 1972 Stockholm Conference, received broad political acceptance after the issuing of the Brundtland report (WCED, 1987). Assuming an integrated approach was an essential part of this sustainable development agenda (Biermann, Davies, & Grijp, 2009). The European Union (EU) had traditionally dealt with environmental protection issues under separate environmental departments and under a command-and-control rationale (Lenschow 2002:5) but evaluations implied that this had not been an efficient policy approach. Subsequently, the EU called for a greening of the economy in its fifth Environmental Action Plan and the EPI principle has been regulated in the EU treaties (Lenschow 2002:4). The fundamental idea is that reconciling environmental, or indeed sustainability principles into

other policy areas allows societies to shift into development paths that take into account the long-term sustainability of ecological and social systems. Environmental governance has been referred to as shallow and overshadowed by economic considerations (Bosselmann, 2008), something which the EPI principle seeks to address by its holistic orientation. While the political response to EPI was generally very positive, not least in the European Union, the success by which EPI has been implemented in different sectors or policy areas has been questioned (Jordan & Lenschow, 2010a). Part of the explanation to this is found in the contested nature and different interpretations of the concept, both on a *normative* (interpretation) and *positive* (operationalization) level (ibid.).

3.3.1 Implementation issues

Integration of environmental dimension in sectorial policy can be likened to a policy learning process which “reframe sectorial objectives, strategies and decision-making processes” (Storbjörk & Isaksson, 2013). However, many studies have observed problems in implementing EPI in different sectors. Although the EPI principle had spread internationally, along with the notion of sustainable development (Lenschow, 2002), the principle has not achieved the intended widespread implementation. In fact, the issue of EPI was largely neglected by the EU despite its “widely recognized importance for environmental protection” (Lenschow 2002:1) among policy makers. The sometimes contradictory objectives of economic and environmental sustainability have proven a challenge for implementation stages in departments, where actual trade-offs between these objectives are necessary. The tradition of organizational sectorization have proven a challenge in assuming the responsibility for EPI (Storbjörk & Isaksson, 2013). The linkages between the abstract notion of sustainable development and the principle of environmental policy integration partly explains the acceptance on a political level. So while the EPI principle was considered attractive in theory, it has not experienced widespread implementation on the operational level (Lenschow 2002:5). Lenschow (2002) argues that some of the reasons to this is the *normative ambiguity* of the overarching principle of sustainable development (interpretation issues), as well as challenges in *changing responsibility* among administrations (operationalization issues).

Operationalization issues

The shift from a vertically segregated and regulatory-oriented approach to environmental protection, towards a horizontally integrated approach of shared responsibility did not take into account that the responsible (environmental) administration under the policy structure that had failed to achieve sustainability was separate from the sectorial administrations that were to assume responsibility for the implementation EPI. The sectorial responsible administrations did not necessarily have the necessary expertise to implement the necessary measures of EPI. For policy-makers to reassess the objective of their operations, a deeper *understanding of the issue* at hand and a *shared understanding* of sustainable development as a prioritized principle need to be assured. For such a capacity-building project to take place, there need to be some external pressures, or educative measures. Further, with a *lack of clearly defined objectives, indicators and timetables*, administrations are left with a lot of space to navigate away from substantive changes in the policy-making process (Lenschow 2002).

Incentives for sectors to alter policy patterns in a way that was seen to go against the *traditional policy objectives* were clouded. The “no trade-offs” discourse is not likely to be function in sectorial EPI process, where there are real “winners and losers as a consequence to policy integration” (Lenschow 2002). Operational ambiguities thus take the form of *implementation dilemmas* at the sectorial level as it is only at this level that trade-offs are felt, where actual policy choices have to be made and activities governed accordingly.

Lenschow (2002) further discusses three dimensions that she considers potential explanatory

factors; *actors*, *ideas* and policy traditions and *institutions*. Where environmental policy makers are marginalized, the success of EPI therefore depends on the commitment of sectorial *actors*. This commitment may of course vary between different sectors, between different political levels and between politicians and bureaucrats (Lenschow 2002). An individual commitment can of course also exist; this may be better framed in the *ideas* dimension. Here, policy interests are understood as embedded in a frame of reference that differs between organizational-, policy-, or indeed societal sectors (Lenschow 2002:17). This dimension may explain why EPI has been attractive at a conceptual level, while proving more difficult to implement as the win-win story has faltered at the sectorial level. (Lenschow 2002). Lenschow also discusses the *institutional* dimensions and policy tradition, arguing argues that new policy responsibilities are simply more easily adapted the less that they depart from traditional practices. Administrative structures at different political levels also matters, where sectorial division often leads to policy fragmentation (Armstrong and Bulmer in Lenschow 2002) under which responsibility for EPI risks being undefined.

Interpretation issues

The concept of sustainable development seeks to reconcile the objectives of economic growth, social development and environmental protection by a “process of change in which the exploitation of resources, the direction of investment, the orientation of technological development, and institutional change are made consistent with future as well as present needs” (WCED 1987:8-9). The interpretation of this concept however varies widely between and amongst national, local as well as political and private actors. Ranging from far-fetching attempts to restructure patterns of production and consumption to focus being put on using the integrative focus as a tool to rationalize and slim sectorial practices (Lenschow 2002:7). Sustainability has been explained as a complex idea that needs to be defined normatively, based in a reflection on its criteria, values and principles (Bosselmann, 2008).

On this normative level, interpretations of sustainable development range from “strong” interpretations, where all sectors should take all necessary measures to assess and take environmental impacts into account in the decision-making processes, to “weaker” interpretations, aiming broadly at identifying synergies, pragmatically weighting sector-specific and environmental objectives against each other and aiming for long-term consistency and comprehensiveness (Jordan & Lenschow, 2010a). These interpretive differences are also reflected on the operational level, where e.g. the Agenda 21 stresses the need to contextualize the implementation of EPI, opening up for both national and sectorial level differentiation, while the Brundtland report’s calls for actors to put environment and development “at the centre of economic and political decision-making” making EPI a “principled priority” (UNCED, 1992:8.2). Scholars also noted that the EU’s interpretation of EPI has been watered down over the years, moving away from a defined EPI terminology and towards more diffuse and differentiated concepts like mainstreaming sustainable development, prioritizing the environment and climate policy integration. The interpretations and implementations remain differentiated on a sectorial level, with relatively little actual impact on everyday decision-making. Jordan also notes that the UK and Sweden stand out as examples of countries that have found different ways of operationalizing EPI. In Sweden’s case, the explanation is a combination of sector responsibility and objective oriented political traditions and a strong public support for environmental policies (Jordan & Lenschow, 2010a)

What then, constitutes “strong or ‘weak’ interpretations of sustainability? Susan Baker’s framework “the ladder of sustainability” proposes a categorization of different interpretations of sustainability. The framework offers a device for the different policy imperatives that are associated with each category (Baker, S. 2006). The concept of sustainable development essentially seeks to capture the linkages between environmental, social and economic systems;

i.e. that environmental stresses are linked to each other, that these in turn effect the economic (e.g. resource prices, value of ecosystem services) as well as social development (e.g. food security, public health) and the contribution of social and political factors to steer this development (Baker, S. 2006). Thereby, the sustainable development concept also underlines the interdependencies between the traditionally economic and social objective of 'development' and the traditionally environmental objective of 'sustainability'. However, several interpretations of the concept co-exist, which as note has been causing implementation difficulties. Baker (2006) has proposed four models of sustainable development in her 'ladder of sustainability'. The *pollution control* model takes a pragmatic approach to sustainable development. Based on an assumption that technological innovation can be used to address any environmental problem, it argues that environmental issues should therefore not put limits to development. Further, pollution is thought to arise in the early stages of development and thereafter diminish in the post-industrial phase. The approach thus fails to recognize that the pollution burden may be shifted to other developing countries. The second model of *weak sustainable development* seeks to further integrate growth and environmental objectives, with economic growth as a primary policy objective. By placing monetary values on environmental assets and ecosystem services, these can be managed by the market economy. After such a value has been applied, it is possible to use cost-benefit analyses to determine if a natural resource should be used or not. However, the legitimacy of various environmental valuation methods has been questioned, not least to the lacking potential to sufficiently address e.g. issues of intergenerational equity and non-use values. The *strong sustainable development* model takes a more precautionary approach to environmental impacts, stressing the importance of managing risks although there may be factual scientific uncertainties about environmental impacts. This approach requires stronger policy intervention, new governance forms and a more inclusive form of governance to enable what is considered necessary changes to consumption patterns. The objective of development is also shifted, from a focus on economic growth to a focus on quality of life. Finally, the *ideal model of sustainable development* suggests a more profound change to society based on radically different attitude towards nature, where all life forms have attributed values and human societies and economies are not allowed to prosper at the cost of nature (e.g. deep ecology) (Baker, 2006). See Appendix four for the full account of the model. Proponents of the stronger form of sustainable development suggest that the weaker model's (including ecological modernization) solutions are not bold enough to solve the sustainability challenges. Specifically, it is argued that the environmental benefits achieved by ecological modernization will be overridden by the rebound effects created, as increased levels of consumption is possible (Carter, 2007).

In order to understand the different conditions behind why EPI is given a strong or weak meaning, governing processes have been analyzed in several studies. Jordan and Lenschow separate between analyses of political *systems* (institutions, politics and cognitive predispositions) and of policy-making *processes*' (phases/points of intervention or choice of policy instruments).

Political system perspectives

From an *institutional* perspective, EPI can be described as a multi-sectorial and multi-level operation, organized under different ministries and increasingly decentralized. While the literature concludes that EPI has generally not become routine, differences in institutional design can affect the capacity to implement EPI. For example, independent ministries (e.g. Germany) are more segregated while the heightened "sector responsibility" (e.g. Sweden, United Kingdom) should promote higher levels of ownership of common objectives like EPI (Jordan & Lenschow, 2010a). Favorable institutions are generally the ones that have sufficient decision-making power in the issue at hand, however this is not a sufficient condition for strong EPI implementation. From a *political* perspective, political will and leadership are

important but less researched components of successful EPI implementation. Generally, left-center governments have proposed most policies favoring EPI. In Sweden, the change of government in 2006 (to center-right) has been seen to reverse some of the measures taken in favor of EPI (the ministry of sustainable development). Certain political leaders have also been important in pushing EPI implementation. The *cognitive* perspective focuses on the frames of ideas in which policy is embedded and how these different discourses shapes the thinking in a policy sector. The Scandinavian countries consensual policy-making style is seen as supportive of coordinated policy making, as opposed to the more legalistic style of e.g. USA and Germany. The cognitive frameworks can also be found on a sectorial level (Jordan & Lenschow, 2010a).

Policy process perspective

From a policy process analysis perspective, points of intervention in the policy cycle have been one of the focus areas of analysis. Here, we can distinguish four different steps of the policy cycle: ex ante influencing objectives, resource allocation, interaction and coordination between policy makers and monitoring impacts of past instruments. Concerning *objective setting*, many jurisdictions have implemented EPI, but most often opt for soft instruments without legal force. At the national level, Sweden is one of the few countries that have made strategies operational, by national environmental objectives and indicators (although the progress of reaching the objectives have been quite poor). These strategies are most often found in the environmental ministries and have not succeeded in spreading to sectorial policies (Jordan & Lenschow, 2010a). Regarding the *resource allocation*, green budgeting is mostly understood as cost post regarding environmental objectives and has not amounted to an overall reorientation of goals towards sustainability as proposed by the Brundtland commission. Concerning *coordination*, organizational changes have been focused on lower administrative changes and where impacts have been monitored, it has been rather unstrategic in its form. Overall, Jordan and Lenschow found that EPI has been implemented in a rather fragmented, piecemeal manner throughout the EU. Jordan and Lenschow also discuss the different logics of intervention (institutional, political and cognitive), where institutional and cognitive are the most studied. Among the institutional interventions, networking is one popular measure (from a rationale of more meetings and cooperation will lead to the development of mutually shared ideas and policies), however without a political will these activities are less likely to be successful. The attention given to EPI seems to fluctuate along with the issue attention cycle. Academic evidence is also showing that EPI procedures targeted at learning is rather weak and that learning primarily occurs as a cause of a crisis or sudden event. Finally, the *outcome effectiveness* of EPI is relatively little studied, potentially caused by the many potential causal factors, lack of good data among other factors (Jordan & Lenschow, 2010a).

In most sectors, the level of priority/attention to given to environmental protection is still a contested topic. The positive/operational meanings that are actually implemented vary between jurisdictions, sectors and over time. We now need to start compiling findings on “what facilitates and what impeded EPI within and across different levels of governance” (Jordan & Lenschow, 2010a).

3.4 Policy cycle analysis

The policy cycle theory also described to provide further structure to the question of what facilitates sustainable innovation policies. EPI can take place on different stages in the policy cycle, and previous studies have found that it is often stronger at the agenda setting level than at decision-making or implementation stages, where real conflicts around resources may arise (Storbjörk & Isaksson, 2013). The policy cycle analysis literature has describes closer this literature.

The policy cycle theory has developed into perhaps the most used descriptions of the policy-making process. The model describes the different stages of policymaking in a rather sequential and linear way and proposes a framework that allows the researcher to organize public policy research. While the literature includes many different variations of the stages, the most conventional differentiates between agenda setting, policy formulation, decision-making, implementation and evaluation. While it is widely acknowledged that this description of the process is a simplification as real-world decisions rarely follows this linear path of discrete steps, it has proven useful as an ideal type description of how planning and decision making occurs (Jann and Wegrich in Fischer et al 2007). The policy cycle analogy is useful to describe and contextualize the analysis and will inform the creation of an analytical framework.

In a rational linear policy cycle model, each decision should be based on a inclusive collection and analysis of information and a search for the best alternatives to achieve the goals set out, based on for example a cost-benefit analysis. It proposes a model of rational and evidence based policymaking that is based on democratic representation and neutral public administration. Contrasting to this, the policy cycle perspective considers political process continuous and accumulative and therefore less linear. The model also suggest that administrations and policy makers take results into consideration; outputs of earlier process will inform new decisions, emphasizing feed-back loops (ibid.).

Agenda setting: problem recognition and issue selection

In order for an issue to be introduced into policymaking processes, there has to be recognition of the social problem at hand and an idea that public intervention is necessary to solve it (Jann and Wegrich in Fischer et al 2007). After such recognition, the issue can be put on the agenda for policy consideration. This “agenda” can be defined simply as the list of problems that policy officials are paying serious attention at a given time (c.f. Kingdon 1995 in Jann and Wegrich in Fischer et al 2007). It exists in a governmental policy making unit and is separate from media agendas or other public agenda. Societal actors (inside and outside government) continuously seek to influence the agenda, for example by involving specific actors (e.g. experts) using media coverage or choosing institutional venues for debates. Studies of environmental policy development have shown that providing a clear definition of a problem are more important variables to effective agenda-setting processes than the magnitude of the actual environmental problem (Fischer, 2007).

The variables of agenda setting (actors, institutions, ideas and material condition) varies between specific situations, illustrating how agenda setting is far from the rational process illustrated in the ideal type illustration. Kingdon’s multiple streams model proposes an explanation to how issues make it onto the agenda. It suggests that a policy window opens up when the policy stream (solutions) the politics stream (public opinion, change in government) and the problem stream (problem understanding) intersect (Jann and Wegrich in Fischer et al 2007). The attention given to a specific policy issue varies with external triggers, such as accidents or disasters, which is not least true for environmental policy issues (Fischer, Frank, Miller, Gerald J., Sidney, 2007).

Policy formulation and decision-making

Here, the defined problems are transformed into governmental programs, including a definition of the objectives and the possible action alternatives. Since policies are not always formalized in decisions, it is difficult to draw a clear line between formulation and decision-making; rather, they can be seen as two sub stages. The policy formulation literature has focused on the relationships between different actors, including a wider range of actors over the years. For example, in contrast to the early rational information gathering and processing perspective, later studies have focused on public policy as a conflict resolution mechanism

between public and private actors and departments. As such, it has focused on less formal processes of negotiation and formation with political actors and interest groups as the main contributing actors. This perspective regards policy decision making rather as a process of negotiating between the stakeholders involved.

Constellations of stakeholders are often referred to as policy networks. The power relationship within, and the ease of access to, these policy networks differ between pluralistic approaches (many actors, no privileged access) and corporatist approach (few privileged actors with strong influence). Getting access to policy networks is regarded more conflictual than the relationships within the networks, typically considered non-hierarchical and horizontal. Governments can also play an important role in initiating policy networks by creating or abolishing different ministries (e.g. VINNOVA). It is possible to differentiate between two main types of policy networks; policy communities, iron triangles and sub governments on one hand, where the organization is more firmly connected to government bodies (iron triangles) or where the group is characterized by a relatively coherent worldview (issue networks) - and issue networks on the other hand, that focus on specific policy issues. Whether or not and in which form the policy will eventually be adopted finally depends on a number of factors, such as economic resources and political support for the solution, and the competencies of different actors to make decisions. Think tanks and large organizations (outside the traditional bureaucracy) play an increasingly important role in communicating knowledge, Here the policy making literature has drawn many insights from the organizational literature in studying how policies are transferred between, or lessons are learned amongst organizations (Fischer, Frank, Miller, Gerald J., Sidney, 2007).

Implementation

The analysis of implementation focuses on the different aspects that lead to that the policy-makers' objectives differ from what is actually carried out in a program, or alternatively, what makes the transfer from objectives to action successful. Many implementation failures can be related to intra and inter-organizational coordination problems and interaction between agencies and target groups. The first generation of implementation studies focused on top-town governance focus, oriented towards an analysis of what policy instruments was best fit for what purpose. Later, a second generation of implementation studies had more of a bottom up approach, dealing with the central role of personnel at government agencies in actually shaping the policy (Fischer, Frank, Miller, Gerald J., Sidney, 2007).

3.5 Conclusion and analytical frameworks

We can conclude that both the EPI approach and the ecological modernization literature seek to reconcile the seemingly contradictory objectives of economic growth and environmental stewardship. While the ecological modernization literature suggests that the development of products and services can be redirected towards less resource extraction and energy use, the EPI approach proposes that environmental considerations should be included in all policy sectors as a way to achieve this redirection towards sustainable development. The transition management and sustainable innovations approaches aim to describe how larger policy frameworks that promote the transition to a sustainable society may be designed, wherein environmental policy integration plays an important part.

Sustainability interpretation framework

The environmental policy integration literature suggests that varying interpretations of sustainable development can provide an explanation to the implementation of sustainability principles in sectorial policies. Susan Baker's framework is used to categorize the interpretations of sustainability that are found in the analyzed innovation strategies, in order to

determine their normative understanding of sustainability and to compare these interpretations with the operationalization of sustainability in the policies. Baker's framework is described in section 3.3.1 above and is depicted in Appendix four.

Sustainability operationalization framework

Drawing heavily on the guiding principles for sustainable innovation policy processes (Foxon & Pearson, 2008) which correspond well to the transition management approach, a framework for analysis of *how sustainable innovation strategies and policies operationalize sustainability principles* has been developed (figure 3). The framework clarifies how the sustainable innovation criteria correspond to different points of intervention in the policy cycle. By applying the framework to the qualitative analysis of the innovation strategies, we can determine to what extent these constitute sustainable innovation strategies. The environmental policy integration literature has identified common barriers in operationalization process of sustainability integration, which can be compared to the findings from the analysis. This analysis seeks to provide an answer to the first research question; whether sustainability principles are integrated with, and operationalized by, innovation policies.

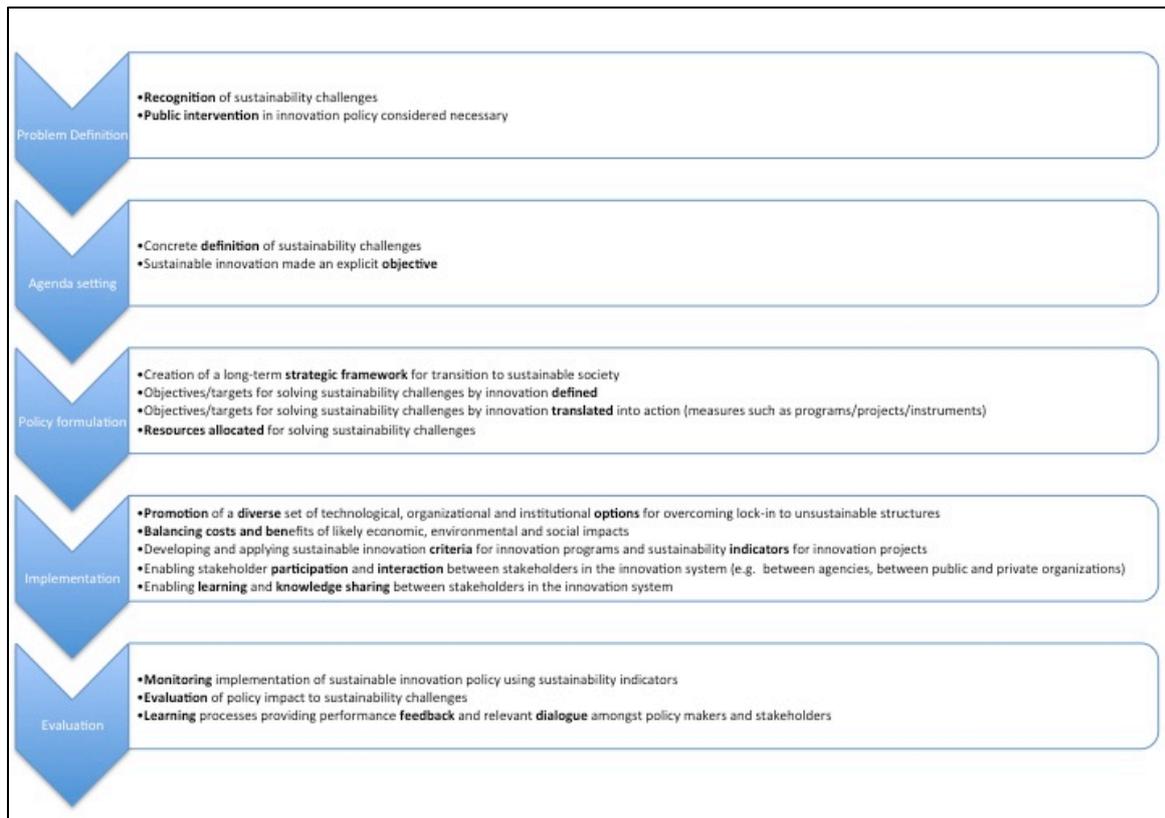


Figure 3. Operationalization framework for sustainable innovation strategies.

4 Findings

4.1 National level

This section presents the findings of sustainability interpretation and operationalization in the key document at national level; the Swedish national innovation strategy. The qualitative and quantitative text analysis of the national innovation strategy is supplemented with findings from interviews with national level actors whose activities relate to healthcare and innovation.

4.1.1 The Swedish National Innovation Strategy

Following a dialogue with a range of actors, including industry and civil society actors, most Swedish regions and governmental departments (Regeringskansliet) (VINNOVA 2013), the Swedish national innovation strategy (SNIS) was launched in October 2012 by the ministry of enterprise, energy and communications (MEEC). The strategy intends to provide a long-term vision on how to strengthen the Swedish innovation capacity until the year 2020 (SNIS, 2012:5). The 62-page document initially received criticism for being too vague, lacking measurable goals (IVA 2013a, Swedish parliament 2012) and not including sufficient policy measures (Swedish Association of Graduate Engineers, 2014). The MEEC responded that the SNIS does not intend to set specific targets and guidelines for innovation and that the government's role is rather to stimulate innovation by developing good regulation for e.g. taxes and capital provision (IVA 2013b¹). Following this criticism, two public agencies were assigned to develop tools for evaluations. These included a set of indicators (Swedish Agency for Growth Policy Analysis, hereinafter SAGPA, 2013:14) and a strategy for evaluation (VINNOVA 2013). The content of these tools is discussed further below.

The SNIS's seven chapters present an overview of the current discourse in the Swedish government's innovation policies. Following the *raison d'être* of a national innovation strategy (chapter 1) and the definition of concepts and understanding of innovation strategies (chapter 2), the "vision for increased innovation in Sweden until 2020" is presented (chapter 3, own translation). The following chapters elaborate on Sweden's current position in the global market (4) and highlights the importance of a shared responsibility between the multitude of actors involved in the innovation system (5) at different levels (SNIS 2012:19). Chapter six (6) provides a list of six targets, constituting the ingredients of a "world-class innovation climate by 2020" (SNIS, p. 22). The targets are broken down into 17 intermediate targets and 72 action points, however no concrete policy measures are attached and no defined target audience is indicated. Chapter seven (7) highlights the importance of collaboration, dialogue and continuous learning and evaluation in the work of strengthening the national innovation capacity. The national innovation strategy (SNIS) has been analyzed both quantitatively and qualitatively.

Interpretation of Sustainability

In order to evaluate the interpretation of sustainability suggested in the strategy, the SNIS was read and analyzed qualitatively several times. The *motives* and *vision* of the SNIS (found in chapter one and three) constitute the two most important sections for this analysis. Chapter one (pages 5-7) clarifies that the fundamental objective of the SNIS is to strengthen the innovation capacity. Seven so called 'societal challenge's (derived from the Europe 2020 strategy and the Horizon 2020 program, the EU's growth and research strategies respectively), present the drivers behind the need to strengthen national innovation capacity. Four of the challenges are considered primarily environmental and three primarily social (see figure 3) and the chapter highlight the importance of coordination between different actors to meet the complex challenges (SNIS 2012:5)

Societal challenges in the SNIS:	
•	Health, demographic changes and wellbeing (<i>social</i>).
•	Challenges for a European bio-economy: food security, sustainable agriculture and forestry, marine, naval and water research (<i>environmental</i>).
•	Safe, clean and efficient energy (<i>environmental</i>).
•	Smart, green and integrated transports (<i>environmental</i>).
•	Climate measures, resource efficiency and raw materials (<i>environmental</i>).
•	Europe in a changing world: inclusive, innovative and reflecting societies (<i>social</i>).
•	Safe societies: protecting Europe’s freedom, security and citizens (<i>social</i>).

Figure 4. Societal challenges defined in the Swedish national innovation strategy.

Page 6-7 of the SNIS explain the motives in more detail, see table X for an analysis of the identified motives. The first motive, “meeting global challenges”, is considered primarily *environmental* these are in majority among the identified drivers (figure 4). It is illustrated by traditional environmental symbols (a globe, trees and clouds) and the position of the image possibly signals a higher-level priority. The second motive “creating competitiveness and jobs in a global knowledge economy” is considered primarily *economic* and the third motive “delivering societal services with increased quality and effectiveness” is considered primarily *social*. Human characters illustrate both these motives. The illustration connects all three motives, signaling their interconnected relationship. While the order of presentation suggests a priority to the environmental motive, the space and centrality granted to each motive show a slightly different picture. The environmental motive is given the least space (60 words including headline) and the social motive the most space (154 words including headline). The analysis also considered the centrality of social, economic and environmental arguments among the motives. Out of the total nine identified arguments, economic arguments (5) were the most and environmental arguments (1) the least central.

Motive	Primary orientation	Space	Centrality
1. Meeting global challenges	Environmental	60	1
2. Generating competitiveness and employment in a global knowledge economy	Economic	101	5
3. Delivering societal services with quality and efficiency	Social	154	3

Table 3 – Sustainability motives in the Swedish national innovation strategy.

Chapter three, the “vision for increased innovation capacity in Sweden year 2020”, presents the objectives of the SNIS. Here, there is a relatively balanced division of objectives, divided as two environmental, two economic and three socially motivated objectives. The vision does not provide any clear definition to sustainability or what it means that people in Sweden create “value for the people, the economy and the environment”.

The interpretation of sustainability in the SNIS is considered a “weak sustainability” in Baker’s framework, according to the qualitative text analysis. However, the picture is quite fragmented (ranging from pollution control to strong sustainable development), indicating that the

framework and its ideal type classification may be to simplistic. The ‘societal challenges’ suggest that sustainability function as a driver to innovation, but the main focus of the SNIS is economic growth and international competitiveness. The commitment to sustainability is rather declaratory than integrated: it serves as a driver to innovations, but not clearly defined as the objective of innovation policy (growth and competitiveness remains primary objective). The SNIS has a fairly strong focus on collaboration amongst stakeholders and has been developed in dialogue between them.

Integration of Sustainability

The quantitative content analysis included 98 different key words, divided into seven categories. These were then weighted/analyzed based on their frequency in total and within each category (see appendix 5).

National level, word categories	Number	Share
TOTAL	1487	100%
Innovation system	585	39%
Economic	466	31%
Social	203	14%
Sustainability	100	7%
Environmental	81	5%
Participatory	45	3%
Health	7	0%

Table 4 –Swedish national innovation strategy, content analysis.

The emphasis primarily lies on the economic category (39%), where *enterprise* (225) and *growth* (58) are emphasized, as well as in the innovation system category, where the most central aspects were *public sector* (83) *global* (71) and *international* (72). In the less frequent social category, there was a strong focus on *knowledge* (105), and little mentioning of tolerance (0), equality or gender equality (2) and employment (13). In the environmental and sustainability categories, generic words such as *challenge* (46), *environment* (32) and *sustainable* (30) were the most frequently used. Notable is the very low frequency of specific environmental words such as eutrophication (0), waste (3), carbon dioxide (1) are very rare and commonly found words, such as energy (9), green (6) or cleantech (1) (see appendix also have a low frequency (see Appendix 5).

Operationalization of Sustainability

Most targets and intermediate targets set out in the strategy relate to processes of building innovation capacity in general; two out of the seventeen intermediate targets relate specifically to the societal challenges. The first intermediate target relating to societal challenges is to “*use the potential in social innovation and social entrepreneurship to contribute to meet societal challenges*” (SNIS 2012:40, own translation, italics added). This ‘social innovation target’ considers among other things the needs of the global bottom of the pyramid, put directly into relation to the purchasing power of this consumer segment. Further, social innovation is considered especially interesting in “meeting environmental or societal needs”, not least in relation to markets that are taking over services that have previously been performed by the public sector. The action points relate primarily to the need to increase knowledge about social innovation and business models that are suitable for societal challenges and bottom of the pyramid markets, as well as having a diversity of actors performing societal services (SNIS 2012:40-41, own translation).

The second intermediate target relating to societal challenges is that the “*public sector contributes to developing innovative solutions to meet societal challenges*” (SNIS 2014:44, own translation, italics added), highlighting the challenges presented by limited natural resources. The Swedish public sector’s strengths in social models (e.g. in childcare and safety) and its ambitious work in environmental area are considered unique opportunities for the international market. The action points propose that the Swedish public sector should engage in innovations processes such as innovation procurement to meet societal challenges, to continue developing innovation in international development policies, identify the national environmental targets where environmental innovations are especially important and develop the international collaborations around environmental innovations.

As previously mentioned, the SNIS was criticized for being difficult to operationalize as it did not include concrete targets, not specifying relevant actors in the innovation system that should assume responsibility for the fulfillment of the targets, or provide measurable indicators to evaluate target fulfillment. To further understand how the sustainability dimensions of the SNIS are operationalized, the evaluation tools that have (so far) been developed are included in the analysis. Two agencies, VINNOVA and the Swedish Agency for Growth Policy Analysis (SAGPA), were assigned the task of developing evaluation tools for the SNIS². To this date, VINNOVA has reported on different agencies’ activities that feed into the SNIS targets and SAGPA has suggested a set of 29 indicators to measure the progress on the targets³. SAGPA has suggested that that a prioritization among the different indicators should be made⁴. This section provides findings from these evaluation documents, as they suggest the actual operationalization of the SNIS.

In VINNOVA’s report, the agency underlines the complexity of evaluating a strategy with abstract targets and an undefined large number of stakeholders: “Considering the level of abstraction of the intermediate targets, an in-depth assessment of the future target fulfillment is not possible” (VINNOVA 2013, p. 13). Suggestions for such a target evaluation is considered better addressed by the SAERG indicators and VINNOVA considers its task to be following and reporting the development of activities until 2020. The 2013 VINNOVA follow-up report thus describes which activities have been started as a result of the SNIS and which previously started activities that have been strengthened by the SNIS.

Both activities that directly relate to the SNIS and activities that support the SNIS are included in the report. A total of 25 programs have been started within SNIS activities, whereof 11 stem directly from the SNIS. Although the report maps out a range of potential actors on different levels, including the regional level, it only covers the activities of four governmental agencies (VINNOVA, SEA, SAERG and PRV) and two governmental companies (RISE and ALMI). The regional administration is not listed in among the relevant stakeholder organizations for environmental policies. VINNOVA further comments on how societal challenges have influenced the six organizations’ strategies. This impact of societal challenges is diverse, ranging from core mission’ (SEA), ‘societal challenges’ being an integrated approach (VINNOVA) and the development of both innovation and sustainability strategies (ALMI) to no specific mentioning of societal challenges (PRV) and unclear definitions of “sustainable growth” as a development area (SAERG) (VINNOVA 2013, p. 15-17). VINNOVA’s report also explains that the motive of meeting global societal challenges has developed into a “central strategic point of departure for several agencies and regions” and that “the goal is to combine societal good with business to thereby strengthen the competitiveness” (VINNOVA 2013, p. 3, own translation).

SAGPA proposed a set of 29 indicators to evaluate the 17 intermediate targets of the SNIS. Out of the two intermediate targets that relate to how innovations can be used to meet

societal challenges, only one is attached with an indicator. For the goal “*use the potential in social innovation and social entrepreneurship to contribute to meet societal challenges*” (italics added), SAGPA finds that there is no clear definition of social innovations and that there is a lack of data in the area. SAGPA further suggests that there is a discrepancy between the intention of the strategy and the actions that so far have been taken to strengthen social innovation. The report does not suggest any indicator for this intermediate target, but calls for further clarifications about social innovation (SAGPA 2013:14, p. 49-50)

SAGPA further suggests that the goal “*public sector contributes to developing innovative solutions to meet societal challenges*” (italics added) can be measured using the KKV report about public procurement as a progress indicator. While this indicator corresponds to one of four action points under this intermediate target, concerning innovation procurement (PPI), it does not contain any data on innovation procurement or innovative elements in procurement. The indicator contains data on whether price, or a combination of price and quality, has been applied as determining criteria in public procurement processes. While SAGPA justifies this indicator with the argument that procurement selection criteria based only on cost is directly negatively related to procuring innovatively, there is no clarification on whether procuring for quality is positively correlated with procuring innovatively. It is thus unsure whether such an indicator would actually reflect PPI, and whether this practice has enabled meeting societal challenges. The difficulties in measuring PPI are further discussed in the report. These difficulties are based on different legislation applicable to different types of PPI and the divergent understanding of PPI among procurers/respondents in previous studies (SAGPA 2013:14, p. 54-56).

A potential supplement to this may be the indicator suggested for the intermediate target *public sector works systematically with innovation to increase efficiency and quality* (italics added). This is measured using the SCB Measuring public innovation study (MEPIN) and data from the Innovation Council survey of quality and organizational development in government authorities. The latter indicator does not reflect private firms’ or local authorities’ performance (e.g. hospitals) and does not measure efficiency. There is no reference to whether and how this indicator could be used to evaluate the contribution to meeting societal challenges (SAGPA 2013:14, p. 52-53).

However, the SNIS presents provides no concrete objectives for, or measures to use innovation to meet sustainability challenges. Instead, the operationalization is performed by the agencies. This is in line with the generally decentralized character and shared responsibility of Swedish policies that also was highlighted in the EPI literature. However, not having defined any objectives or targets for sustainable innovations is a potential weakness of the SNIS. Leaving the operationalization to the agencies limits the influence of the innovation policy and allows a lot of space for interpretation among different agencies on how to work with innovation to meet societal challenges. The EPI literature suggests that a lack of specific definitions, targets and clear follow-up mechanisms leaves the NSIS at risk of being watered down in sectoral innovation policies.

4.1.2 Interview findings: barriers to sustainable healthcare innovation

Interviews were carried out with stakeholders that interact with innovation in healthcare at a national level, with the purpose of determining the barriers that exist for healthcare innovation at the national level.

The Swedish Competition agency (SCA)

The Swedish competition agency (SCA) has recently taken over the national responsibility for procurement support⁷, sustainable procurement support⁸ and innovation procurement support⁹. It is within these support functions that the healthcare sector has primarily engaged in PPI projects and other innovation related projects and the SCA is currently formulating future projects in this area (Personal communication, SCA 2014) . Many projects where the SCA is involved concern processes of innovation procurement and focused on enabling and empowering public agencies to engage in PPI. Examples include an innovation procurement in the Stockholm region (Innovationsupphandling stockholmsregionen, IUSR), project with Karolinska hospital and Stockholm city, mapping out how to work with PPI, process-oriented), the Innovative Nordic Healthcare Procurement project, (INHP, run by the Nordic council of Ministers, process-oriented) and a biopolymer project seeking to create working market conditions for biopolymers leading up to a procurement guideline. At least two regions are currently in the process of applying these guidelines (as a material for healthcare single use plastic products, product-oriented). SCA identifies knowledge and resources as two of the barriers for PPI deployment in regions; the regional organizations are not constructed for these time-consuming and demanding procurement processes where a lot of preparatory work is required. Extensive human and monetary resources are required to carry out PPI's and the individual region usually does not have these resources at hand. Success factors identified in the biopolymer project¹⁰ included the presence of an external managing agent (SEMC), and the provision of external funds (project financed by the SEA). While the SCA has contact with some regional innovation departments, there is currently no regional network for innovation procurement support (Personal communication, SCA 2014).

SCA further explains that the current focus of PPI activities is to make organizations aware about PPI in the first place. The projects are currently oriented towards identifying support needs as a first step. She argues that sustainability aspects constitute the driving force for some people working with innovations, but that it is not are not the general driving force for PPI. SCA considers a wider range of perspectives on procurement drivers (e.g. promoting small and medium sized enterprises, enabling supplier-procurer dialogue). While promoting sustainability is often the ambition, it is unclear how this is measured and PPI is not necessarily framed as sustainable even if it has positive impacts (Personal communication, SCA 2014).

Environmental Managers of the County Councils

The network of environmental managers in Swedish county councils, (Environmental managers of the County Councils, hereinafter EMCC) was started in 2005 with the objective to share knowledge and experiences and discuss important environmental issues, both internally and with external public authorities (SALAR, 2014).

The present chairperson of the EMCC, states that “in our region, and probably many other regions, we have a (healthcare) organization for innovation, (...) it is more about catching up good ideas and solutions in healthcare (...) does not have to be environmentally related, we don't have any specific collaboration there so that they are environmentally oriented, that is something I feel we could develop” (Personal Communication, EMCC, 2014). EMCC also explains that environmental aspects have not been a target in the innovations generated at

⁷ From 2014-03-01, previously KK.

⁸ From 2014-07-01, previously SEMC.

⁹ From 2014-01-01, previously SEMC.

¹⁰ Environmental and procurement representatives from several regions collaborated in the project.

regional level “There has not been that many environmental innovations, and I do not think that that is the primary focus, but (rather) to reduce time, (improve) the working environment (...) there is probably more to do to get environmental aspects in there, but this is not the main focus (...) We could have more collaborations in this area, we will probably see a development here (...) and it is an important area to work more with, also for LMC I think.” (Personal communication, EMCC 2014).

EMCC identifies time consumption and the difficulty of prioritizing as two main barriers to PPI. PPI should be prioritized to areas that are considered relevant by the operating staff and today, regions are “glad to be able to set environmental criteria in procurement in the first place.” (Personal communication, EMCC 2014). EMCC further argues that environmental objectives are not a primary motive for employee innovations, the typical motives is rather to reduce time consumption, physical effort (OHS aspects), avoiding injuries and risks. Another possibility is that employees think that the environmental department should handle environmental aspects.

Med tech & life science industry

Swedish Medtech (SMT) is an interest organization for the medical technology companies. Part of their activities is also running a series of interest groups, on topics such as innovation and growth, regulatory affairs and procurement and growth. Its environmental affairs working group is assigned to identify, follow and evaluate existing and new environmental legislation. They also aim to assist the member companies to develop their environmental management and work. (Swedish Medtech, 2014). SMT identifies some concerning tendencies in public procurement practices “...one part is the extensive focus on price” (SMT, 2014). He explains that while innovations may be initially more expensive, they may make good sense looking at the totality of care processes and health economic factors¹¹. However, hospitals often focus primarily on the purchasing price, forgetting possible health economic or efficiency gains. Except for a few examples representing a very small part of the volume procured, these health economic aspects have been lacking from the public procurement processes. SMT also argues that wholesale procurement “is a big problem when looking at innovation, high quality products, and products that are more environmentally friendly (...), developing a new technology or manufacturing process (is often involved) if you are going to substitute materials to something (...) less harmful (...) and it is often not possible to choose these products, even if the healthcare sector perhaps wishes that they should be free from PVC or BPA or something else. Here, the wholesale procurement is a big problem I’d say.” (SMT, 2014). The CEO of the life science cluster Medeon¹², argues that while environmental certification has been sought by companies of a certain size, sustainability aspects has not yet made it into the product development/design phase (e.g. eco-design) among life science companies: “I don’t think that the competency is there (...) yet, but we are seeing a development.” (Medeon, 2014). Functionality is the important thing for companies, and it is not certain whether the demand side has been looking for environmental performance beyond certifications and policies. “In test bed organizations and procurement organizations of med tech, bio tech and pharmaceutical products, there is a certain level, but it is limited to environmental certification and it is less sure how these certifications relate to the products that are purchased.” (Medeon, 2014)

¹¹ I.e. evaluating the products total effect on patients or disease treatment, e.g. .g. reduced days of sick leave, quicker return to working life.

¹² Including pharmaceuticals, med tech, bio tech and healthcare companies.

He is also cautious about the idea of using sustainability aspects as selection criteria for innovations: “(It is) risky. The more detailed selection criteria, the more you frame the context and it requires a great deal of competency from the ones evaluating the projects. And that competency may not always be there. Then you end up using the criteria to filter out a number, rather than to filter out a number of poor quality innovations. If you tick the wrong boxes you may be out of the process, although you may have a genius product. The entrepreneurs can’t always express the business plan in a conventional way.” (Medeon, 2014).

4.2 Regional level: Quantitative analysis

This section presents the findings from a quantitative content analysis of the *fourteen* existing regional innovation strategies (RIS). To supplement these findings, a survey was sent out to key respondents working with regional innovation in *all* twenty regions. The purpose of the survey is to map out how and to what extent the regions actually work with sustainability in their innovation related activities and to determine these respondents’ perception of sustainable development. This is done in order to capture practical aspects and perspectives from the regions, supplementing the crude quantitative content analysis.

4.2.1 Quantitative Content Analysis

Of the fourteen analyzed RIS’s, three were in their draft version, These have also been included in the analysis as they are expected to be adopted within the near future and, more importantly, they provide a similar approximation of the regional innovation discourses as the adopted innovation strategies. See appendix 1 for a table of the innovation strategies. The six remaining regions have regional innovation strategies integrated with a regional development plan or strategy (RUP or RUS) (Swedish Government, 2014). These strategies are not included in the quantitative content analysis for reasons of comparability. The exception to this is the regional development plan of the Västra Götaland Region, as it is one of the case study regions, a comparison with the qualitative analysis (section 5.3) was considered important. As in the quantitative content analysis of the SNIS, 98 key words in seven categories were included in the analysis. Each word was added to a total regional sum, which was then analyzed, based on frequency, in total and within each category (see appendix 5).

As in the national innovation strategy, there is a heavy (high) emphasis on the ‘innovation system’ category, pointing out the innovation system’s various actors (39,4% of analyzed words, most frequent words are mentioned 0,5-1 times/page). The ‘economic’ words constitute the other primary category (27,6% of analyzed words). Here, there is a primary orientation to *growth*, *competitiveness*, *business* and *industry* (on average mentioned 0,5-2,8 times/page). The ‘social’ and ‘sustainability’ categories constitute secondary categories. In the social category, the key focus is on the education systems’ social inputs, highlighting *knowledge* and *education*. Less frequent, but still significantly important areas include job creation, diversity, gender equality, integration and health. The sustainability category includes a handful of very frequently used concepts, such as *sustainable*, *challenge* and *2020*. The environmental category constitutes about 5% of the analyzed words, most frequently mentioning generic words such as *energy*, *transports* and *environment* (on average mentioned 0.2-0,3 times/page). More specific words such as *climate*, *renewable* and *resource* are less frequent and very specific words such as *organic*, *clean tech*, *carbon dioxide* are very rare if present at all. The participatory category, closely related to innovation system category has four percent of the words and the health category about 2 percent.

Regional level, word categories	Number	Share
TOTAL	5978	100%
Economic	1647	28%

Social	694	12%
Environmental	322	5%
Sustainability	609	10%
Health	126	2%
Participatory	226	4%
Innovation system	2354	39%

Table 5 – Swedish regional national innovation strategies, content analysis.

4.2.2 Survey results

A survey was sent out to all twenty (20) regions, whereof eleven (11) participated in the survey (see Appendix 1 for the survey questions and a list of regions). The relatively low response frequency of 55% is considered acceptable, but constitutes a limitation to the validity of the results (Esaiasson, 2005). Seven of the respondents represent region associations¹³, two represent regions, one presents a county administrative board and one present an innovation association. Six of the respondents have regional innovation strategies and five have the regional innovation strategy integrated with the RUP/RUS document. When asked to reference what constitutes the central document regional innovation document, four regions (36%) indicate the RIS, six regions (55%) indicate a combination of RIS and RUS/RUP and one region indicates a combination of both these regional documents and the national innovation strategy¹⁴. The respondents were initially asked an open-ended question on what is the most important overall targets of the regional innovation strategy. Here, three regions (27%) indicate concrete sustainability related targets. Most stated targets generally relate to increasing the capacity of the innovation system by improved processes etc. The respondents were also given a closing general question concerning their general perception of innovations' potential contribution to a transition to a sustainable society. Four different levels of impact to sustainability were suggested and ten regions (91%) indicated the highest level, that innovations could contribute to transformative/factor 5 improvements.

Targets and impact

Ten regions (91%) could indicate regional sustainability policies external to the own organization that affect the regional innovation activities. Five regions (45%) indicated regional sustainability policies and five (45%) regions indicated regional and national sustainability policies. Seven regions (64%) indicate that positive (or reduced negative) environmental impact is a defined objective for the innovation activities. Examples include having defined programs, making growth sustainable generally and definition of concrete targets (on energy and fossil fuels). Eight regions (73%) indicate that positive (or reduced negative) social impact is a defined objective for the innovation activities. Examples include enabling the individual's self-realization, possibility to be creative and entrepreneurial, sustainable living environments, higher share gainfully employed than the national average, gender equality and integration. Five regions (45%) also consider sustainability aspects to be an underlying objective to the regional innovation activities. When asked to rank the different sustainability aspect's (economic, environmental, social) importance to the regional innovation activities, nine regions (82%) indicate that they are equally important and two regions (18%)

¹³ Swedish: regionförbund

¹⁴ Interestingly, two regions that do not have a formalized RIS have indicated that this is one of the central documents. As one of these regions has indicated only the RIS, the reason should be a terminological misunderstanding.

rank economic sustainability the highest (differing order between first and second place). Ten regions (91%) indicate that sustainability aspects are reflected in actually implemented innovation activities. Implementation is e.g. done via selection criteria for innovation projects and programs (five regions) and in workshops (two regions).

Ten regions (91%) also collaborate with the regional environmental administration. Where other regional administrations perform innovation related activities, the respondents have collaborated in these projects. Five regions indicate that environmental department leads these innovation projects, four indicate procurement and one indicates a range of ways (cluster, parks, universities, clusters – should apply to most of the regions?). Eight regions (73%) indicate that there are innovation projects in the healthcare sector. The healthcare innovation projects are thought to consider all sustainability aspects in four regions, social and economic aspects in two regions and only environmental aspects in two regions (sic!).

In conclusion, regional innovation strategies (RIS) focus primarily (much like the SNIS) on developing a well-functioning (regional) innovation systems; building capacity, generating knowledge (generally in universities and specialized in clusters), enabling cross-disciplinary collaborations, leading in to capital access making the region an attractive place to live and increasing its competitiveness. Compared to the SNIS, the RIS generally make a more well defined connection between the innovation policy, the promotion of sustainable development and regional development. Specific sustainability challenges are more clearly defined. The RIS use more concrete words to describe the sustainability challenges (as seen in the content analysis) and the innovation administration (survey respondents) exemplify with objectives such as fossil free region, energy efficiency etc. The respondents (survey) see a strong connection between the RIS and regional sustainability policies, RUS or RUP.

All regions (100%) claim that sustainability aspects (including economic aspects) have an impact on the actual innovation projects. Selection criteria and educational measures are the most common examples. Most regions respond that sustainability aspects are integrated in the regional innovation work. Similar to the SNIS, sustainability functions mostly as a driver for innovation, the primary objective is still economic growth. However, 67% of the regions respond that reduced environmental and social impacts is a defined objective and 30-40% have clearly defined targets for reduced environmental and social impacts. All (100%) respondents claim that the innovation administration collaborates with the regional environmental administration, indicating that cross-department collaboration is taking place, at least to some extent. Innovation projects are carried out by participants from other regional administrations, such as the environmental, procurement (and others) and the innovation administration is said to collaborate with these projects.

From the case studies, the results however point to a lower level of collaboration between innovation and environmental administrations. The environmental departments work with their own innovation projects, and do not use the regional innovation policies specifically. For the healthcare sector, innovation projects led by the environmental department are typically carried out in collaboration with the procurement department and the hospital's wards.

4.3 Regional level: Qualitative analysis of case regions

This section provides the findings from the two case studies: the regions Skåne and Västra Götaland. First, the regional innovation strategies are analyzed, using the analytical frameworks introduced in section 3.5. Mirroring the general heterogeneity of regional innovation strategies, these regions' innovation strategies differ quite substantially from each other. Region Skåne's 'international innovation strategy' was developed in 2011 by a innovation-specific regional organization for the period 2012-2020. A regional committee for

sustainable development developed Västra Götaland's innovation strategy 'VG 2020'. Covering the period 2014-2020 is integrated with the regional development plan (RUP). Interviews with regional actors were also carried out to supplement the qualitative text analysis. The interviews are concentrated on the innovation projects in the healthcare sector.

4.3.1 Västra Götaland

The Västra Götaland region (VGR) is the largest region in Sweden in terms of personnel, employing about 50 000 people (VGR, 2014a). The region has about 1,6 million inhabitants and large clusters within e.g. clean tech and chemistry. VGR is one of the larger municipalities organized as a region. The largest part (90%) of the region's operations is healthcare, but it is also responsible for regional growth promotion and the cultural sector, as well as regional projects relating to sustainable development. The regional development strategy (RUS) 'Vision Västra Götaland' and the development plan (RUP) "Västra Götaland 2020" are the main steering documents for the regional development, the environmental work (VGR 2014e) and innovation activities in VGR. The region has a coordinating role for sustainable growth and development and sustainable development is set as the frame for all development work.

The region has developed an ambitious and detailed environmental program, with the objective of a fossil free energy supply to the region's operations by 2020, increased energy efficiency, sustainable resource use along the lines of the waste hierarchy, 50% organic food purchase and lowering the use of pharmaceuticals, hazardous chemicals and nitrous oxide. The objectives are operationalized by a multitude of projects, such as large scale investments in solar energy in own property, purchasing locally produced food (e.g. meat produced at the region's agricultural schools), implementing a re-use project for furniture and using procurement contractual mechanisms to phase out fossil fuels in goods transports by 2020. A lot of work has been done in waste reduction at healthcare level (VGR, 2014b) and the region is currently looking into healthcare-specific strategies for chemical reduction (e.g. 'the toxic free waiting room') (VGR 1, 2014).

Innovation policy

The regional innovation document of Västra Götalandsregionen (VGR) is the regional development plan (RUP) "*Västra Götaland 2020 – strategy for growth and development in Västra Götaland 2014-2020*" (hereinafter 'VG2020', own translation, italics added). VG2020, adopted in 2013, was developed to operationalize the vision set out by the regional development strategy (RUS) "*Vision Västra Götaland – The good life*" (own translation, italics added) in 2005 (RUP p. 4). The document was developed in collaboration among a large number of stakeholders in VGR, in a process that took over two years and was led by 'Beredningen för hållbar utveckling' (BHU).

Interpretation of sustainability in innovation policy

The regional definition of sustainable development is found in the underlying RUS document (which VG 2020 sets out to operationalize): "*A sustainable society shall meet the needs of today without putting the needs of future generation at risk. Sustainable development includes three dimensions – economic, social and environmental. These are mutually dependent and shall interact and reinforce each other. Present and future generation shall be guaranteed sound economic social and environmental conditions. This means that all decisions shall be designed in a way that takes economic, social and environmental consequences in a longer perspective into consideration*" (VGR, 2005 p. 6, italics added). Further, the RUS explains that all three dimensions are fundamental and that the majority of the variables should be heading in the right direction for a development to be considered sustainable. An absolute reading of this is that at least two out of three dimensions should be fulfilled, a less stringent understanding is that positive development for only one variable is acceptable as long as there

is comparatively no negative impact on the other variables. Here, the RUS also provides examples of the content of each sustainability dimension. Interestingly, innovation is considered a part of the economic dimension. Another interpretation of sustainable development is found under the region’s environmental department webpage, referencing the Brundtland commission’s definition of sustainable development. Here, it is instead clearly defined that sustainable development does not grant greater value to any of its three dimensions and that “all three dimensions have to be considered and integrated into each strategic decision.” (VGR 2014c).

Integration of sustainability in innovation policy

Within the VG 2020 document, sustainable development arguments are put forth without internal ranking of the dimensions in the introductory sections (p. 3-8, foreword, point of departure, drivers). While regional competitiveness (an economic dimension) is the typical first argument of each section (e.g. connectedness, the importance of clusters, raising global attractiveness, research and education), this is continuously connected with social and environmental dimensions. The importance to continuously integrate sustainability dimensions is highlighted and specific implementation measures (e.g. management support, educative measures, development of tools for integration) are indicated for gender equality and climate adjustment related targets (VGR 2013, p.12). Since different sustainability arguments are continuously interlinked, an analysis of the space granted to different arguments was not possible. However, an analysis of the centrality of different sustainability arguments was possible. Table six (below) provides an overview over the different arguments as presented in the VG2020. The social arguments dominate the document in total, however there is a continuous integration of all three sustainability aspects in the different chapters.

Chapter	Economic	Social	Environmental
1. Introduction	2	7	3
2. Vision	4	4	2
3. Drivers	3	4	4
4. Direction	3	4	3
5. A leading knowledge region	9,5	6,5	1,5
6. A region for everyone	8	16	7
7. A region that takes global responsibility	4	2	9
8. A region that is seen and engages	6	8	2
TOTAL	39,5	51,5	31,5

Table 6 – Sustainability motives, VG2020.

Operationalization of sustainability in innovation policy

The RUS provides a clear definition of sustainable development, emphasizing that sustainability challenges of all three dimensions constitute the larger framework for all regional development activities and that the region has an important role to play in meeting sustainable

challenges. However, while societal challenges are exemplified in both documents, a clear definition of sustainable development is missing from the VG2020 document. How innovation should be used to meet sustainability challenges is not explicitly explained, but it is mentioned that the societal challenges should be in the center of innovation activities (p. 16), new infrastructure solutions (p. 22f.) and innovation procurement (p. 16, 24-27). The VG2020 document can in itself to some extent be seen as a strategic framework for the transition to a sustainable society, considering also the subsequent action plans of the responsible agencies, which range over a wide spectrum of issues.

A two year long document development process including stakeholders from many different regional organizations enabled the development of some *clear targets and prioritizations* (VG 2020, p.4). EU 2020 indicators are used for the overall evaluation where the region's starting position (in 2012) and target position (by 2020) is contrasted and compared to EU and national 2020 goals (VG 2020, p. 11) The operationalization is divided into four themes, nine areas and 32 prioritized issues with goals for each prioritized issue, of which *half are defined in a measurable way and half are less specifically formulated* (e.g. 'more participants in a program'). An operationalization of the issues is thus done already in the document. Operationalization further takes place by the development of five action programs, setting direction and granting support for the regional development work in five strategic areas¹⁵. These action program set out more detailed activities and assigns implementation responsibility and budget to a regional administration.

VG 2020 thus set out *generic targets* but leaves it to different administrations to develop detailed action plans, targets, evaluation models and indicators shall be developed by the responsible agencies. These are then to suggest *resource allocation* and *report back* on progress on a regular basis. This evaluative focus and the BHU governance, where stakeholders from different regional organizations are included, should allow for *knowledge transfer and continuous learning among the stakeholders*, however there are learning processes to allow cross-organizational knowledge sharing. While the formal overall responsibility for implementation of the RUP is assigned to the BHU, the participating municipal associations shall also develop implementation plans. It is further stated that all organizations in the region has a responsibility for fulfilling the RUP. A yearly evaluation by the region (determining budget priorities for the coming year) is accompanied by a half-time evaluation in 2017 and a final evaluation in 2020.

Barriers to sustainable innovation in healthcare: interview findings

The manager of the regional environmental secretariat highlights the importance of identifying needs early on in the development process and agenda-setting process and the necessity of political will to generate innovative solutions. She argues that procurement is not the critical driver for innovation, but rather that *identifying the need* is: "Procurement is not the critical point. If we decide to buy [a more sustainable product], the (technical aspects of) procurement is not the problem, it is the decisions. There has to be a will, [if we for example say] 'we will only have solar energy, we are going to invest in solar panels' – then we'll do that. Region Skåne is procuring wind power, its own wind power. Imagine getting that decision in place." (VGR 1, 2014).

The VGR regional objective of a fossil fuel free goods transport is presented as an example of how political will and formalized objectives is driving industry and innovation processes: "We

¹⁵ The action programs cover the areas Sustainable energy, Life science, Food and green industry, Sustainable transport and International research and innovation collaboration.

have had a very clear political ambition about renewable fuels. In the goods transport procurement you can see this ambition put into practice. It is supported throughout to reach the VG 2020 goals” (VGR 1, 2014). This clear political will is considered even more important in large scale areas such as healthcare or transport, where there may be a lock-in to existing solutions.

A better understanding of the organization’s **needs** could allow in the agenda-setting process to drive innovations more effectively: “people say ‘we have to work with innovation procurement’, but I say that what we should work with is identifying our *needs*.” (VGR 1, 2014). Material consultants, previous healthcare staff with specific knowledge about the needs of operating stadd, are hired by the region to provide such need-formulation. A material consultant in the region, explains that the material consultants **lack competence** on environmental impacts, and that this is contributing to that sustainability aspects are not included in the **needs** formulation: “I wish that we could get more hands-on help actually, as most of us don’t have any environmental training, but also that it actually would be good if we could get input from others, including the innovation center but also from the environmental strategists in our region and other regions: the competence is there but the issue is how to access it.” (VGR 2, 2014).

Healthcare is indeed described as a very **innovative type of organization**, however innovations are perhaps mostly perceived to occur in high-tech or research heavy areas: “Healthcare is actually the organization that takes in an enormous amount of innovations, one shouldn’t forget about that. The “Bild- och interventionscentrum” that is being built at Sahlgrenska for the moment, they are world leading in new technologies. So the competence is there and it is being done.” (VGR 1, 2014). However, a highlighted barrier is the heightened level of **trade-offs between different interests** in the healthcare sector. Not only do products and processes have to be cost-efficient, the impact on care quality sometimes undermines the use of more environmentally friendly products. An example is individually packed single use articles (sometimes more effective/cost-effective compared to surgery kit packaging) and autoclaves (costly and complex installation). There is no collaboration between material consultant and Innovation Gateway (VGR 2, 2014).

The regional focus on improving waste management has led into resource efficiency projects, based in a **solid understanding of environmental challenges** and their interconnectedness: “What both we [VGR] and Region Skåne have understood, is that we need to economize on the resources, the whole decoupling thing that researchers are talking about. That’s why we are working with our furniture, food waste, reducing single use products in surgery. So we are having workshops with healthcare to make sure that we get new products, so that we don’t get the 70 liters of waste from the average surgery.” (VGR 1, 2014). VGR also connects the development of sustainable innovations to improved regional competitiveness, indicating a harmonized view of economic and other sustainability aspects: “We think that ReDesign is a really big market opportunity for Sweden, or VGR, (...) we’re really good at textile and design. It’s not just about building new markets, but to assure that the ones we have are growing ” (VGR 1, 2014). However, as previously noted, this solid understanding is centered on the environmental specialists, a capacity separation that potentially hinders sustainability aspects from the needs formulation. A material consultant explains that the requirement specification process (functional criteria) is separate from the environmental criteria. These come in at a later stage in the process, where environmental and ethical aspects are prioritized and applied by specialists working with procurement. Environmental considerations are important but the material consultants do not work with them: “not on our level, but higher up [in the administration] I think it is a big issue” (VGR 2, 2014).

4.3.2 Region Skåne

Innovation policy

Region Skåne's central innovation document "*An International Innovation strategy for Skåne 2012-2020*" (own translation, hereinafter IIFS) was developed by the region's business development department and published in 2011 by two regional organizations; the research and innovation council (FIRS) and Soundingboard Innovation in Skåne (SIS). FIRS is a strategic council with regional and municipal politicians, business representatives and two university principals as regular members. Students shall also be represented, however they are not among the regular members (Region Skåne, 2014Z). Soundingboard Innovation is a forum for meetings among the representatives from different parts of the innovation system. Both organizations are said to be "leadership communities" (IIFS, p. 2). The IIFS was developed with the intention of meeting both global challenges and increasing global competition, and considers knowledge and innovation capacity to be determining success factors to do so. The IIFS also was intended to inform the then upcoming national innovation strategy (SNIS), an OECD regional study of Skåne and an innovation proposition that was being developed at national level. The IIFS seeks to provide answers to *what* should be done (vision), *why* it should be done (background documents) as well as to *how and by whom* (action plan). The vision element is represented in the IIFS, while the background documents are found elsewhere and the action plan is to be developed. The document points out towards the development of an action plan that is going to be developed separately.

Interpretation of sustainability in innovation policy

The vision is for Skåne to become Europe's most innovative region by 2020. Global markets and global challenge are both underlying drivers for the vision, which has the primary focus to raise the innovative capacity of the region. Global challenges is the first point on a list of prerequisites to reach the vision – because of their system oriented nature, these innovation require greater extent of collaborative capacity and public support and here, the aim is for Skåne to be the world leading region (p 4). While the important role of public organization in driving innovations meeting societal challenges is accentuated (e.g. healthcare, climate and energy issues and system innovations), the connection between these global challenges and large global markets is also highlighted. The remainder of the document maps out further prerequisites (system innovations culture, innovation and entrepreneurial capacity, co-ordination, research, competence/education, finances), describing important elements in the innovation system and points towards the future development of an action plan. A concrete such action plan has however not been developed (Personal communication, Region Skåne 7, 2014).

The IIFS presents "global challenges, large demographic changes and increased global competition" as the drivers behind the innovation strategy (IIFS, p. 2) and the goal to be "international competitiveness and living environment" (IIFS, p. 2). Further, it claims that the ultimate purpose of the strategy is "an inclusive, smart and sustainable growth" (IIFS, p. 2), however there is no definition of these adjectives. The IIFS provides no concrete definition of sustainability, but the argument is focused on sustainability challenges as a driver for change, whereby a regional competitive advantage could be gained with economic growth as the objective. The IIFS continuously connects the drivers proposed by global challenges to marketability and competitive advantage.

Integration of sustainability in innovation policy

Since the primary focus of the IIFS is put on innovation system capacity the material did not allow for an analysis of the space granted to different arguments. The analysis of sustainability

arguments' centrality reveals an overall low number of sustainability arguments and a focus on economic aspects in all parts of the strategy. Table seven (below) provides an overview over the different arguments as presented in the IIFS. The economic arguments dominate the different chapters of the strategy.

Chapter	Economic	Social	Environmental
1. Introduction	<u>4</u>	1	2
2. Vision	1	1	1
3. Prerequisites	<u>5</u>	4	4
4. Strategies	<u>2</u>	1	0
TOTAL	<u>12</u>	7	7

Table 7 – Sustainability motives, International Innovation Strategy for Skåne.

Operationalization of sustainability

The IIFS does not provide specific ways of operationalizing the strategy, but points towards the importance that a large number of stakeholders collectively assume responsibility: “no one actor owns the whole question, the problem or the business” (IIFS, p. 9) but further points to the action plan for a description of how the necessary coordination shall be organized.

While the “global challenges” are present as a driver in the document, the **IIFS** provides no explicit definition of what the global challenges are, or indeed of what constitutes sustainability. Instead, very general examples like “sustainable cities”, “personal health” (IIFS, p. 2), sustainable environment, energy supply, an ageing population and effective integration (p. 3, 5) are provided. There is a firm recognition that the public sector has a key role to play, especially in developing the necessary innovative environment (education, living environment), but also in initiating and acting as a procurer of innovations (IIFS, p. 9) Steering the innovation system towards solving the sustainability challenges is not an explicit objective in the IIFS. These sustainability challenges rather constitute a business opportunity that should be sought out. As the IIFS is not a detailed document and does not constitute a strategic framework for sustainable innovation, set out targets or define action points and resources.

The IIFS sets out six general strategies to strengthen the innovative capacity, however these are not related to the sustainability challenges. There are no criteria or indicators for projects or programs defined in the IIFS. There is no indication of how monitoring, evaluation should be done and how learning processes are enabled. Interview findings also indicated that this is not an intention of the implementing organization. The focus is rather on following the processes and reporting to FIRS on a regular basis than defining specific sustainability objectives (Personal communication, Region Skåne 7, 2014).

Barriers to sustainable innovation in healthcare: interview findings

Several barriers to sustainable innovation in healthcare was identified. A first topic revolved around the need to have access to feedback- and information channels. Following climate analyses (in both 2001 and 2011), Region Skåne recognized that, contrary to previous assumptions, products, not buildings stood for the healthcare sector's largest climate impacts. Based on this realization, the region is currently creating a list of the 10-20 products with the highest climate impact. When this mapping is finalized, the clinics will be able see this

information in the region's product catalogue when they are purchasing, creating an informative channel to raise awareness about the impacts of the products that clinics purchase (Personal communication, Region Skåne 1, 2014). A click view system for material consumption impact is currently being developed, however there is only systematic measuring of product flows in and out of wards on an aggregate level. Detailed feedback on product flows is not possible as of today, but there is a continuous development process in that direction (ibid.).

The region also has a information feedback system for transports based on staff registration of the mode of transportation used for job trips. Sub administrations are charged a "climate fee" for each registered flight and private car use. The reports go back to the clinics, further providing information that could strengthen the incentive to improve performance. Still, detailed feedback channels are missing in many areas, disabling staff from identifying the environmental impact of the operations. An example of this is the hospital's waste management system. The lower detail in feedback can weaken the incentives for the wards to reduce their waste generation. The same issues exist for energy consumption (ibid.). Among companies, a prioritization to sustainability criteria had not been formulated. "The healthcare's focus is patient benefit, safety, risk minimization and cost are the primary focus areas for healthcare. Environmental considerations come further down the list, most doctors are not looking at it, possibly suppliers." (ClinTrials Skåne, 2014).

A lack of capacity was also regarded a key barrier. In order to identify staffs' needs and potential environmental improvements, capacity building among staff is an important element. This capacity among hospital staff relates strongly to agenda setting (would probably improve the information flow to procurement). Creating understanding about environmental issues from an integrated view is a challenge; there is typically a usually focus on single issues when thinking about environmental impacts: "Environmental issues is not a separate track, it permeates everything. But the difficulty lies in getting people to realize this and that it is not just about sorting waste." (Personal communication, Region Skåne 1, 2014). The environmental department at SUS is working to build capacity around environmental issues in various ways. They are currently working to get environmental issues into the Research and Development group's agenda and engaging with staff out on the clinics: "Concerning education for doctors and nurses, [we seek to] talk about environment and environmental impacts at an early stage [and] we are giving a course in this for the managers this autumn." (Personal communication, Region Skåne 2, 2014). Understanding and describing the environmental effects is an essential first step to be able to address these issues, capacity building is still needed: "We have to leave the waste management discussion and look at the actual operations, looking at the environmental impacts of our treatment methods and be able to describe the effects. We may not always be able to take environmental considerations, but we have to be able to describe the effects and why we are unable to avoid them. That's where we want to be." (Region Skåne 2, 2014) A hospital environmental manager also argues that there is a need to make the environmental impacts seen when new care models, treatment and surgery methods are being developed. Implementation issue: Centrally, there are "clear guidelines, policies and management systems, but it then needs to be taken to the employee level and out to the real production and I guess that is where things get lost under the way." (Personal communication, Region Skåne 2, 2014).

Further, a lack of collaboration between administrations was one of the barriers to enabling the previously mentioned capacity development and information exchange. Skåne's environmental management unit (EMU) works closely with the procurement department, where they sometimes provide environmental support in procurement processes. Following a prioritization of the importance of the purchase, environmental criteria are applied. If the

purchase is not prioritized, basic level criteria are applied (often applying SEMC criteria). From participating in procurement projects, it has been the environmental focus has increased. In the case of single use gloves, the focus has been to reduce waste (6-7% of the gloves are wasted due to packaging design). “we notice that [when the environmental management unit participates] in the expert groups, the participants from the clinics become really [environmentally] aware and start to think about these issues – and then it spreads (...) procurement then collects all this information and requirements and puts together a specification.” Here, the environmental representatives are highlighted as a potential strength to reach out / create environmental awareness (Personal communication, Region Skåne 1, 2014).

The EMU has had some collaboration with the innovation administration in setting environmental criteria in innovation processes (Personal communication, Region Skåne 7, 2014). However, in practice, it is less certain how the innovation administration has engaged with healthcare innovation projects. As an example, there was no collaboration between the innovation administration and the CLIRE project (Personal communication, Region Skåne 1, 2014). There is also a perception that innovation projects tend to focus primarily in technical solutions rather than on how to change consumption levels. Looking at how to decrease use, increase efficiency, altering services and healthcare production processes may be more important than technological innovations to reach e.g. the regions fossil free goals (Personal communication, Region Skåne 1, 2014). The hospital environmental manager also experiences the link between innovation projects in healthcare and the regional environmental program as “*very weak*” (Personal communication, Region Skåne 2, 2014).

Communication between the many different stakeholders involved in healthcare innovations was also considered essential. “What we have seen [is important] in all of our projects is communication, it is [important to get a] report to the regional procurement when something is not going right at the clinics, so that [procurement] knows that something is wrong and can communicate this to the suppliers. So that there’s collaboration there, between suppliers, care providers and procurers.” (Personal communication, Region Skåne 1, 2014). The region is currently going over to a common reporting system for all errors (e.g. safety, fire, environment), previously many different reporting systems and lengthy process to report product errors to procurement office (Personal communication, Region Skåne 1, 2014). As part of the CLIRE project, a handbook on how to map out, work with and evaluate climate impact has been put together especially for clinics. However, even when communication of practices for sustainable development does occur, organizational barriers may hinder knowledge transfer of good practices. Outreach can be especially difficult among clinics with strong traditions: “...you know the saying that you never become a prophet in your hometown. We have had a great outreach with the [CLIRE] project internationally and nationally, but reaching out within our own organization is really difficult. The organizations are often really used to their own way of doing things and copying from the neighbor seems to be more difficult than copying a model from another region or another country.” (Region Skåne 1, 2014) The suppliers need to have better communication with the procurers and material consultants, not sustainable to have companies running around at the hospital. Need to get better at putting expert groups together to communicate the right needs to suppliers (Personal communication, Region Skåne 2, 2014).

The possibility of “tapping in” to “non-environmental” improvement processes (e.g. LEAN projects) has a large potential. An example is a improvement project following the identification of an inefficient patient process for patients with bladder cancer. The CLIRE group joined forces with the project and helped to identify environmental impacts (e.g. decreased transports, material and antibiotics use): “Our idea is that the environmental work

shouldn't be a separate track but be a natural part of the activities. So if we can participate in these processes and identify and point at the environmental impacts, we can achieve dual goals." (Region Skåne 1, 2014). Similar improvement processes/projects take place all the time in healthcare. By improving the participant's capacity to think both innovatively and about sustainability aspects, dual goals can be achieved. "The goal is to create awareness, but these processes are never finished but part of an on-going improvement work." (Personal communication, Region Skåne 1, 2014). There has been some success in integrating environmental aspects in lean processes: "we are supposed to think in lean processes to increase efficiency, make care as good as possible for the patients and to save money. But then we see that when we are working with Lean (...) we often get an environmental benefit/improvement, but it is never described" (Personal communication, Region Skåne 2, 2014). Staff and R&D are not thinking of environmental impacts: "No one asks for it, but we have to (...) make the issue interesting for the people that are working with it, it's about knowledge and education. (...) I mean the researchers today, the environmental impacts is not what they primarily think about." (ibid.). Highlighting the co-generation of environmental benefits in different projects is seen to have large potential: "Although when they are developing new treatment methods they are making huge environmental improvements, without even knowing it, like shorter hospital stays, reduced material use and perhaps removing the need for anesthesia. The driving forces are not really there, it's more efficiency and economic benefits, if it is there, then that is a driving force." (ibid.). "I would say that economic efficiency and patient value are the two unavoidable aspects in healthcare today. But [innovations for] economic efficiency, often has built-in environmental benefits, because a lot of these products decrease patient transports" (Personal communication, ClinTrials, 2014). An economist at the regional hospital that has engaged in calculating environmental flows and costs on own initiative, considers the environmental issues to be treated "step motherly" – everyone thinks it is great but no one knows how to manage it. "As long as environmental issues remain separate from other parts of the management system, they will be treated as a separate issue. It should be integrated with everything we do, because it is no separate issue". (Personal communication, Region Skåne 5, 2014). He further notes that environmental innovation projects sometimes fails to demonstrate the economic aspects. To counter this, he sought to include all the relevant aspects into this project; patient, employee, environment and economy. "We did this because we saw that we could save time, money resources and effort. And we can put that time, money, effort and resources into generating value" (Personal communication, Region Skåne 5, 2014).

The environmental coordinator at SUS explains while he has previously worked in innovation projects, there is no such activity today, primarily explained by a lack of resources is the primary explanation: "We would like to [work with innovation] but there has not been enough time and resources." (Region Skåne 2, 2014). One respondent who has on individual initiative started a project to measure processes at a cardiac clinic in the region also identifies that the main barriers include time, resources and motivation (Personal communication, Region Skåne 5, 2014).

From participation in environmental expert groups in procurement processes, stakeholders identify that when it comes to weighting between different objectives, social and environmental criteria are given a lower priority. 'Should-requirements' are used more often than 'shall-requirements' in procurement processes and price and delivery certainty are the two main focus areas (Personal communication, Region Skåne 2, 2014).

Region Skåne has also identified the importance or **policy formulation** and are introducing sustainability aspects to balanced scorecards. These targets are now the responsibility of the division managers: "Region Skåne's environmental program (...) is transposed by us at SUS to

detailed goals, which are then introduced into the balanced scorecard, where all other production targets are found (..). Just getting environmental objectives into the same documents as the other organizational target formulation, (...), that's a huge win; because then no one can close their eyes to it." (Personal communication, Region Skåne 2, 2014). However, environmental objectives are not present in the balanced scorecard for research and development, which should be an important perspective for innovations: "The environmental objectives are present in all perspectives of the balanced scorecard, except the research and development perspective, so in that area we have not succeeded." (Personal communication, Region Skåne 2, 2014). A lack of sustainability objectives and implementation is also mirrored in a regional innovation project targeted at the private sector healthcare actors. Region Skåne's business development department has developed entrepreneurship and innovation programs for private healthcare sector actors. While many of their projects involve innovation support and is organized under the business development department (also responsible for the region's innovation strategy), there are no specific environmental objectives for project proposals. "We have (guidelines) in all the work we do. When you are writing an proposal there are different headlines, we are always supposed to take (environmental) considerations, but we don't have specific (objectives). It's the policies and structures for how to work, I cant quote it from the top of my head. (...) The only thing our proposal forms say is 'does this have an impact' and 'does it follow policy' and you write yes or no. It is at that level. In the context of my projects we have not gotten further concerning these aspects and that's a job that remains to be done. (28:30) I think I work with these aspects but we don't have the criteria for what it could be" (28:40)" "Reality and vision, they do not always meet" (Personal communication, Region Skåne 6, 2014). Company organizations have also identified the need for policies to be clearly communicated to industry: "[Environmental] market signals need to come from above and trickle down to the organization" (Personal communication, ClinTrials, 2014).

Procurement process: The regional procurement department can also, as we have seen, drive innovations by implementing PPI processes. The purchasing director at Region Skånes central procurement unit explains that in Region Skåne, an Ethical code of conduct shall be used in all procurement processes. This code of conduct was been developed in collaboration with all Swedish regions. The region applies basic environmental requirements (a documented and structured environmental program) for all purchases and often requires that their suppliers have an environmental management system or equivalent. Specific environmental requirements are set for each procurement, where Region Skåne frequently use the MSR criteria and mostly apply the highest level (Personal communication, Region Skåne 3, 2014). Decisions concerning specific procurements and strategic issues in procurement (both ordinary and innovation procurement) are handled in the political organization "Upphandlingsstrategiutskottet" and in an advisory board (for innovation procurement). Both organizations meet regularly and often discuss environmental and ethical trade issues (Personal communication, Region Skåne 3, 2014).

Region Skåne's procurement process can be divided into three phases: preparation, procurement and follow-up. Environmental requirements are set in the preparation phase, and here, Region Skåne is increasingly working with market analyses and mapping the specific environmental aspects from specific products (Personal communication, Region Skåne 3, 2014). Region Skåne works with different methods engage with suppliers and to map what is on the market; the request for information (RFI) method uses "a form that is sent out to the suppliers that are relevant for the procurement" and supplier meetings, or hearings, are sometimes held "before the procurement where we dig deeper and discuss the normal aspects and environmental aspects. I this way, we can use the information about the environmental work and focus that some of the companies have, by setting that at in the (lowest) requirements we can inspire others to start working in the same way." (ibid.). A subsequent

possible method is the external referral, where a draft of the procurement specification is published online and open for comments from suppliers. During the last year, the region has used external referral in about 40 occasions. The information that is collected with these methods is filtered and weighted by the procurement department. The region performs about 200 procurement processes every year, and to whether these methods for deeper market analysis shall be used, the procurers use a toolset of parameters to assess the strategic importance of the purchase (Personal communication, Region Skåne 3, 2014). The objectives in the regional environmental program are transferred into the environmental requirements set in the preparation phase. Here, a range of environmental aspects are considered (e.g. energy and chemical use, emission, waste generation) and weighted to the volume purchased, and the value of the procurement.

The procurement director explains that innovation procurement projects are too specific to have their own environmental criteria, however the generic environmental criteria are always applicable. “Out of 200 procurements per year, maybe 0,5 is an innovation procurement. These projects are then so specific that it is impossible to say that we have a specific process for doing an innovation procurement.” (...) it is so specific that we create everything especially for that case, we cannot talk about processes.” “It is so specific cases, so you need a bigger elbow room” It is not possible to “answer specifically what process that has been followed concerning environmental criteria” (Personal communication, Region Skåne 3, 2014). She further argues that it is difficult to determine what actually constitutes innovation procurement. Rather it is more relevant to think of different methods for innovation procurement, such as pre-commercial procurement and forward commitment. “We are more and more moving towards describing the need, rather than writing a detailed requirement specification – we do this and talk about *innovation friendly procurement*, where we go more for the function and the need - and describing this”. One on-going innovation process is the procurement of an “environmental product” - which is an environmental project where they are procuring fossil free aprons (feeding into the regional goal of fossil free region). (ibid.).

4.4 Local level: Innovation Gateways

This section analyzes the integration and perception of barriers of sustainability at local level, in actual innovation projects at hospitals. Many different projects with an innovative content take place in the healthcare sector. The so called Innovation Gateways (‘Innovationslussar’ in Swedish, hereinafter IG) were chosen as the study object. It should be noted that the validity of the findings from the local level innovation projects is thus limited to the IGs. Ten IGs are currently operating in Swedish regions and a combination of methods was used to improve the validity of the results. A survey was sent out to all Innovation gateways and interviews with actors from the IGs in the two case regions were carried out.

4.4.1 Interview findings

The analysis sought to analyze sustainability integration in innovation projects; whether the IGs used regional sustainability policies or internal sustainability policy. The analysis also sought to map out the IG’s perceived barriers and opportunities for implementing sustainability dimensions in their innovation activities.

Skåne

Innovator Skåne has existed for seven years and is a commercially driven publicly owned company with the mission to assist publicly employed in the Region who come up with innovations that have commercial potential to reach the market. Region Skåne has chosen to separate healthcare innovation functions into two companies; one for innovations going from the organization and out (Innovator Skåne) and one for innovations from external parties that

need to get access to healthcare for clinical trials (ClinTrials Skåne). This division differentiates Innovator Skåne from many other IG's. Innovator Skåne's primary tool to promote innovation is communication (e.g. employee meetings and newsletters) and so far about 70 innovations have been processed each year. If an innovation is taken for further development, the IG can provide various supportive services, e.g. analyses, finding industrial partners, technological- and patent assistance according to need. While the amount of technological innovations are considered too few, most of the ideas coming in and about 75% of the innovations taken for further development are product innovations. Services are seen as "a lot more difficult to commercialize to a third party, not least because they are so difficult to protect" (IG, 2014).

Innovator Skåne are internally governed by the regional policies and has *no internal sustainability policy that guides the operational activities* "All Region Skåne's policies relate to its companies (including Innovator Skåne) too, for example the environmental policy. But they do not govern the orientation of our activities, it's more [a concrete policy] for [how we choose the] mode of transportation and so on." (Personal communication, IG, 2014). Innovator Skåne further *do not have any specific activities related to environmental aspects*. "if there are clear environmental benefits [of an innovation] then we can place a monetary value on that, or communicate it [however] I don't think we have had one single case (...) it is cost saving that has been the most prominent, and not environmental aspects." (ibid). Care-related social sustainability aspects permeate all the projects: "Improvements in care, and especially improvements to the working environment, is a constant theme (...) patient security too" (ibid.). Only the innovations that show a commercial potential are taken to further development. In order to evaluate the commercial potential, the IG looks at whether there is a well-defined need in the organization (making it sellable) and a commercial value. *Currently, no specific sustainability criteria are applied in the evaluation process*. A part of the explanation to this is an overall low amount of commercially viable innovations: "We have decided to welcome everything and everybody coming in. I would have wished that we could make the effort to maybe even perform an active search for products or services that have a potential positive environmental impact. But we have not done so this far. That could be an aspect [too look for]." (ibid.).

Västra götaland

The IG ("Innovationsslussen) in Västra Götaland is put in place and run by the VGR region to capture all innovations generated by staff working in the hospitals regardless of commercial potential. The rationale is that innovations that do not initially have commercial potential have still defined an organizational need. The IG serves also to capture such needs, thus enabling solving problems in the organization (Personal communication, VGR 3, 2014). Employees can post their ideas on the IG website to get feedback on their ideas and move towards product testing and market launch. Activities include building innovation capacity (assisting employees to generate ideas) and problem-based workshops (intended to identify needs for innovation), which often take the working environmental as a point of departure (ibid.). Further services include structures to capture ideas ('innovation conveyors'; employees at wards that guide innovators to the IG), innovation development and expert evaluation of ideas, performed by an innovation council and a priority council.

Sustainability criteria has not been used in the projects, such criteria currently enter at a later stage in the process, where the procurement department is involved (ibid.). The IG notes a potential in using sustainability aspects in innovation processes to raise awareness about how innovations can simultaneously generate benefits in multiple sustainability dimensions. The project manager of Västra Götalands innovation gateway explains that the competency on sustainability issues is not found in the innovation gateway and suggests that an already well-

developed collaboration between the regional development secretariat and the environmental secretariat could be used to design relevant innovation evaluation criteria. While resources are probably not sufficient to sustainability dimensions in the organization's evaluation council, the development of an evaluation form should be possible. Using sustainability perspectives in the workshops is also a possibility (ibid.). Worth noting is that one of the innovations the IG has worked with (generated in a research project) has independently performed a study on sustainability impacts of the product. The study evaluated economic (cost-benefit analysis) as well as social and ecological impacts (VGR, 2014d).

4.4.2 Survey results

A survey was sent out to all (10) identified Innovation Gateways (IG's), whereof eight (8) participated in the survey (see Appendix six for the survey questions and a list of the identified Innovation Gateways). The achieved response frequency of 80% is considered satisfactory (Esaïsson, 2005). Some of the IG's were initially financed by VINNOVA while others had other previous external financial support or were started directly by the region. All IG's are currently financed and operated by the regions. The survey questions sought to define which sustainability policies govern the IG's activities, how they work with sustainability aspects, how they collaborate with other stakeholders and what the IG's consider to be the main barriers of working with sustainability aspects.

Policy: The IG's are primarily governed by regional sustainability- or environmental policies. *Seven* (87,5%) IG's indicate that both internal and external activities are governed by these regional level policies, while *one* IG pointed out national policies. One IG mentions internal sustainability objectives that remain in the organization from a previous policy of an EU project, which previously financed the organization. **Selection criteria:** *All* IG's apply (or will apply) selection criteria to choose which projects to move forward with. *Five* (62,5%) IG's have both social, economic and environmental selection criteria, *two* only apply economic selection criteria and *one* only applies social selection criteria. **Information and support for innovators:** *Three* (37,5%) IG's state that they include some sustainability aspect in information- or education activities with stakeholders, *whereof two* IG's (25%) take all three sustainability aspects into consideration. One of the IG's provides an exemplification of how they work with this: information activities accentuate how innovations should improve care in both health economic, environmental and care related perspectives. One IG (12,5) only considers only the economic aspect. *Five* (62,5%) of the IG's thus do not include these aspects in information or education activities, however one IG indicates that sustainability aspects are integrated but not formalized. *All* (100%) of the IG's state that they assist innovators to account for the positive sustainability aspects of their innovations. This assistance is provided for economic aspects in all (100%) IG's, environmental aspects in *seven* (87,5%) IG's and social aspects in *five* (62,5) IG's.

Other activities: When asked if sustainability aspects are highlighted in other parts of the activities, *two* IG's point specifically at *informing innovators about procurement requirements* on sustainability aspects. One IG also points indirectly at the sustainability requirement set by procurement processes, stating that it is important to include sustainability dimensions early on in the development process to make the product or service as attractive as possible for buyers and users in a later stage. One IG indicates that working with sustainability aspects is important, as they want to support the development of innovations that last over time. **Collaboration with other regional administrations:** When asked to indicate collaboration with other parts of the regional administration, *all* IG's indicate *procurement* as an important partner for collaboration. *Four* IG's point out material/technical working groups and/or concerned stakeholders and *two* IG's point out organization development units. One IG

point out collaboration with the environmental department, one IG points out internal communications.

4.4.3 Barriers and opportunities

The IG's were also asked to indicate identified barriers for including sustainability aspects in their activities. *Three* IG's point at an *internal lack of knowledge* about the sustainability issues and how to work with them. *Three* IG's also point at a *lack of resources* to work with these issues. *Two* IG's identify a *missing external understanding* of sustainability issues, for example procurement department's focus on price and a missing long-term perspective in the organizations. One IG claims that there are no barriers, but that prioritization is always needed, where the need of patients and personnel has the highest priority. The identified opportunities for including sustainability aspects in their activities, the answer varies between IG's to a large extent. One IG highlights the support of existing long term sustainability strategies, while two IG's see the opportunity to translate just these sustainability strategies into operational activities (e.g. by developing a guide) as a future opportunity. One IG considers the opportunities as limited to mirroring procurement requirements, and argues that it would not be a good idea for the IG's to set higher demands on companies. Additional comments from the IG's include an identified need to consider sustainability aspects already under the initial development phase in order for products and services to be attractive on a commercial market. Another IG argues that the regional sustainability ambitions and requirements need to be clearly communicated, so as not to use resources in an inefficient way. It is considered too late to discuss sustainability issues at the procurement stage, however if planned strategically this product and service development could be a Nordic competitive advantage.

Potential to collaborate with other projects was further highlighted as a current barrier: "We have realized that we probably have to take a more holistic approach and join efforts, be more proactive in the search for certain innovations and this is where this fits in, among other things. That you are searching for these projects.. but no. And vice versa, they have not come to look for us." (IG, 2014) In improving innovation capacity, management is key, but a current barrier is a lack of their participation "...its very much a management issue. Working with these issues is not really set among the leaders out there. And it is similar to sustainability issues, all these aspects, it is a management issue. If its not acknowledged, prioritized and talked about, it disappears." (IG, 2014). Providing training in innovation for management is considered essential to overcome this barrier, as these have the potential to motivate and showcase innovators. Establishing goals for innovation in balanced scorecards could be one way to get the issue on the agenda (ibid.).

The need to get healthcare managers to work with innovation, both to stimulate the innovative capacity internally and to demand more innovative products and services, ha been previously identified (Swedish government, 2010). VINNOVA and SCA have been assigned the task to build the innovation capacity (development and adoption) in public sector and an initiative to specifically build innovation capacity among public sector leaders was also launched in June 2014. A suggestion is that this program should include the societal challenges angle to the training – including environmental challenges and sustainability capacity building.

5 Analysis

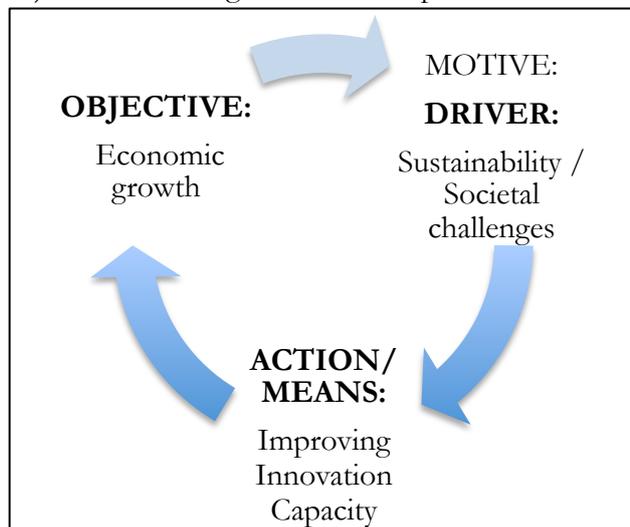
This section provides the analysis of the finding from the national, regional and local level. The analysis considers both the interpretation of sustainability, based on Baker’s ladder of sustainability, and the operationalization of sustainability, based on the policy cycle framework presented in section 3.5. An analysis of the identified barriers to integrate sustainability principles in innovation projects is also performed.

5.1 National level

5.1.1 Interpretation of sustainability in innovation policies

The analysis on the interpretation of sustainability is based on Baker’s framework “the ladder of sustainability” and considers findings from both the qualitative and quantitative analysis. Findings from the qualitative analysis of the SNIS suggest that the “societal challenges” presented in the SNIS constitute challenges for a sustainable development and that these challenges are environmental (four) and social (three). Additionally, a separate chapter elaborating on the need to improve national competitiveness present challenges focused entirely on the national economy, depicting the clear focus on economic competitiveness. These challenges are presented as the drivers behind, and motives for the SNIS and support its argument for the need to increase innovation capacity. The analysis of chapter one and three of the SNIS allowed us to identify the space and centrality granted to the different motives. Here the analysis identified that while the ‘global challenges’ (considered primarily environmental) is the motive first presented in text and given priority in illustrations, it ranks lowest both in terms of space and centrality in text. The majority of identified arguments were related to the economic motive and the social motive was granted most space. Based on this analysis it is possible to identify a relative dominance of the economic motive to the SNIS.

Concerning normative principles, the lack of clear sustainability objectives suggest that the *declaratory commitment* to solving societal challenges is stronger than implemented solutions (weak sustainable development). Analyzing the type of development suggested by the SNIS, a *priority given to market led growth* is identified as environmental and social aspects are rarely presented as standalone objectives throughout the SNIS (pollution control). Rather, these objectives are throughout combined with economic arguments, revolving primarily around economic growth and international economic competitiveness. As for the role of nature, the societal challenges suggest an underlying understanding of constraints to natural resources (strong sustainable development). Concerning the governance aspect, a *shared responsibility* is emphasized (strong sustainable development) and technological solutions point towards an *ecological modernization* approach (strong sustainable development). The SNIS has resulted in the *integration of environmental consideration* at sectorial level, however this implementation varies between agencies and it is beyond the scope of the thesis to determine to what extent this implementation has occurred (weak to strong sustainable development). As to the policy tools used, *market-led policy tools and voluntary agreements* remain the focus and although some of the agencies (e.g. VINNOVA) have redirected their policies towards supporting all sustainability aspects, this is not governed



by the SNIS. No concrete objectives or follow-up structures are defined in the SNIS, and sustainable development constitutes a ‘motive’ or ‘driver’ rather than an objective (weak to strong sustainable development). The civil-society state relationship is primarily related to top down initiatives (weak sustainable development). In total, the interpretation of sustainable development suggested in the SNIS corresponds closest to the “weak sustainable development” as suggested by Baker’s framework.

5.1.2 Integration of sustainability in innovation policies

The quantitative content analysis identified that the concepts found in the SNIS primarily revolve around the innovation system. Added together, the innovation system category and the participatory category accounts for 42% of the analyzed words. While this points at a system-oriented nature in the national innovation policy, it does not provide any information about the sustainability interpretation and operationalization. To this regard, the findings in the economic, social, environmental and sustainability categories support the qualitative analysis. The economic category includes 31% of the identified words, demonstrating the growth-oriented character of the document. The lower frequency of specific words in the environmental, social and sustainability categories underlines the sweeping character of sustainability or “societal challenges” in the SNIS. Indeed, more generic words such as environment (32) and energy (9) also have a low frequency.

5.1.3 Operationalization of sustainability in innovation policies

The sustainable innovation framework found in chapter three is used to evaluate the operationalization of sustainability principles in the SNIS. The societal challenges identified in the SNIS also constitute both a recognition and definition of sustainability challenges. Besides the seven listed environmental and social challenges, maintaining international competitiveness is presented highlighted and considered part of an economically sustainable society. Hence, intervention in innovation policy is linked to the societal challenges; however promoting sustainable innovation is not an explicit objective. As for the agenda setting step, no concrete objectives, targets or instructions are specified; rather agencies are to determine their own policy choices and prioritization. This decentralized governance is considered to be a strength in Sweden in the EPI literature, however it currently makes it somewhat uncertain what the SNIS will actually lead to. The SNIS does not allocate resources (this takes place elsewhere: e.g. R&D propositions) and rather constitutes a visionary document.

The SNIS was developed in collaboration with a wide range of stakeholders. The process is thus considered inclusive, however it excluded input from parliament. It is uncertain how agencies and other stakeholders will continue to collaborate for knowledge sharing and learning. Since no clear targets objectives have been set, it is not possible to evaluate target fulfillment, however suggestions for indicators are underway. Who assumes responsibility for fulfilling the SNIS is altogether quite unclear from the document.

5.1.4 Barriers for sustainable healthcare innovation

Interviews with respondents from the national level innovation system sought to identify barriers for integration of sustainability principles in healthcare’s innovation practices. Both SCA and EMCC identified the lack of *knowledge and resources* as typical barriers to engage in PPI. Factors considered successful in counter these barriers included an external managing agent and the provision of funds. In addition to this, the mentioned projects provides a network function that allowed discussion and could create a sense of urgency among the participating stakeholders. These findings are supported by the Nordic Innovation study Measuring Public Innovation (MEPIN, 2010). According to this study, management support constituted the key driver for innovation and a lack of resources was the most important

barrier for innovation in public sector. Respondents also identified that representatives from regional innovation administrations rarely participated in the projects that concerned sustainability aspects in the healthcare sector, pointing towards a lack of collaboration between these administrations. Other highlighted barriers for PPI include an excessive price focus and tendency to move towards wholesale procurement for consumption products. A regional life science organization also pointed at *outdated standardized procurement conduct* concerning sustainability, focusing solely on environmental certifications and highlighted risks of adding detailed sustainability criteria to healthcare innovation projects (Medeon, 2014).

5.1.5 Summing up

Summing up the national level, we can conclude that the the national innovation strategy displays a normative interpretation of sustainability that on average corresponds to the ‘weak sustainable development’ category in Baker’s framework. However, it is worth noting that the categorization differs between the topics provided in Baker’s framework, ranging from pollution control to strong sustainable development. We also conclude that the indicated societal challenges function as drivers, rather than objectives in the SNIS, which has a clear focus on economic competitiveness and economic growth. To this regard, the findings from the content analysis also indicate that the SNIS is focused primarily on the actors and processes in the innovation system. Consequently, concerning the operationalizing of sustainability principles, the SNIS does not set out sustainability objectives or targets but merely links the activities to societal challenges. Rather, the SNIS leaves it to its agencies to operationalize the strategy. Both the transition management approach and the policy cycle theory have pointed out that this lack of clearly defined needs and goals in the agenda-setting stage can lead to the watering down of measures to promote sustainable innovations in the implementation stage. The identified barriers were primarily related to the innovation procurement practices, where a lack of knowledge and resources were the main identified barriers. Supportive functions such as networks and information building campaigns and organizations are established to counter the knowledge gap.

5.2 Regional level

5.2.1 Interpretation of sustainability in regional innovation policy

The interpretation of sustainability was analyzed in the innovation strategies of the two case regions, applying Baker’s ladder of sustainability framework. Västra Götaland’s innovation strategy, the VG2020 document fulfills most of the criteria for *strong sustainable development*. Sustainable development is well defined (in the reference to the RUS that VG2020 seeks to fulfill). Principles have been operationalized into governance arrangements by defining concrete objectives and assigning responsibility for implementation. VG2020 highlights need for a change in consumption patterns as well as other aspects found in the strong sustainable development category, such as resource constrains, heightened local self-sufficiency, shared responsibility across governance levels, internalization of sustainable development norms and green regional planning.

In contrast to this, Region Skåne’s innovation strategy does not provide an explicit definition of sustainable development. Although the strategy specifies that ‘global challenges’ (in interview referenced to an international report) constitutes drivers behind the strategy, the lack of specification on these challenges leads to a ‘pragmatic’ or ‘declaratory’ categorization concerning the normative commitment to sustainable development. The process-oriented nature of the document does not provide any information about what type of growth that is suggested, although the focal area smart sustainable cities imply a stronger sustainable development. While the orientation towards partnership and shared responsibility among

stakeholders also points to a stronger sustainable development definition, the lack of concrete statements concerning topics such as spatial focus, technology, policy integration or -tools leads to a classification somewhere between *pollution control* and *weak sustainable development*. It should be noted that the findings from the policy are not consistent with the regional environmental strategies and findings from interviews, where clearer definitions and a more integrated approach have been identified. The large differences between the two regional innovation strategies are perhaps partly explained by the format of the strategies and the actors included in their development. The VG2020 strategy development was led by the BHU, with a clear focus on sustainable development. Further, it is integrated with the regional development plan and thus closer connected to overall regional development. The IIFS on the other hand, was developed by the regional business development department and published by a high-level, multi-stakeholder research and innovation council. This is perhaps part of the explanation to the IIFS' orientation towards innovation system processes.

5.2.2 Integration of sustainability in regional innovation strategies

Quantitative content analysis

Similar to the national innovation strategy, the regional innovation strategies heavily emphasize the actors and processes of the innovation system (innovation system and participation category together constituted 43% of the identified words). Economic objectives, such as accomplishing regional growth and increasing regional competitiveness, constituted the second largest focal area with 28% of the identified words. The more generic words in the 'sustainability' category most commonly referred to the drivers (challenge, 2020) and desired character (sustainable) of the innovation system. The environmental words used were mostly generic and relating to infrastructure (energy, transport). While the more detailed words were less common, there was a not insignificant frequency of environmentally related issues (e.g. climate, resource) and solutions (e.g. renewable), which primarily related to climate change. The inarguably most frequent social words (education, knowledge), overlap with the innovation system words. Compared to the SNIS, a bigger number of specific 'social' category words were use quite frequently. The spread/diversity of words used, e.g. employment, health, gender equality, diversity, integration, was also greater. The greater mentioning of social aspects can potentially be explained by the closer contact with these issues that exists at a regional administration. On average, the figures evident in the regional innovation strategies closely mirror the national innovation strategy. Altogether, the quantitative analysis of regional innovation strategies indicates that there is a *strong focus on innovation system processes* and support for various actors in the innovation system. However, the documents provide *limited references to a range of sustainability challenges and generally do not go into detail in describing them*. A comparison with the RUS/RUP was not possible as they were excluded from the analysis, with the exception of Västra Götaland.

Survey

Some of the questions in the survey concerned perception of the purpose of a regional innovation strategy. Faced with an open-ended question about what constitutes the most important overarching objectives of the regional innovation strategy, about a third (27%) of the participating regions indicated sustainability related objective, of which all had a RUS/RUP as the governing innovation document. Other responses generally related to increasing innovation system capacity. A potential explanation to this is that RUS/RUP documents are designed to set plans for regional development generally, which may grant a more *integrated understanding of the interlinkages between regional sustainability objectives and regional innovation strategies*. When faced with a close-ended question at the end of the survey (having reflected upon and answered to 13 several questions specifically concerning sustainability aspects), 91% of the respondents indicated that their perception of innovations' potential

contribution to sustainability challenges were at the highest level suggested (transformative/factor five improvements). This general perception of innovations' *potential* is thus not reflected in the perception of the overall *objectives* of the RIS.

Several questions were also asked concerning sustainability policies and objectives of the regional innovation system. 91% of the respondents indicated that regional sustainability policies influenced the innovation activities. However, the share of regions that had set *defined sustainability objectives*¹⁶ was reduced to 64% for environmental objectives and 73% of for social objectives respectively. While this is a fairly large number, it is notable that there are a number of regions that have not defined such targets. Again, *the RUS/RUP group seems to have a more integrated perspective*. 80% of the respondents in the RUS/RUP group had defined environmental or social objectives while 50% and 33% of the RIS group had defined environmental or social objectives respectively. In practice however, contrasting the policy and objective related findings, almost all (91%) of the regions indicate that *sustainability aspects affect the actual innovation activities*. About half of the regions (45%) apply project or program selection criteria related to sustainability. There is a general perception among the regional innovation administrations that there is a good collaboration with other regional administrations and their innovation related activities (91%). Notable here is that this differs from the findings from environmental and healthcare innovation organizations.

Case regions' innovation policy

The analysis of the case regions integration of sustainability focused on the centrality of arguments concerning different sustainability dimensions in the regional documents. Similar to the findings concerning interpretation of sustainability, the integration of sustainability aspects differs between Västra Götaland and Region Skåne. Whereas VG2020 continuously integrates different sustainability aspects throughout the different (see table 6), the IIFS focuses rather on innovation system processes and makes generic links to 'global challenges'. The VG2020 presents a total of 122,5 sustainability arguments¹⁷ (4,08 per page), whereof 42% are social, 32% economic and 26% environmental. In comparison, the IIFS presents 26 sustainability arguments (2,88 per page), whereof 46% are economic, 27% social and 27% environmental.

5.2.3 Operationalization of sustainability in regional innovation strategies

The VG 2020 proposes an example of how sustainable innovation policy processes could be designed according to the literature analysis and framework, i.e. integrated and harmonized with broader societal development plans. It fulfills the majority of criteria set out; having been developed in dialogue with many stakeholders, setting sustainability, or societal challenges, at the center of the development process (both as a driver and as an objective), balancing all three sustainability dimensions, setting out both broad ambitions and clear operational targets, providing measurable indicators of progress and decentralizing implementation. VG2020 provides some information about the design of the feedback process but less certain how reporting back will be performed, how indicators will be evaluated, what incentives exists for administrations to work ambitiously with sustainability objectives or how learning processes are designed etc. These are developed and decided in processes and documents outside the scope of the analysis.

¹⁶ Defined as positive or reduced negative impact to environmental and social sustainability respectively.

¹⁷ For each text segment, main sustainability arguments were given one point and supporting arguments were given half a point.

In contrast, the IIFS focuses primarily on processes and strengthening the capacity of the innovation system. While the IIFS was developed in collaboration with many different stakeholders, it sets out few concrete ambitions or clear operational targets, no measurable indicators of progress and unclear implementation organization structure. There is no information about the feedback process, evaluation of development, how learning processes are designed etc. While this may have been developed in documents outside of this analysis, the analytical framework suggests that it is a strength of sustainable innovation policy process when these aspects are clearly defined in the strategy. Further, it is uncertain how the IIFS connects to the regional RUS and environmental strategies. This lack of a clear connection between sustainability and innovation could point towards a policy sectorialization, where sustainability targets are not reflected in the regional innovation organizations.

The fact that there are several documents to consider collectively for understanding the VG2020 implementation (key documents considered are RUS, RUP, five action programs) may constitute both a strength and a challenge. The definitions and objectives in VG2020 are more concrete but also provide a more complex picture of the implementation. In order to implement such a detailed strategy, targets, evaluation and learning structures need to be set up, which has also been done in VGR. Compared to the IIFS, the VG2020 has a less specific focus on innovation; rather innovation is an integrated method/tool for achieving the targets set out in the document. The IIFS is a much shorter document, primarily providing information of the orientation of the innovation policies but not pointing out specific stakeholders that have responsibility for implementing this. Findings from interviews imply that different stakeholders carry out the implementation. The regional business administration provides the process support while networks of actors are to implement projects in the three strategic areas. The lack of this information in the IIFS leads to a lower level of transparency concerning the implementation. A lack of information on implementation responsibility is also . While excluding such specific responsibility assignment may be necessary in order to maintain flexibility, it would conceptually be a strength to the strategies to provide this information.

5.2.4 Barriers for sustainable healthcare innovation

Interviews were carried out with representatives from regional administration and staff working in the healthcare, identifying several barriers that exist for sustainable innovations in the healthcare sector. Generally speaking, the identified barriers revolve around three central themes: agenda, capacity and resources.

Agenda: knowing what to do

Several respondents identified concrete policy formulation as a central prerequisite for getting sustainability issues on the clinic manager's agenda. SUS has recently been able to introduce targets from the regional environmental program to the balanced scorecards, which is expected to increase the performance of the clinics. Since it is currently up to the clinic managers to determine clinic-specific targets themselves, this is done to a varying extent. Where sustainability dimensions were not a part of healthcare innovation projects, they were simply not included (e.g. personal communication, Region Skåne 6, IG, ClinTrials, 2014). When no policy sets out plans for collaborations between relevant organizations/stakeholders, this is only done on an ad hoc level (e.g. collaboration was done in the 'red phone project', following an individual initiative, while no collaboration between Innovator/Innovationsluss and EMU, Lean projects etc.). This lack of collaboration between e.g. environmental administrations on innovation related organizations was also identified in the interviews (Personal communication, VGR 1, 2014).

Capacity: knowing why and how to do it

The majority of the findings revolved around capacity issues in various ways. Firstly, several respondents identify a general conception that environmental issues mostly concern waste management and constitute “*the last priority*” in the healthcare sector, and that there is a *failure to connect economic, environmental and social impacts* of care production. Not identifying co-benefits (e.g. e-health, home-based care, treatment methods) between economic, social/health/OHS and environmental improvements, pointing towards a lack of holistic understanding of the healthcare system’s impacts is thus a barrier in itself. Pre-determined conceptions (lack of understanding) also hinder the development of innovation in the most important areas. An example is Region Skåne’s previous focus on buildings/energy consumption, when it was actually products that have the largest climate impact. Focusing on environmental management systems and (to some extent) innovation procurement – when innovative solutions to care production (e.g. e-health, home-based care) may be more important.

Not receiving feedback on performance also keeps sustainability issues from the stagg’s agenda. Region Skåne is currently implementing several new processes to enable integrated feedback and reporting systems, however it is too early to determine the impact this has on consumption levels and changes in prioritization among staff. This lack of knowledge also keeps the sustainability issues away from the agenda setting – if staff does not know about and understand their impacts, it is not put on the agenda for change.

Resources: Having the means (and capacity) to do it

The innovation capacity in general is also seen as a barrier; several respondents (e.g. personal communication, VGR 3, Region Skåne 6, 2014) identify a lack of innovative culture, especially in public sector healthcare organizations. There is still a ‘jante’ hindering improvement processes, be they economic, social or environmental (they are often connected). Last but not least, monetary resources (working time) to implement capacity-building activities, to allow for cross-administration collaboration (e.g. procurement processes, LEAN processes, collaboration between EMU / IG’s) are perhaps the overriding barrier to achieving more sustainable healthcare innovations. As put by one respondent: “we don’t have resources to participate in innovation projects” (personal communication, Region Skåne 2, 2014). Another respondent points at the production efficiency focus as a constraint to needs-driven organizational innovation “we need to get a bit more google”, meaning that there needs to be time and resources allocated for the staff to think innovatively in the organization in order for it to develop and for innovations to be generated (personal communication, VGR 3, 2014).

5.2.5 Summing up

Summing up the analysis from the regional level, we can conclude that the interpretation of sustainable development was categorized as *strong* in Västra Götaland, where the strategy provides a reference to a clear definition and highlights key elements such as resource constraints, the need to change consumption patterns, shared responsibility and green regional planning. In Region Skåne, the interpretation was categorized as weak sustainable development. Here, there was a lack of concrete definition, a focus on processes and lack of information on several key aspects. The analysis has suggested that a part of the explanation to these differences may lie in the structures of the documents and the character of the developing organization. In Västra Götaland, the document is integrated in the regional development plan and was developed by an organization that has a clear orientation towards sustainable development. In Skåne, the document was developed by the regional business development administration and published by a high-level research and innovation council with a less specific focus on sustainable development. Here, the ideas dimension and the cognitive perspective suggested by Lenschow and Jordan propose a possible explanation as it

suggests that the frame of references in organizational- or policy sectors can determine the orientation of a policy. While both policies were developed in collaboration with many different stakeholders and over a longer time period, the frames of reference and policy orientation of the driving organizations differ. Where the organization was oriented towards sustainable development, the output is a clear definition and stronger reading of sustainable development as well as more specific objectives. Where the organization was oriented towards business development and innovation, the document lacks definitions of sustainable development, presents a weaker interpretation of sustainable development and does not suggest sustainability objectives. Previous studies have also indicated that regional development plans in Sweden have increasingly mainstreamed sustainability aspects (Storbjörk & Isaksson, 2013). Similarly, the VG2020 document fulfills more of the criteria in the operationalization framework, while the IIFS document is rather focused on processes and does not provide information for most of the indicators of the operationalization framework (see Appendix two for a comparison).

As to the integration of sustainability principles in innovation policies, the content analysis suggested that regional innovation strategies, like the national innovation strategy, focused primarily on innovation system processes and economic growth and included relatively few words in the social, environmental or sustainability categories (see Appendix 5). The analysis of survey responses suggests that the innovation strategies that were integrated in the RUS/RUP documents had a more integrated perspective to sustainability. Only RUS/RUP regions indicated that sustainability objectives were objectives of the overall strategy. Almost all regions claim that sustainability aspects influence the innovation activities. However a lower number of regions had defined sustainability objectives and again the RUP/RUS group had defined sustainability objectives to a greater extent. Finally, the barriers to

The main barriers to sustainable healthcare innovation revolve around three main areas. Firstly, agenda setting is essential in order for sustainability aspects to be taken seriously. The organizational capacity to work with these issues is also a main barrier. A low level of priority and shared understanding of the topic as well as the lack of information and feed back that would be needed to clarify the impacts and the possible alternatives. Finally, a restricting organizational culture and lack of resources have been identified as barriers to

5.3 Local level

At the local level, the analysis is focused on determining whether the chosen innovation case organization at local (hospital) level integrates sustainability aspects/principles in their activities (survey, interviews) and identifying barriers for such sustainability integration (interviews).

5.3.1 Integration of sustainability in regional innovation strategies

The findings from the survey identified that the IG's sustainability work is primarily governed by regional sustainability policies; only one IG had internal sustainability policies. All IG's apply some selection criteria, and 62,5% applies selection criteria for all sustainability aspects. There is thus a fairly large indicated implementation of sustainability dimensions, however there is no knowledge about how different aspects are weighed against each other in evaluation processes. All IG's also claim that they assist innovators to highlight sustainability aspects of their innovations where this is relevant. No case region IG had an internal sustainability policy and demonstrated a low focus on these issues (personal communication, IG, VGR 3, 2014). Only 25% of the IG's participating in the survey takes all three sustainability aspects into consideration in the education and information activities held for

innovators. One comment from the survey however suggests that these aspects may be implemented although they are not formalized.

Concerning collaboration with other administrations or organization, the procurement department was considered the most important organization. The IG's explained that there was a need to collaborate with procurement both to communicate sustainability requirements to innovators and to ensure that innovations' benefits to sustainability is understood by the procurement department. Collaboration with technical and material expertise was highlighted by half of the IG's but few IG's mentioned collaboration with organizational development groups or environmental administrations. This may constitute a missed opportunity to improve the capacity to work with environmental aspects and to promote needs-driven innovation, which was highlighted as a barrier to sustainable innovations.

5.3.2 Barriers/opportunities for sustainable healthcare innovation

Survey respondents indicated an internal lack of knowledge about sustainability issues as an important barrier, which also leads to uncertainty about how to work with them. As previously mentioned (and noted by the IG in VGR), an increased collaboration with environmental administration could possibly address this issue. IG Skåne noted that benefits need to be a clearly explained so that a monetary value can be attached to them (personal communication, IG, 2014). Valuing sustainability benefits would of course require an increased competency to do so. This could for example be added to the IG's by educative measures or collaboration with environmental administrations.

The interviews also identified that internal lack of knowledge has also kept this issues off the IG's agendas. (personal communication, IG, VGR 3, 2014). Additional barriers included a lack of understanding among external organizations, both at clinic level and with procurement administrations, where the price focus was identified as a barrier. One IG commented that it was not possible to ask for more than requirements set by the procurement department, further highlighting the need for IG's to collaborate and communicate with procurement and environmental administrations. A lack of resources was also identified as a more general barrier to achieve necessary improvements. The importance of linking and communicating long-term regional sustainability strategies, policies and targets to procurement and innovation practices was highlighted as an opportunity to meet some of the identified barriers. Regional sustainability ambitions need to be clearly communicated to the IG's (and procurement department), to prioritize resource spending and enable the inclusion of sustainability dimensions early in the product development phase. Here, information and educative measures are two ways to promote a sustainable product and service development. It was considered difficult to achieve a competitive advantage by highlighting sustainability benefits of an innovation at the procurement stage, if the innovators were faced with requirements below performance this was not a competitive advantage. Procurement departments need to develop and express that prioritization is granted for products/services that had sustainability benefits before these innovations can be developed.

Summing up

Summing up the local level of the analysis, we can conclude that IGs are governed by regional policies and do not have internal sustainability policies. A majority of the IG's participating in the survey applies all three types of sustainability criteria, but only 25% of them include sustainability aspects in their educative activities. The main barrier to include sustainability aspects in their work is a lack of internal capacity to work with these issues. The low level of collaboration with other administrations may be a missed opportunity to address this. The innovation gateways also highlighted the importance that regional policymakers and procurers communicate the priority given to more sustainable innovations.

6 Discussion

This section pans out from the analytical focus of the thesis to reflect upon and discuss the potential limitations to the research. It also provides some comments on notable observations outside of the main research topic that have been made during the research process.

6.1 Limitations

Analytical choices

A varied body of literature was scanned in order to identify a plausible approach to the topic of sustainable innovations. No one theory was considered sufficient in itself to understand the topic of integrating sustainability principles in innovation policy. The system of innovations theory was included to provide a context for the analysis, as this approach is characteristic for the innovation policies in Sweden. The environmental policy integration approach was used as a point of departure as it constitutes a well-known approach to mainstream environmental considerations into other policy areas. However, the environmental policy integration approach proved to be difficult to apply to innovation policies, possibly because they too are horizontal to their nature. Therefore, the transition management approach and the sustainable innovations theory was used to inform a framework for analysis. The policy cycle theory was applied to provide further structure to Foxon and Pearson's framework. As the EPI literature identified that varying interpretations of sustainability may constitute a determinant to successful implementation, a framework that categorized different interpretations of sustainable development was also used. There may of course have been a more straightforward single theory or framework to analyse sustainability in innovation policies, but the literature review did not capture any such catch-all framework.

An analytical outcome from these different approaches is that the four analysed topics sometimes overlapped with each other. The interpretation, integration and operationalization topics proved to be mutually dependent which led to that one method could be used to analyse different topics. For example, at the national level, the qualitative text analysis corresponded to the interpretation topic, while at the regional level, the qualitative text analysis informed the integration topic. This was considered the most appropriate approach, as the national innovation strategy did not present sustainability arguments throughout the document in the way that the regional innovation strategies did.

Another issue that should be addressed is the normative aspect of the analysis. While it is surely possible to consider sustainability in innovation strategies a normative question, the analysis has sought to refrain from making normative judgements about this. Rather, it has sought to take a point of departure in the constituents of a 'sustainable innovation policy' framework to evaluate how well these correspond to actual innovation strategies and practices. As such, it has been the author's intention to not make normative judgements about whether or not one should seek out sustainable innovation policies, but rather to determine whether innovation strategies live up to them as described by literature.

Methodological choices

Several methodological choices deserve mentioning and discussion. Concerning the analysis of regional innovation strategies, three of the analysed strategies were in the draft version. While it can be discussed whether these are to be considered appropriate data for analysis, the choice to include them was based on an expectation that they would be adopted. As have been mentioned, a assumption was also that these strategies provide a similar approximation of the regional innovations as do the adopted innovation strategies.

Findings from the survey indicated that there were differences between the stand-alone regional innovation strategies and the ones integrated with the RUS/RUP. While it could have been interesting to include them in the quantitative analysis for a comparison, this was not done due to time constraints. While this constitutes an interesting topic for further research, it limits the certainty of the finding that the regional RUP/RUS strategies take a more integrated approach to sustainability and innovation. This is primarily based on the survey and quantitative text analysis, which may not provide sufficient approximations.

Concerning the quantitative analysis, the choice of words that were included in the analysis should be discussed. The search words were chosen after initial reading and the list of words was enlarged as the analysis went on to identify more relevant search words. The words included are thus considered to present a fair approximation of the content. For example, the fact that more words are included in the innovation system category is thus not considered to limit the representativeness of this category. More words were included because it was as these words were observed to be both more frequent and more central to the documents. The words were chosen after reading a number of randomly selected innovation strategies, scanning the most common themes.

In retrospect, Susan Bakers framework 'the ladder of sustainability' proved to be difficult to apply to innovation strategies for the analysis of the interpretations of sustainable development. In some cases, the strategies did not provide clear definitions or arguments around sustainable development, and other methods (e.g. qualitative text analysis) were applied in order to determine the interpretation. The framework was chosen because it constituted a broad, generic framework that was thought to be appropriate to capture the interpretations in broad strategies. However, as the analysis has shown, findings do not file nicely into one single category. Rather, they spread over two or three categories and an average had to be estimated in order to determine the interpretation. However, once this average was estimated, it did correspond well to the findings from the operationalization analysis, as was suggested by the EPI literature.

Legitimacy

The conclusions made in this thesis are truly valid for the analysed material; national and regional innovation policies and practices at a single type of healthcare innovation organization (innovation gateways). Further research is of course needed to determine actual implementation in the innovation systems in general since, as the systems of innovations theory suggests, there are several actors that influence the innovation system and the innovation policies are just one document, however central to the innovation policies of the innovation system. A limitation to the operationalization of the third research question is of course the choice of a single innovation organization. Other innovation organizations in the healthcare sector may integrate sustainability principles in different ways although interviews with stakeholders taking part in different regional innovation activities point in the same non-integrated direction as these findings.

Generalizability

The results of this analysis are generalizable to regional innovation strategies, but may not be appropriate to describe innovations strategies integrated in RUS/RUP documents. Since the cases studied in this thesis are limited to the Swedish context, the findings validity are primarily valid for the Swedish innovation system.

6.2 Organizational innovation capacity

The research process has also collected several interesting observations from stakeholders on factors outside the scope of the research question. These include issues regarding access to healthcare for clinical trials, procurement processes effect on innovation processes, issues concerning innovation adoption and knowledge transfer in healthcare and a range of other organizational constraints.

The perhaps most important issue is however observations concerning constraints to innovation capacity in the healthcare sector more generally. Here, Region Skåne witnesses about a ‘public sector mentality’ that limits the innovation capacity in general. Private entrepreneurs are more prone to think innovatively as they are used to competing for clients and adjusting their business models according to market needs. However, the public sector does not share this innovative approach (personal communication, Region Skåne 6, 2014).

One respondent argue that “where people work in healthcare, you know, we don’t have an innovation culture whatsoever. These things with innovating thinking and improvement is not in the organization’s nature, not in the leadership, it’s not these things that are showcased. It is very production oriented. We talk about, (...) *producing* care. This thing about *developing* care, that’s (...) clearly subordinate.” “And then a lot of people experience economic cut downs, it’s getting tougher, we have less time, which means more pressure – and that renders even harsher preconditions for thinking ‘new and big’. And I think that has caused that some experience – in terms of [organizational] culture – that they shouldn’t, or perhaps are not even allowed to develop [innovations] and think [innovatively]. I think that is the main problem, the [organizational] culture aspects.” (personal communication, IG, 2014). Several respondents points to the cultural group behavior known as *jantelagen*, signifying negative attitudes towards individual achievement from the group in which the individual belong: “We can definitely say that there is some ‘Jante’ in the [organizational] culture (...) It should not be possible to hear about people saying things like “you are not here to think” or “you should do this, you shouldn’t fiddle with something else” (personal communication, IG, 2014).

The public-private innovation capacity differences are further noted to correlate with gender structures in the work environment. Typically, the “internal entrepreneur” (often a women) is currently working in healthcare with a public sector background, driven by the objective to deliver good care and has less entrepreneurial experience (less risk-taking). The “external entrepreneur” (often a man) is working in a private company, has a clearer profit motive and long experiences in business development. In the Vårdcheckar project, the external entrepreneurs often applied for much larger sums than the internal entrepreneurs (had to divide the fund into two parts to deal with this issue). The internal entrepreneurs’ innovations are often described with a more cautious language that focuses on the patient (with more service/process innovations) while the external entrepreneur has a more specific and technical language (focusing on specific technological solutions) (personal communication, Region Skåne 6, 2014).

These findings suggest interesting aspects of organizational culture in the healthcare sector that limit the general innovation capacity. Further research on these topics should be well met, as national and regional innovation administrations alike are looking to increase the innovation capacity of the public sector.

7 Conclusion

This section provides a conclusion of how the thesis' research questions have been answered by the findings and analysis previously presented. The conclusions are presented under the four main topics of the thesis: integration, operationalization, interpretation and barriers to sustainable innovations in healthcare. For each topic, recommendations and suggestions for future research is provided.

7.1 Integration of sustainability

The first research question sought to answer whether sustainability principles are integrated with innovation policies at national and regional level and practices at local (hospital) level. Several analyses were carried out to determine the integration of sustainability. The study used a combination of quantitative analyses (national and regional innovation strategies), qualitative analyses (national and all regional innovation strategies), surveys (regional and local level) and interviews (case studies at regional and local level). The quantitative content analysis identified that both the national and regional stand-alone innovation strategies focus primarily on the innovation system's actors and processes and on creating national and regional growth. The lower frequency of words in the environmental, social and sustainability categories suggest that the innovation policies put less focus on these topics, granting them a lower importance. However, quantitative findings regarding the frequency of these topics do not provide much insight as to their centrality. Therefore, a qualitative analysis was conducted to identify the function of sustainability topics in innovation policies. The qualitative analysis of the national and two regional innovation strategies suggest that social and environmental sustainability challenges function as underlying drivers to national and regional innovation policies, rather than as objectives for innovation activities.

The quantitative analysis further identified a slightly more varying and concrete sustainability vocabulary at the *regional* level. Similarly, the findings from the survey and qualitative analysis indicated that there was a clear connection between almost all regional sustainability policies and regional innovation policies, and that about 70% of the regional innovation administrations had defined concrete sustainability objectives for their activities. These results point towards a fairly integrated approach to sustainability at the regional level. However, the thesis has not determined the content or application of these objectives. Further, both the survey and the qualitative analysis pointed towards a *more integrated approach* to sustainability in the regions where the innovation strategy was *integrated in the RUP/RUS*. The qualitative analysis similarly identified that the analyzed RUP document used sustainability arguments more frequently and had a more balanced use of different sustainability arguments than the analyzed regional innovation strategy.

These initial findings thus suggest that a RUP/RUS format may indeed provide a higher level of integration and operationalization of sustainability aspects. However, it is most likely not the format of the policy, but what type of the organization that develops it, that is most essential for integration and operationalization. The organization developing the more integrated RUP document had a clear sustainability orientation, while a regional business development administration and a high-level innovation council developed the stand-alone innovation strategy. In this regard, the literature analysis points out that the cognitive frames of reference of the organizations that develop innovation strategies largely influence the agenda-setting and policy-making stage. While an increasing number of separate regional innovation strategies are developed, these findings suggest that *the efficiency of separate innovation strategies and administrations is questionable, should regions be interested in developing 'sustainable innovation strategies'*. The literature analysis moreover suggests that an important factor in order to develop 'sustainable innovation strategies' is that the organization that develops the strategy

has a (*shared*) *understanding of, and priority given to, sustainable development and using innovation policies to promote it*. Meanwhile, it should be noted that while the level of integration and operationalization may differ between these formats, it is *uncertain how the stand-alone innovation strategies perform* on solving sustainability challenges compared to the more integrated sustainability oriented RUS/RUP documents.

The survey findings also identified a *discrepancy* between the regional innovation agencies' perception of innovations' potential contribution to societal transformation and the perception of the innovation strategy's purpose. While most regional innovation agencies consider innovation to have the *potential* of transformative, factor five improvements, only about a third (all of which RUP/RUS regions) mention sustainable development aspects as an overall objective, or *purpose*, of the strategy. At national level, the innovation agency's perception seems aligned with its objectives concerning this topic (e.g. VINNOVA's target of 80% projects/programs being related to more than one sustainability aspect). However, we know less about other agencies integration of sustainability aspects in innovation activities.

Suggestions for policy makers

Policy makers could consider whether there is an untapped potential as to creating synergies between regional innovation strategies, regional sustainability policies and regional development plans. Findings from this exploration of the topic suggest that an integration of regional innovation strategies into regional development plans provides a stronger link between these two areas, compared to where these two policies are handled in separate strategies and by separate administrations. Both the literature and this thesis's analysis suggest that in order to develop sustainable innovation strategies, highly important factors in the administration that develops the innovation strategy include agenda-setting capacity and shared understanding concerning sustainability objectives.

In order to develop sustainable innovation strategies, policymakers are therefore recommended to assign the development of innovation strategies to organizations where sustainability expertise are highly integrated in the organization. This could for example be achieved by intensive cross-administrative collaboration or by assigning a organization with a clear orientation towards sustainable regional development the responsibility to develop innovation strategies. The latter approach is the one taken in Västra Götaland.

Future research

More research is needed to develop the knowledge about how sustainability aspects are integrated within different types of innovation strategies. Future research could also consider organizational and policy related aspects that effect the implementation of these strategies has on sustainability challenges (e.g. the importance and impacts of having measurable objectives). The actual impact of 'sustainable innovation strategies', as to their increased potential to solve different sustainability challenges, also needs to be further analyzed empirically (e.g. longitudinal studies). The findings indicate that the RUP/RUS document design may present a preferable format for integrating sustainability aspects into innovation policies. A suggested topic for a future research is therefore to further investigate the performance of these different strategy formats. Future research could also seek to identify best practices and develop indicators for measuring the impact of innovation policies to sustainability challenges. Identifying ways to integrate sustainability transformation into innovation policies would also present an interesting research topic.

7.2 Operationalization of sustainability

A framework for sustainable innovations was used to analyze the operationalization of sustainability aspects. This was then applied in a qualitative analysis of the national and the two case regions' innovation strategies. The findings conclude that all three innovation strategies recognize sustainability challenges and link them to the innovation strategy. However, it is only the VG2020 that defines specific targets for improving performance on sustainability challenges, which innovation activities should contribute to. It also defines progress indicators and an evaluation plan. VG2020 integrates sustainability objectives with innovation policies in a way that is different from the SNIS and the IIFS, which both are primarily oriented towards improving innovation system processes and both has economic growth as a primary objective. The VG2020 thus comes closer to providing a strategic framework for the transition to a sustainable society.

It should be noted that these findings are applicable to the documents and do not evaluate output performance. Doing so would require both a longer implementation time of the strategies and perhaps a longitudinal study design. The analyzed strategies were developed between 2011 and 2013 and all set out targets primarily for the year 2020. It is thus too early a stage to evaluate the strategies' effects on sustainability performance. However, it is worth noting that the VG2020 is the only document that sets out indicators for evaluation. The SNIS and the IIFS are more process-oriented to their design and do not develop sustainability indicators (although the SNIS has assigned two agencies to develop indicators). This lack of objectives, targets and indicators lead to a lower operationalization of sustainability objectives, and may lead to that the usability and legitimacy of the strategies is questioned. While national and regional innovation policies integrate sustainability aspects as drivers, evaluation criteria is lacking in many cases. The sustainability aspects of innovation strategies therefore risk being watered down in the implementation stage (observation for stand-alone innovation strategies, not including RUS/RUP where there is too little data collected). Rather than focusing on innovations that promote meeting on sustainability challenges, innovation projects risk ending up focusing on the process of the innovation projects (e.g. the level of gender equality in an innovation project, rather than also focusing on innovations that can promote gender equality).

Suggestions for policymakers

Findings from the study of the IIFS highlight the difficulty of evaluating the performance of a process-oriented strategy. While the need to improve processes is highlighted in the innovation system literature, the sustainable innovation literature suggests that *linking innovation strategies to regional objectives, targets and indicators for sustainable development* is important for organizations that wish to use innovation as a tool for the transformation to a more sustainable society. Doing so could also enable defining measurable sustainability indicators for innovation activities' performance (as has been done in VG2020), which could strengthen the legitimacy of innovation administrations. A suggestion for policymakers that wish to promote sustainability in the innovation strategies is thus to develop clearer sustainability objectives and targets in the innovation strategies. This would in turn enable the development of sustainability indicators.

Future research

Future empirical research is needed to evaluate different innovation strategies performance in relation to meeting sustainability challenges. Future theoretical research could also further the development of frameworks and evaluative tools for sustainable innovations.

Future research concerning the (currently ongoing) development of indicators for the SNIS should also be interesting. The research could analyze whether these indicators consider sustainability aspects and to what extent sustainability aspects of the SNIS influence different governmental agencies, regions and other actors in the innovation system. This would add an important part to the analysis of the sustainability orientation of the national innovation strategy. Research on the implementation and performance in different agencies could also be an interesting further research topic. While VINNOVA may currently have an integrated approach to sustainability, it is only one out of a large number of organizations that are effected by the SNIS. Research focusing on implementation in other agencies would be interesting to understand the implementation performance and barriers in organizations that are not equally oriented to innovation. Another interesting research topic would be the historical development of the SNIS in itself, concerning how sustainability aspects were included in the process of developing the strategy.

7.3 Interpretation of sustainability

The thesis sought to define what interpretation of sustainability was found in the innovation policies at national level and regional level (the two case studies), using Baker's ladder of sustainability as a framework for analysis. The analysis suggested that the national innovation strategy had an overall *weak* interpretation of sustainable development, while VG2020 had an overall *strong* interpretation and the IIFS had somewhere between *weak* interpretation of sustainable development and pollution control. A correlation has been noted between the interpretation of sustainability and the operationalization of sustainability, strengthening the arguments from the environmental policy integration literature, which highlights how normative interpretations of sustainable development often guides the operationalization thereof.

Suggestions for policymakers

As previously noted, the understanding of sustainability challenges is important for successful implementation of sustainability aspects at the agenda-setting stage. Therefore, sustainability expertise (e.g. from environmental/sustainability administrations) could be engaged in the development and update of innovation strategies in order to improve the operationalization of sustainability in innovation strategies. This could for example be done by cross-administrative collaboration, bringing in sustainability expertise at innovation administrations or integrating innovation strategies in overarching documents such a regional development plans.

Future research

As noted in the discussion, Baker's framework may not propose an ideal framework for analyzing interpretations of sustainable development in innovation strategies. The analyzed strategies corresponded to different categories on different topics and an average result thus had to be determined. This may imply that Baker's framework is perhaps too generic for analyzing different interpretations of sustainability in innovation policies. Future research could look into the development of a framework for analyzing sustainability interpretations in innovation strategies.

7.4 Barriers for sustainable innovations in healthcare

The thesis finally had a particular focus on determining the main barriers for integration of sustainability principles in the healthcare sector's innovation practices. To analyze this, interviews were carried out with respondents from national, regional administrations and the case study innovation gateways. A survey was also sent out to all the Innovation Gateways.

The findings relating to barriers largely mirrored several previously indicated barriers; mental

barriers in organizations, the need for managers to encourage innovation and to improve collaboration processes (see section 1.1.1 and 1.1.2). The findings from this research conclude that the barriers for sustainable innovation in the healthcare sector revolve around three main topics, both at regional and local level. Firstly, the *agenda-setting* stage proved to be of great importance. The innovation projects that did not have specific sustainability objectives or policies did not work actively with these issues. Here, several stakeholders also highlighted the importance that regional sustainability policies and targets are clearly communicated to, and understood by, both innovation organizations, procurement departments and the healthcare sector (i.e. clinic managers) in general. Making these targets seen at an operational level (e.g. by their introduction in clinic's balanced scorecards) is one possible first step to do so. Several respondents also identified a general disconnect between regional sustainability and innovation policies and local healthcare sector innovation projects. Making ambitious innovation and sustainability policies more operational on the local (hospital) level presents an important task for regional administrations. This points at a need for increased collaboration between these organizations. Most Innovation Gateways were started as a project intended to build innovation capacity (designed and co-financed by VINNOVA). Although they have now been taken over by the regional level administration, the objective of improving innovation capacity is the most evident and regional sustainability policies are generally not reflected into the Innovation Gateways' activities. The survey indicated that Innovation Gateways have generally not developed sustainability training or selection criteria

Secondly, a *lack of capacity* was a commonly identified barrier, relating both to a lack of competence in the innovation organizations on how to work with sustainability aspects and to the capacity in healthcare organizations to understand the importance of, and interlinkages between, sustainability issues. Several respondents highlighted the importance of being able to attach a monetary value (e.g. health economic value, the value of energy efficiency improvements) to environmental improvements in order to make them interesting for decision-makers. The organizational capacity to do so constitutes one of the most important barriers to sustainable healthcare innovations. A *lack of resources* constituted the important third barrier to sustainable innovations in healthcare. The focus on economic efficiency in care production has slimmed down organizations, leaving little maneuvering space for thinking innovatively about processes, services or products. For a sector that calls out for needs-driven innovation, this lack of reflection on production systems threatens the capacity to deliver sustainable innovations.

Suggestions for policymakers

Following these conclusions, policymakers should focus on improving communication on *how to implement sustainability policies to lower levels of the administration*. This could be done by *top down* strategies (e.g. introducing sustainability targets in balanced scorecards or bonus points for sustainability aspects in innovation projects' evaluation criteria) or *bottom up* strategies (focusing on capacity building and learning for staff in the organization). A special focus should be put on enabling staff (especially clinic managers, procurement departments and innovation administrations) to calculate and communicate economic values of sustainability improvements. These measures could for example mean that health economic and resource efficiency improvements are included in innovation evaluation and procurement practices.

A related task is to clarify and communicate interlinkages and co-benefits between innovations, improvement processes (e.g. lean processes) and sustainability impacts. Not only would this contribute to putting all three sustainability dimensions on the agenda, it could also improve the innovative capacity. An innovation window of opportunity can open up during the creative space allowed in extraordinary improvement processes. This creativity could be strengthened by introducing non-traditional improvement aspects (e.g. time, money) in these

processes. Doing so could also generate the engagement of staff that are less incentivized by improving economic performance but may be interested in contributing to improved social or environmental sustainability. Thompson et al. have similarly suggested that tapping into sustainability awareness can help “expand idea space” in order to strengthen innovation capacity. Sustainability experts can of course not be hired at any number of local administrations or hospital departments. Therefore, the need to *provide resources for cross-administrative collaboration* should not be underestimated. There is already a great competency on sustainability in regional administrations, but this research indicates that they are rarely included in innovation projects in the healthcare sector. Cross-administrative collaboration should be supported in order to implement many of the provided suggestions. When designing innovation projects or programs, including sustainability aspects early on in the project formulation and enabling participants to work with these issues, is important to achieve sustainable innovation systems. This recommendation primarily intended for regional innovation administrations and the national innovation agency VINNOVA. Most Innovations Gateways studied in this thesis were originally designed to increase the innovation capacity of healthcare sector staff, and did not have specific focus on sustainability. As they were taken over by regional administrations, this focus has remained and sustainability aspects have not been integrated into the Innovation Gateways’ activities. However, developing tools for implementing sustainability aspects in innovation projects could make local practices more sustainable, make the links between regional innovation and sustainability administrations clearer and strengthen the national innovation agency’s capacity to reach the goal of 80% sustainable innovation projects.

Future research

Several observations have been made concerning organizational barriers to innovation in the public sector. Future research could focus on how innovation culture in healthcare sector can be linked to sustainability as well as analyses of the impact of gender in the public sector’s innovation capacity.

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Appendix 1 - Analyzed Innovation Strategies

Region		Innovation strategy	RUS / RUP	Action plan
A B	Stockholm	X		X
C	Uppsala	X		X
D	Sörmland	X (draft)		X
E	Östergötland	X		X
F	Jönköping		X	X
G	Kronoberg	X (draft)		
H	Kalmar		X	X
I	Gotland			
K	Blekinge	X (draft)		
M	Skåne	X		
N	Halland	X		X
O	Västra Götaland		X	X
S	Värmland		X	
T	Örebro	X		X
U	Västmanland	X		
W	Dalarna		X	X
X	Gävleborg	X		X
Y	Västernorrland		X	X
Z	Jämtland	X		X
A C	Västerbotten	X		
B D	Norrbotten	X		

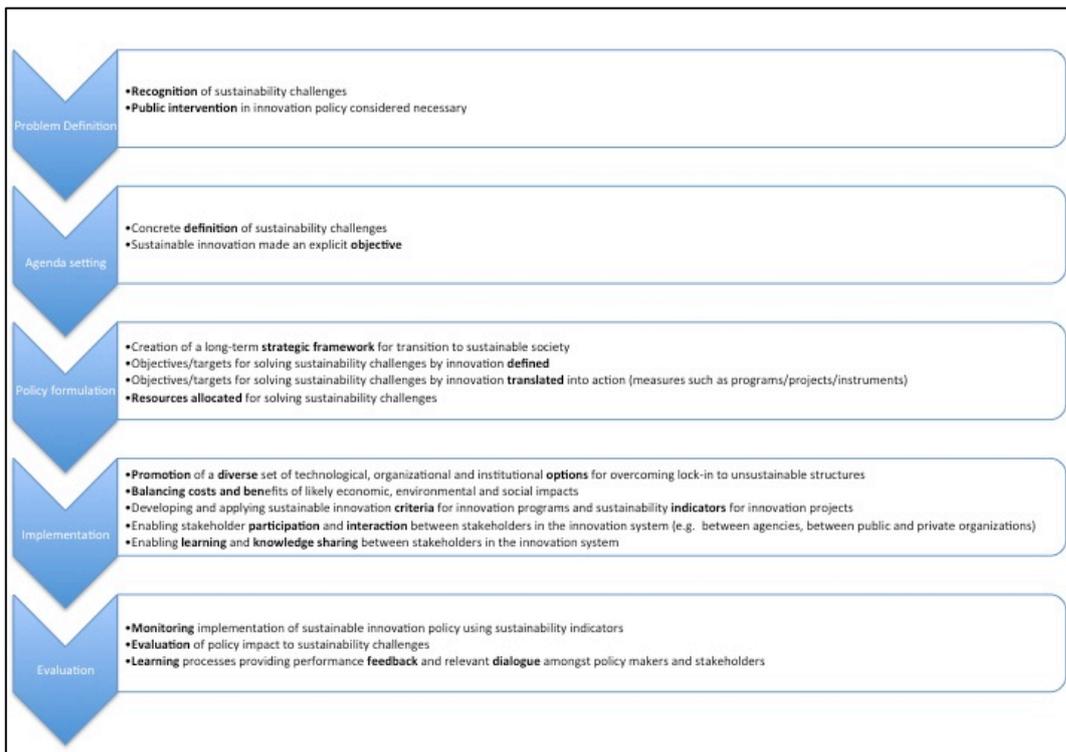
Appendix 2 – Operationalization analysis, results

CRITERIA	SNIS	VGR	RS
Recognition of sustainability challenges	Yes	Yes	Yes
Intervention in innovation policy considered necessary	Yes, somewhat	Yes	Yes
Concrete definition of sustainability challenges	Yes	Yes	No
Sustainable innovation explicit objective	No	Yes	No
Strategic framework for transition to sustainable society	No	Yes, to some extent	No
Sustainability objectives defined	No	Yes	No
Sustainability objectives translated to activities	No	Yes	No
Resources allocated	No - agency level	No - department level	No
Promotion of diverse options	Yes , range of stakeholders	Yes , range of stakeholders	Yes , range of stakeholders
Balancing cost and benefits of sustainability impacts	No	No	No
Developing criteria for innovation programs & projects	Not specified – ex post process performed by ministries	Yes (interview)	Yes (interview)
Enabling stakeholder participation	Yes (document creation) (ministry/decentralized implementation)	Yes	Yes (interview)
Enabling stakeholder learning	Not specified	Yes	Yes (interview)
Monitoring implementation	Not specified – ex post process performed by ministries	N/A	
Evaluation of policy impact on sustainability	Not specified – ex post process performed by ministries. No objectives such evaluation proposed so far	Yes	No
Learning process and feedback	Not specified – at ministry level	Yes	No (Yes in interview)

Appendix 3 – Operationalization analytical framework

Box 1. Guiding principles for sustainable innovation (SI) policy processes [10]

- (1) Stimulate the development of a SI policy regime, bringing together the innovation and environmental policy regimes, by:
 - (i) Making *sustainable innovation an explicit goal of policy making*;
 - (ii) Facilitating *systemic changes* to current technological and institutional systems;
 - (iii) Creating a *long-term, stable and consistent strategic framework* to promote a transition to more sustainable systems;
 - (iv) Formulating clear, *long-term sustainability goals*.
- (2) Apply systems thinking, engaging with the complexity and systemic interactions of innovation systems and policy-making processes, to promote a transition to sustainability, by:
 - (i) Developing and applying the concept of '*systems failures*' as a rationale for public policy intervention;
 - (ii) Taking advantage of the appearance of '*techno-economic*' and '*policy windows*' of opportunity;
 - (iii) Promoting a *diversity of technology and institutional options* to overcome 'lock-in' of unsustainable technologies and supporting institutions;
 - (iv) Developing and implementing the '*substitution principle*'.
- (3) Advance the procedural and institutional basis for delivery of SI policy aims, by:
 - (i) Promoting *public/private institutional structures* to enhance regulator/regulated relationships and stakeholder activities;
 - (ii) Ensuring broad *stakeholder participation*, particularly from the '*innovation constituency*'.
- (4) Develop an integrated, synergistic mix of policy processes and instruments that cohere to promote sustainable innovation, by:
 - (i) Applying *sustainability indicators and sustainable innovation criteria*;
 - (ii) *Balancing benefits and costs* of likely economic, environmental and social impacts;
 - (iii) Utilising a *dedicated SI risk assessment tool* in developing policy support instruments;
 - (iv) Assessing instruments in terms of appropriateness to *stages of the innovation process*.
- (5) Incorporate policy learning as an integral part of SI policy process, by:
 - (i) *Monitoring and evaluation* of policy implementation;
 - (ii) Review *policy impacts on sustainable innovation systems*;
 - (iii) *Learning and policy process enrichment*.



Appendix 4 – Ladder of Sustainability

Model of SD	Normative principles	Type of development	Nature	Spatial focus	Governance	Technology	Policy integration	Policy tools	Civil society - state relationship	Philosophy
Ideal model	Principles take precedence over pragmatic considerations (participation, equity, gender equality, justice; common but differentiated responsibilities)	Right livelihood; meeting needs not wants; biophysical limits guide development	Nature has intrinsic value; no substitution allowed; strict limits on resource use, aided by population reductions	Bioregionalism; extensive local self-sufficiency	Decentralisation of political, legal, social and economic institutions	Labour-intensive appropriate, green technology; new approach to valuing work	Environmental policy integration; principled priority to environment	Internalisation of sustainable development norms through ongoing socialisation, reducing need for tools	Bottom-up community structures and control; equitable participation	Ecocentric
Strong Sustainable Development	Principles enter into international law and into governance arrangements	Changes in patterns and levels of consumption; shift from growth to non-material aspects of development; necessary development in Third World	Maintenance of critical natural capital and biodiversity	Heightened local economic self-sufficiency, promoted in the context of global markets; green and fair trade	Partnership and shared responsibility across multilevels of governance (international, national, regional and local); use of good governance principles	Ecological modernisation of production; mixed labour and capital-intensive technology	Integration of environmental considerations at sector level; green planning and design	Sustainable development indicators; wide range of policy tools; green accounting	Democratic participation; open dialogue to envisage alternative futures	↑
Weak Sustainable Development	Declaratory commitment to principles stronger than practice	Decoupling; reuse, recycling and repair of consumer goods; product life-cycle management	Substitution of natural capital with human capital; harvesting of biodiversity resources	Initial moves to local economic self-sufficiency; minor initiatives to alleviate the power of global markets	Some institutional reform and innovation; move to global regulation	End-of-pipe technical solutions; mixed labour- and capital-intensive technology	Addressing pollution at source; some policy co-ordination across sectors	Environmental indicators; market-led policy tools and voluntary agreements	Top-down initiatives; limited state-civil society dialogue; elite participation	
Pollution control	Pragmatic, not principled, approach	Exponential, market-led growth	Resource exploitation; marketisation and further closure of the commons; nature has use value	Globalisation; shift of production to less regulated locations	Command- and-control state-led regulation of pollution	Capital-intensive technology; progressive automation	End-of-pipe approach to pollution management	Conventional accounting	Dialogue between the state and economic interests	Anthropocentric

Source: Susan Baker (2006)

Appendix 5 - Quantitative analysis categories

Category	Words	National innovation strategy	Regional innovation strategies
Economic	Tillväxt, konkurrenskraft, arbetskraft, lönsam, ekonomi, värde, industry, affär, företag, bolag, finansiering, affärsutveckling (12)	466 words = 31,34%	1647 words = 27,55%
Social	Mänsklig, rättigheter, jobb, sysselsättning, social, kunskap, utbildning, hälsa, jämlik, jämställd, rättvis, mångfald, tolerans, etni-, kön, genus, integ-, demokrat-, demograf- (19)	203 words = 13,65%	694 words = 11,60%
Environmental	Miljö, miljöteknik, energi, grön, bio-, resurs, ekologi-, kemi, föroren-, förstör-, koldioxid, CO2, klimat, förnybar, återvinning, uppvärmning, växthus, cirkulär, övergödning, transport (20)	81 words = 5,45%	322 words = 5,38%
Sustainability	Hållbar, utmaning-, system, 2020 (4)	100 words = 6,72%	609 words = 10,18%
Health	Hälsa, hälso, sjukvård, sjukhus, frisk, life science, medicin, åldrande, äldre (9)	7 words = 0,47%	126 words = 2,10%
Participatory	Deltagande, delaktig, långsiktig, mandatperiod, idébärare, inkluder-, öppe-, open (8)	45 words = 3,03%	226 words = 3,78%
Innovation system	Näringsliv, akademi, universitet, offentlig sektor, offentliga medel, upphandling, civil- ideell, brukare, användar-, kund, finansiärer, aktörer, innovationssystem, innovaitonsstödsystem, global, internationell, globalisering, samarbete, samverkan, omvärld, kluster, nationella innovationsstrategin, forskning, entreprenörskap (25)	585 words = 39,34%	2354 words = 39,37%

Appendix 6 - Survey questions, Innovation Gateways

Den här enkäten söker svar på hur ni arbetar med hållbarhetsfrågor inom er innovationssluss. Den tar upp frågor som huruvida det finns en specifik hållbarhetspolicy som ni arbetar efter, samt huruvida och på vilket sätt hållbarhetsaspekter omsätts i er verksamhet

- Styr innovationsslussens interna verksamhet (t.ex. rutiner för resor, inköp etc.) av någon miljö- eller hållbarhetspolicy?
- Om ja, på vilken nivå? Regional – Nationell - Övrigt
- Styr innovationsslussens externa verksamhet (t.ex. era aktiviteter i projekt, med deltagare och intressenter) av någon miljö- eller hållbarhetspolicy?
- Om ja, på vilken nivå? Regional – Nationell - Övrigt
- Har ni en egen hållbarhetspolicy (alternativt hållbarhetsmål) för innovationsslussen?
- Om ja, ge exempel på mål och konkreta åtgärder som finns i policyn.
- Tillämpar ni urvalskriterier för vilka projekt som ni går vidare med?
- Om ja, finns det några hållbarhetsfaktorer med i urvalskriterierna?
- Om ja, vilken slags hållbarhetsfaktorer finns med i urvalskriterierna? Sociala – Ekonomiska - Miljömässiga
- Om ja, var vänlig klistra in eventuella sådana hållbarhetskriterier.
- Finns hållbarhetsfrågor med i informations- eller utbildningsaktiviteter ni genomför med intressenter?
- Om ja, vilken slags hållbarhetsfrågor? Sociala – Ekonomiska - Miljömässiga
- Om ja, exemplifiera kortfattat
- Hjälper ni innovatörer att plocka fram innovationernas miljö- eller hållbarhetsnyttor under stödverksamheten?
- Om ja, vilken slags hållbarhetsnyttor?
- Sociala förbättringsfaktorer hos produkt/tjänst/process - Ekonomiska förbättrings- eller effektiviseringsfaktorer hos produkt/tjänst/process - Miljömässiga förbättringsfaktorer hos produkt/tjänst/process
- Lyfts hållbarhetsfrågor fram på andra sätt i verksamheten med innovationerna?
- Samverkar ni med andra projekt eller organisationer inom vården (till exempel upphandlingsenheten, miljöadministrationen eller under förändrings- eller effektiviseringsprocesser på avdelningar)? Om ja, beskriv detta kortfattat. - Nej - Ja
- Vilka hinder finns för att lyfta in hållbarhetsaspekter i innovationsslussens arbete? Beskriv kortfattat
- Vilka möjligheter ser du att lyfta in hållbarhetsaspekter i innovationsslussens arbete?

Tack för din medverkan!

Appendix 7 - Survey questions, regional innovation administrations

This survey seeks to collect information about sustainability aspects in the regional innovation strategy.

- For which region's account is the survey respond?
- What is the central document for your region's innovation activities?
- What are the most important objectives of your region's innovation strategy (or corresponding)? Please indicate at least three objectives.
- Is there any environmental- or sustainability policy or –program that influences the regional innovation activities? Yes – No – Other
- If yes, at what level are these policies located? Choose all relevant policies: the national level (e.g. environmental quality objectives) – regional level environmental program/policy – other, namely:
- How important are the different sustainability aspects for the innovation activities? Please indicate the order of importance.
- Economic sustainability (e.g. profitability, job creation, regional growth etc.)
- Environmental sustainability (e.g. reductions of climate change impacts, eutrophication, transports, materials used, chemicals etc.)
- Social sustainability (e.g. health benefits, job creation, safety aspects, comfort etc.)
- Is positive **environmental** impacts / reduction of negative environmental impacts one of the defined **objectives** of the innovation activities?
- If yes, how is this / are these objectives formulated?
- Is positive **social** impacts / reduction of negative social impacts one of the defined **objectives** of the innovation activities?
- If yes, how is this / are these objectives formulated?
- Is positive environmental or social impacts / reduction of negative environmental or social impacts an underlying **objective** of the innovation activities? (policy formulation)
- If yes, please provide a short explanation (can also be pasted from policy)
- Are sustainability aspects reflected into innovation activities of the innovation policy? E.g. are environmental/sustainability impacts selection criteria for projects that you sponsor? Do you perform educational measures in sustainability for participating innovators/customers (e.g. organizing courses or setting up networks that discuss sustainability issues? Are innovators encouraged to report on sustainability performance?
- Yes – No – Other
- If yes, comment and exemplify.
- Do you collaborate / coordinate your work with environmental administration at the regional level?
- If yes, how?
- Do you know if the environmental administration carries out innovation projects?
- Yes, environmental administration – Yes procurement – Other
- If yes, do you collaborate in these projects?
- Yes, environmental administration – Yes procurement – Other
- Is there currently any innovation project in the healthcare sector in your region?
- Yes – No – Other
- If yes, is there a clear sustainability focus in any of these projects? Yes, environmental aspects are considered – Yes, social aspects are considered – Yes, economic aspects are considered – No – Other
- What role can innovations play in the development of a more sustainable society? Please choose all answers you believe corresponds closest to the regional innovation policy or complete with own answer: Innovations can develop technological and services that help to reduce negative environmental impacts – Innovations can develop cleaner technologies and services that drastically reduce negative environmental impacts – Innovations can change production and consumption systems towards more sustainable solutions – Innovations can radically transform production and consumption systems towards more sustainable solutions

Appendix 8 - Personal communication

National level

Medeon, personal communication with Ulf G Andersson, CEO, Medeon, The Science Park for companies in Life Science. July 10, 2014.

SCA, personal communication with Anna Lipkin, The Swedish Competition Agency. August 12, 2014.

EMCC, personal communication with Karin Ramstedt, Chairman, Nätverket Landstingens Miljöchefer. August 12, 2014.

SMT, personal communication with Jan Heidebrandt, Project manager Swedish MedTech. July 10, 2014.

Eriksson, personal communication with Daniel Eriksson, expert in Sustainable Helathcare, TEM at Lund University. June 8, 2014.

Hearing on sustainable healthcare, meeting minutes from stakeholder meeting with life science and med tech industry, Stockholm, May 19, 2014.

Region Skåne

Region Skåne 1, personal communication with Anna Palminger, Department of environmental strategy, Region Skåne. July 9, 2014.

IG, personal communication with Jonas Gallon, CEO, Innovator Skåne. August 21, 2014.

Region Skåne 2, personal communication with Lasse Bengtsson, Department of environmental strategy, Region Skåne. June 16, 2014.

Region Skåne 3, personal communication with Louise Strand, Director of procurement department, Region Skåne. July 1, 2014.

Region Skåne 4, personal communication with Mattias Fredriksson, Vice president Business development Schneider Electric Sweden. June 16, 2014.

Region Skåne 5, personal communication with Torbjörn Lindgren, Skåne University Hospital, Region Skåne. July 4, 2014.

Region Skåne 6, personal communication with Anna Nilsson, Business Development, Region Skåne. July 8, 2014.

ClinTrials Skåne, personal communication with Fred Kjellson, Project manager Medtech ClinTrials Skåne. August 7, 2014.

Region Skåne 7, personal communication with Björn Lagnevik, Business Development, Region Skåne. August 4, 2014.

Västra Götalandsregionen

VGR 1, personal communication with Viveca Reimers, Environmental manager, Västra Götalandsregionen. June 10, 2014.

VGR 2, personal communication with Anna Grind, Material Consultant, Västra Götalandsregionen. July 4, 2014.

VGR 3, personal communication with Marika Hellkvist Greberg, Project manager Innovationsslussen, Research, Development and Education department, Regional Development secretariat, Västra Götalandsregionen. July 8, 2014.

VGR 4, personal communication with Mats Fridh, Project Coordinator Innovationsslussen, Västra Götalandsregionen. June 10, 2014.

VGR 5, personal communication with Gabriel Skarbäck, Regional Development officer, Västra Götalandsregionen. September 3, 2014.

