REPORT

A study of the digital green transition in the Nordic-Baltic countries

Nordic Council of Ministers

Table of contents

Executive summary

This report focuses on the concept of the digital green transition, defined as a comprehensive societal transformation in which all sectors adopt relevant technologies that contribute to a low-carbon society. The study maps policies, analyses positions of strength, barriers and potential, and ends with a presentation of 10 policy recommendations to accelerate the digital green transition in the Nordic-Baltic countries (often referred to as the "NB8").

Section one

The results of the policy mapping point to the existence of a policy lag across all of the Nordic-Baltic countries. This means that the general level of integration between digital technologies and environmental challenges in policy documents is superficial. The analysis identifies a widespread recognition of a digital green potential, but that a clearer description is needed of technological solutions, and the environmental challenges to which they can be directed. Only rarely is a description offered of how these goals can be pursued.

Section two

The analysis identifies six foundational enablers driving digital green transition across the Nordic-Baltic countries. A synthesis of the results from the NB8 points to specific cross-regional strengths, such as public-sector funding schemes, green innovation performance and workforce skills. It also identifies potential approaches, such as the strategic building of open green data spaces, improving targets for and monitoring of green public procurement, and increasing the number of higher education programmes dedicated to integrating digital and environmental disciplines and competences. The Nordic and international cases in this section point to an old challenge, however: the lack of collaboration between professional silos in the public sector hinders the development of an effective policy to accelerate the digital green transition. Successful examples of initiatives to accelerate the digital green transition more often than not manage to bridge this divide. The Nordic-Baltic region will need to develop new policies and improve cross-sectoral collaboration.

Section three

By collecting primary lessons learned from the study, a list of 21 suggested policy initiatives was included in an expert community survey in which 148 respondents across the Nordic-Baltic countries contributed to qualifying and prioritising a final list of 10 recommendations to drive the digital green transition forward. The list covers five main policy areas deemed especially relevant to this field – public funding, green data spaces, education and lifelong learning, green public procurement and smart city strategies – and describes two policy recommendations within each area.

About this study

This report presents the work performed over three consecutive phases from September 2020 to April 2021, comprising the study on "digital green transition in the Nordic-Baltic countries" commissioned by the Nordic Council of Ministers.

The study has three main components:

A) A mapping of the current policy initiatives relating to the digital green transition in the Nordic-Baltic countries.

B) An analysis of positions of strength within the Nordic-Baltic countries as a whole and in relation to the EU and the wider world.

C) A list of recommendations for policy initiatives and increased regional cooperation between the Nordic-Baltic countries.

The first section of this report is a broad policy-mapping of national and EU strategies. The primary focus is to identify the degree to which public policy succeeds in making "digital and green integrate" or, more specifically, where digital technologies and solutions are positioned as a means of achieving climate mitigation.

The second section seeks to uncover positions of strength, barriers and potential relating to the digital green transition across the Nordic-Baltic region. It also includes five selected deep-dive cases from the Nordic-Baltic regions, followed by four international case studies to highlight key areas and practices that can provide inspiration for future activities.

The third and final section identifies key policy areas and types of policy innovation that are considered relevant and valuable in supporting the digital green transition in the context of the Nordic-Baltic region This analysis results in a collection of research-based recommendations for policy innovation that can accelerate the green transition by harnessing the potential of digital technologies across the regions.

The project is developed and executed by a consortium led by the Copenhagen-based think tank Mandag Morgen in close collaboration with consortium members Nordic Sustainability, Lead Sustainability and Smartcityinsights.dk[1].

Setting the stage for the digital green transition

A green economy is increasingly accepted as a key driver in promoting sustainable growth and tackling climate change, poverty, pollution, health issues and several other critical challenges to improve life on this planet. To some this may seem a bold statement, but mindsets are shifting, policies are being rethought, investments redirected and innovation is having a real positive impact.

This is not to neglect the indisputable challenges that our societies, business leaders and political decision-makers are faced with. The speed and scale of the transformation we need has no historical precedent. To say that the 2020s will be decisive would be an understatement. In the next decade, we need to prevent breakdowns and hatch breakthroughs – the solutions to global challenges that sustainability pioneer John Elkington calls "Green Swans".[1]

Rather, the point is to acknowledge that even considering a long and testing road ahead, we are experiencing a new momentum in which governments, policy-makers, researchers, entrepreneurs and business ecosystems are placing themselves at the forefront of the green transition. Perhaps nowhere is this more evident than in the Nordic and Baltic

[1] See appendix C for a further description of the consortium.

countries, which continue to pursue ambitious sustainability targets and provide policy support for green growth across sectors.

As with most historical transitions in our economy, the role of technological innovation is central. This case is no exception. Rapidly emerging technologies, like artificial intelligence, machine learning, virtual and augmented reality, blockchain and the internet of things, to name the most prominent, have moved far beyond the initial hype cycles to create a multitude of use-cases, and deliver unmistakable value for consumers, citizens, entrepreneurs and governments.

Witness, too, the proliferation of concepts like greentech, cleantech, envirotech, impact tech, tech for good, responsible tech and so on. All indicate a growing recognition that technology has never been an end in itself; developing new technologies to tackle greater societal challenges means harnessing their full value. As inventor and futurist Buckminster Fuller famously said: "Humanity is acquiring all the right technology for all the wrong reasons".[2] It seems that strong forces are currently coalescing to prove him wrong.

The opportunities for government, public and industry stakeholders in this increasingly digital and green paradigm could be significant. Data-driven systems will guide the rollout of smart and efficient energy systems, green mobility services, circular buildings, low-impact farming solutions, waste reduction systems across cities and a lot more. The question is not whether this will take place sometime in the future – it is already here. The question is what we can do to make sure it becomes widely integrated and accessible, and that it does so at the rapid speed that is needed if we are to prevent climate change beyond the levels at which we can contain and manage the effects on our societies.

The role of public policy in the digital green transition

It can be tricky to tie public policy down to a universal definition with a single clear purpose. It comes in different versions and different levels of abstraction, and serves various government ambitions. This does not signify any shortcomings in policy-making but simply attests to the multiple areas of relevance, and the policy innovation's great potential for impact. In general, it can be said that public policy formulates *the set of activities in which governments engage for the purpose of changing their economy and society*.[3] In short, public policy can be framed as legislation, regulation and advocacy brought in with the primary aim of benefitting citizens in one way or another. As such, public policy plays a vital role in defining societal objectives and goals, being the desired states of affairs that we as a society seek to achieve, like removing poverty, improving health or countering climate change.

More specifically, public policy can express government intentions towards certain sectors of the economy. Here, public policy, in the form of economic or industrial policy, becomes an effective instrument to steer the overall direction of sectors, creating incentives for businesses and consumers that affect their individual behaviour in the marketplace. This is also the case when public policy is used to correct market deficiencies and create fair competition. In many instances, markets do not send out the right price signals, for example when an initial investment that would have triggered many knowledge spillovers is not carried out because the investment does not immediately pay off, perhaps because the financier cannot reap the profits from the resulting secondary technological developments and market opportunities. In other words, in such cases the social and public returns are greater than the individual or private returns, which is a common phenomenon given the cumulative nature of technological development.[4] Similar market limitations occur, for example, when markets do not reflect the full environmental costs of an investment or when market actors lack relevant information.

This is where public policy enters the scene to offer solutions. It has a huge role in encouraging industries with potential knowledge spillovers, coordinating interdependent investments, subsidising early entrepreneurial research and innovation processes, promoting cleaner and greener industries, and facilitating market transparency and access to information.

In essence, public policy can complement the market mechanism. In regulated markets, the question is therefore not whether to apply public policy but how to do it and where to focus its intervention. This is truly the case when it comes to the digital green transition, where policy innovation can create the right incentives and commitments to optimise energy efficiency and develop solutions to concrete environmental challenges. If they are left to the market, such initiatives might not be supported, or might not be developed at the pace we need. In short, to further green solutions, strategic environmental policy initiatives can redirect the market towards sustainable outcomes.

With the announcement of the European Green Deal, a clear set of priorities has been presented to pursue the overall goal of making Europe climate neutral in 2050.[5] The Green Deal reflects the ambition of making policy innovation – both European and subsequently national – the accelerator of a necessary green transition across all implicated regional economies and societies.

As the EU and its member states prepare their recovery strategies for the social and economic fallout of the COVID-19 pandemic, they must honour their commitment to sustainable growth. Furthermore, as pointed out by several experts and commentators, aligning the EU policy agenda for the green transition with its policy agenda for the digital transition carries enormous possibilities and should became a clear and primary ambition.[6]

For the Nordic-Baltic countries there is both momentum and ample opportunity to drive policy innovation by integrating green ambitions and emerging digital technologies. The region can do so by building on the tradition of strong environmental policy in the Nordic countries and high levels of digital skill across the region, and by using the advanced technological infrastructure that exists in several of the countries. It is time to uncover positions of strength and share best practices to make the Nordic-Baltic region the most sustainable and integrated region in the world.[7]

Conceptual clarifications

Before we pursue the analysis in this study, we need to make clear the conceptual foundations upon which it is based. In this case, at least three terms require further explanation: "digital", "green transition" and "policy". We will deal with these in a pragmatic, common-sense way, leaving out any rigorous etymological description.

In defining the digital green transition, we should be clear about what is determined by the word "digital". In the most limited sense, and in this context, it refers to *digital technologies*, which we can take to mean electronic systems, devices, tools and resources that generate, store and process data. However, it is worth noting two different levels of digital technology: there are functionally (semi-)determined applications of digital technologies, like social media, smartwatches or electric cars; and there is a different category of (semi-)general purpose technologies, which are not functionally predetermined and can be applied for a whole range of purposes and ends, like mitigating climate change and creating environmentally friendly solutions. This is the case with emerging digital technologies like artificial intelligence (AI), machine learning, virtual reality (VR), the internet of things and blockchain technologies. It is these technologies, their adoption and distribution, rather than specific applications, that power the more fundamental changes in a society that are often called "digitalisation". In fact, here we are dealing with very wide-ranging potential for societal change.[8] We take our starting point in the definition of digitalisation presented in the Nordregio report, *Governing the Digital Transition in Nordic Regions: The human element*, authored by Linda Randall & Anna Berlina:

> "Digitalisation is the transformation of all sectors of our economy, government and society based on the large-scale adoption of existing and emerging digital technologies" (Nordregio, 2019; p. 12) [9]

We use this as a starting point because it outlines the extent to which digitalisation will influence the majority of our existence. It captures the scope of change necessary for digitalisation to be successful, which is a trait it shares with the radical societal shift needed for a green transition.

The next concept for clarification is "green transition". We use this term to refer to the gradual and full transition to a fossil-fuel-free, low-carbon society. This brings us to a coherent definition of *digital green transition*, combining the understanding of "digitalisation" and "green transition".

Definition of the digital green transition for this study:

The digital green transition refers to a comprehensive societal transformation in which all sectors adopt relevant technologies that contribute to a low-carbon society.

A note on the use of "policy" applied in this study. We take the term "policy" to mean a deliberate and formalised set of principles to guide decisions and achieve intended outcomes in response to real-world problems. While, in principle, all kinds of organisations or governing bodies can develop policies, in the context of this study we are concerned with public policies put forward by EU institutions, national government agencies and local municipal institutions. In other words, we leave out policies from private enterprises, interest groups and NGOs that address "digital" and/or "green" transition.

The Nordic-Baltic Stakeholder Community

As a prelude to the primary activities of this study, a Nordic-Baltic Stakeholder Community was formed by identifying and reaching out to relevant experts and stakeholders in the digital green transition across the Nordic-Baltic regions.

Stakeholder engagement plays a pivotal role in at least three ways. First, stakeholders comprise a large group within which we can identify and access individuals with expert knowledge and otherwise relevant insights and perspectives on the digital green transition. In this case, such individuals will be relevant for interviews and surveys.

Second, stakeholders comprise a community of shared interest with whom we can engage in order to communicate the findings and outcomes of the study, not only after the project is completed but on occasion during the course of the research. In such cases, stakeholders support the research by qualifying and validating the findings and assessments as the project unfolds.

Finally, we can mobilise stakeholders as a group in order to share the study with other relevant parties and put the roadmaps, which are key outcomes of the study, to practical use.

We have taken an ecosystem approach to identifying stakeholders, and this entails widening the scope of the Nordic-Baltic Stakeholder Community to include technology companies, start-up accelerators, industry associations, public innovation labs, public authorities, university research centres, private think tanks and consultancies, government agencies, policy-makers, NGOs and representatives from the funding community.

Due to the many important roles the stakeholder community has – and assuming the importance of engaging key stakeholders early on to plan for interviews and sign respondents up for the policy innovation survey (section three) – we dedicated an initial "sprint-week" to the creation of an overview across all of the Nordic-Baltic countries, to begin the outreach process. This took the form of an invitation to participate in an initial community survey and a prompt to indicate whether we could contact them for interviews and feedback on preliminary results from the study[2].

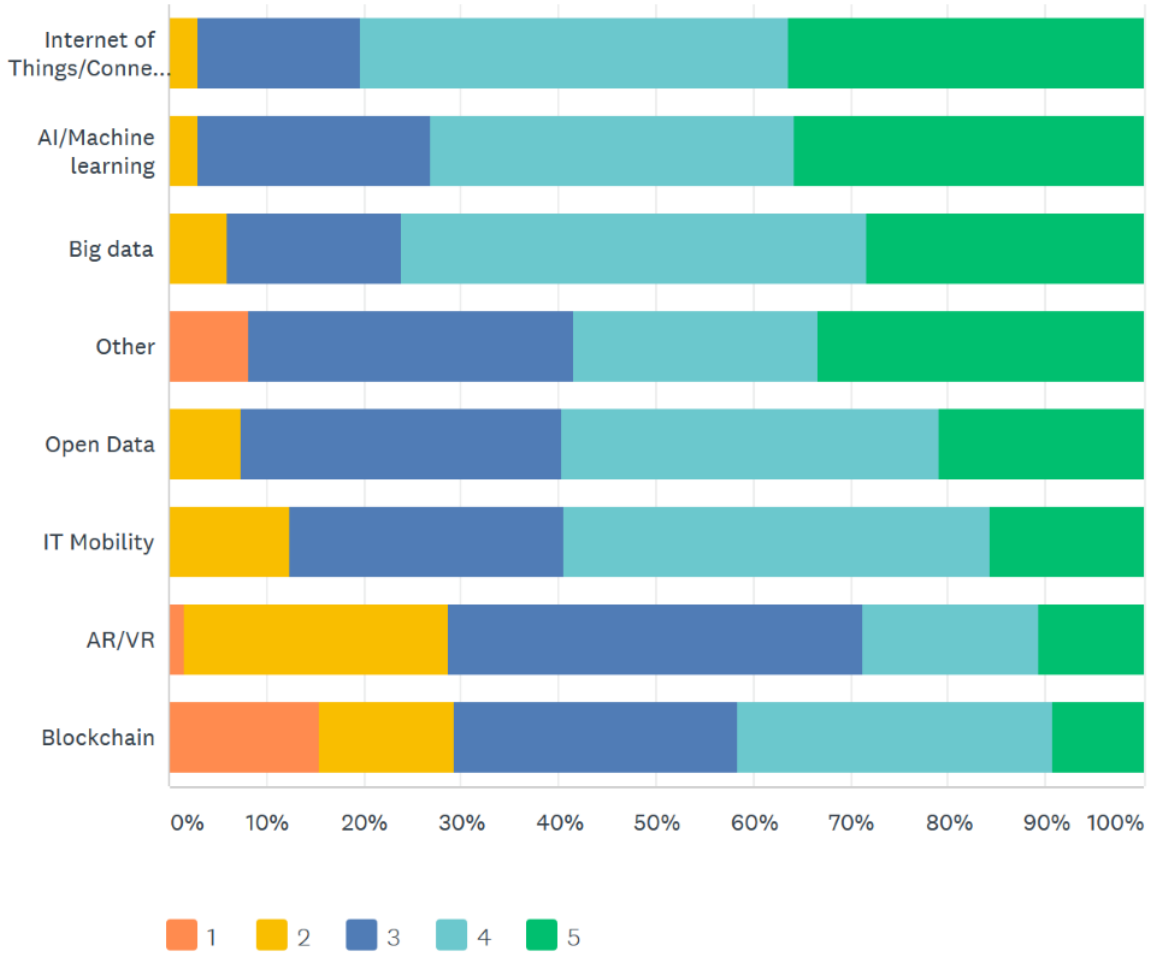
[2] A total of 278 community stakeholders were contacted, leading to 74 survey responses and a conversion rate of 26%.

Results: Stakeholder community survey

Our first source of contributions from the stakeholder community involved a short survey to obtain a first impression of the technologies and policy areas of most importance for the green digital transition. Taken together, the results illustrate the relative importance of specific digital technologies and policy areas as perceived by the individuals who answered the survey.

The survey comprised two primary questions. The first asked respondents to rate the technologies they thought had the greatest potential to reduce greenhouse gas emissions. The second asked participants to rate and evaluate the policy areas on which they thought new digital technologies would have the greatest positive impact, when considering climate change mitigation. The results are presented in this section.

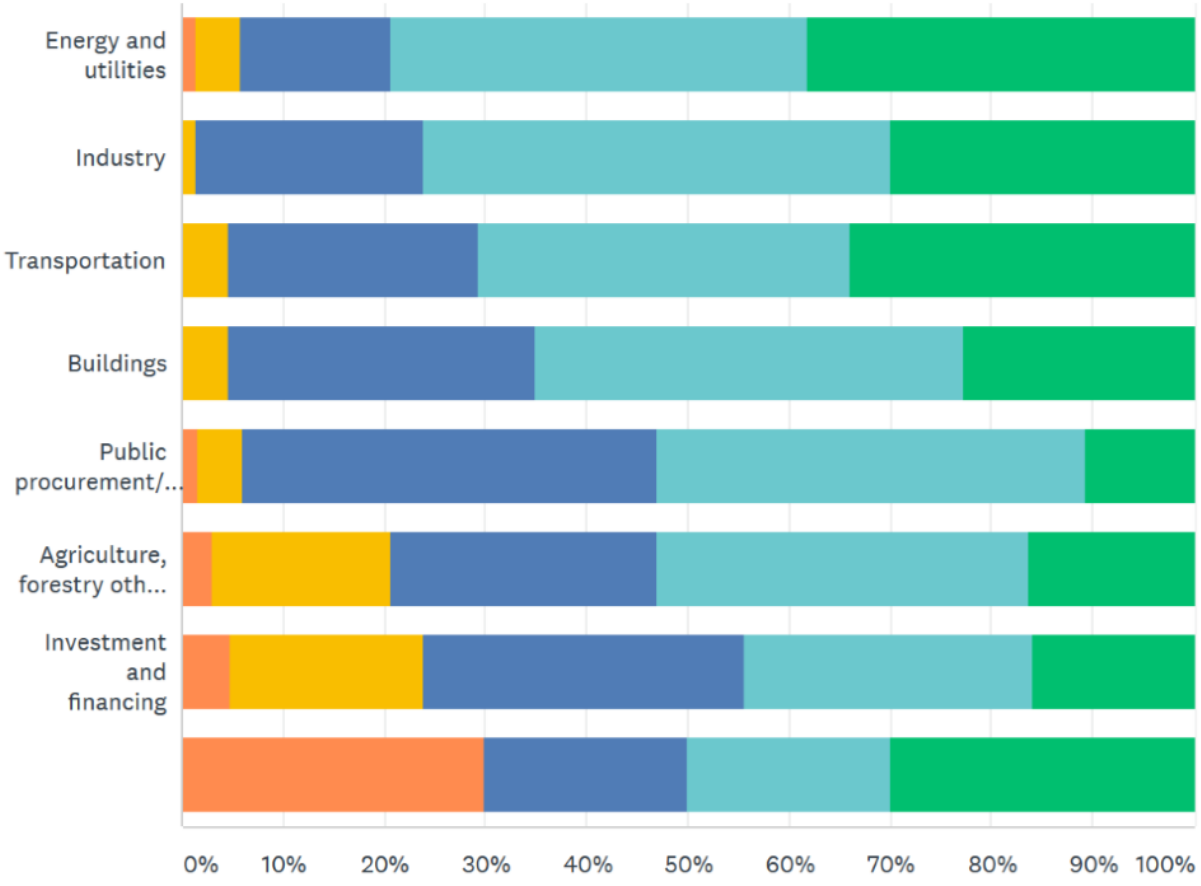
Figure 1. "On a scale from 1 to 5 (with 5 being the greatest) how do you evaluate the potential to reduce greenhouse gas emissions from the following technologies".



Assessment (Figure 1): The respondents rate the internet of things (IoT), AI/machine learning and big data as key technologies with the greatest potential to reduce greenhouse gas emissions. On the one hand this reflects an overall interest in these specific technologies, which are among the most visible and common in media as well as research coverage. On the other hand, all three are also multi-purpose technologies that already display remarkable "green" use-cases across various industries and sectors. For example, IoT and machine learning solutions (building on big data) are already powering scaled-up business solutions for within smart city platforms, green mobility providers, and circular

economy building renovation in the Nordic and Baltic regions and internationally. This is not yet the case with technologies like VR/AR and blockchain, which respondents rate relatively low in terms of their potential to reduce greenhouse gas emissions. Even though these specific technologies have received plenty of media coverage, adding to their hype factor, they are not yet being adopted into impactful digital green solutions.[10]

Figure 2: "on a scale from 1 to 5 (with 5 being greatest" how do you evaluate the potential for digital technologies to reduce greenhouse gas emissions in the following policy areas"



Assessment (Figure 2): The respondents rate energy and utilities, transportation, and industry as key policy areas, where new technologies would be expected to have the highest positive impact on greenhouse gas emissions. Areas like agriculture are also considered highly relevant but score considerably lower with respect to the expected impact of digital technologies. We take this to signify a belief that new digital technologies have the potential to create positive environmental impact across most sectors, provided there is sufficient policy innovation.

Concluding remarks on early community engagement

The community survey served a dual purpose. The ratings and results highlighted above give us an indication of the technologies and policy areas that interest and preoccupy professionals working in fields related to the digital green transition. At the same time, we should recognise that the technologies for which many have the greatest "green" expectations are in fact those that are already proving relevant and creating measurable impact. This is not a case of conservatism, or lack of imagination concerning immature technologies like VR or blockchain, but rather an understandable expression of belief in already proven technological innovations. In addition, the results confirm that the potential these technologies are perceived to hold have not yet been harnessed, and that much more can be done to accelerate the integration of technological development and positive environmental impact.

Thinking ahead towards the later stages of the study, when we will explore relevant policy innovations to accelerate the digital green transition, this early survey can point out those technologies and policy areas that are ready for continued policy innovation. However, as the later analysis will show, the relevant policy areas go beyond those highlighted here. We need to consider a group of structural and wide-reaching enablers, from funding options to green public procurement and educational programmes, in order to grasp the potential and concrete opportunities for a broader societal digital green transition.

Section one

Introduction to section one

This section addresses the first aim of the project: map out current policy initiatives relating to the digital green transition in the Nordic-Baltic countries. This takes the form of a visual mapping of national and EU policies relating to digital green transition and is intended to contribute to a better understanding of the current policy priorities concerning digital transition and environmental sustainability.

At the same time, it provides insight into the degree to which these domains have been integrated or aligned within a given policy so far. Consequently, such a mapping will also point to the potential for further integration where policy becomes an instrument to tie the emergence of new digital technologies, like artificial intelligence, machine learning, open data and the internet of things, more directly to the green agenda.

Policy mapping: Applied method

The policy mapping in this study was initiated by a desktop data-gathering phase in order to identify the relevant policies to be included. The material was mainly sourced from think tanks, research institutions and government websites, applying a key word search relating to the "green" and "digital" domains.

KEY WORD SEARCH

THE GREEN DOMAIN:
"CLIMATE", "GREEN", "CO2", "GREENHOUSE GAS", "GHG", "EMISSIONS"

THE DIGITAL DOMAIN:
"DIGITAL", "DATA", "ICT", "SMART", "AI", "MACHINE LEARNING", "IOT"/"INTERNET OF THINGS", "OPEN PUBLIC DATA", "BLOCKCHAIN", "IT MOBILITY", "VR"/"AR"

The initial search was supplemented by leads coming in from our stakeholder community. We took a snowball approach, using the initial policy samples to indicate other potentially relevant sources, and this resulted in a collection of approximately 100 policy initiatives.

The next stage involved a search by policy area, looking for overlaps between "digital" and "green" within the European Union policy overviews and national government policies, public strategies, political agreements and so on (from here on referred to as "policies").

SEARCH BY POLICY AREAS

KEY POLICY AREAS:
ENERGY AND UTILITIES
INDUSTRY
AGRICULTURE/FORESTRY/OTHER LAND USE
TRANSPORTATION
BUILDINGS
PUBLIC SPENDING/PROCUREMENT
INVESTMENT AND FINANCING
DIGITALISATION
CLIMATE
RESEARCH/INNOVATION
OTHER

This amounted to a collection of 180 policies that were deemed relevant to the scope of the study. By designing and applying an indexing matrix, we organised and identified specific policies of interest. This indexing rated policies based on the extent to which digital technologies are presented and integrated to achieve climate change mitigation. We use the term *integration index* for this scoring.

In order to identify the most relevant policies on a national level, research was carried out to specifically map policies within the same industries across the territories. Once policies were identified across all territories, they were assigned an integration index value from 0–4.

The indexing functions as a generalised indicator for the level of integration, where high integration levels display a comprehensive and/or primary interest in creating incentives for digital technologies to be applied to achieve greenhouse gas reductions. Based on this indexing, 157 policies have been selected and described further[3]. Finally, the findings were validated by conducting interviews with experts from industry, government agencies and research institutions across the Nordic-Baltic region[4].

[3] See appendix F for policy descriptions.
[4] To view the full list, see Appendix F

In the information box below, we describe the integration indexing criteria.

The results are presented in three distinct visual mappings. The first is a geographical and numeric mapping displaying the total number of relevant policies and the average integration index.

The second mapping is a visual presentation of national and EU policies by policy area, and accounts for the relative numbers of policies related to each area. It also displays the average integration index value (from 0–4) for each policy area, whereby we get an indication of which policy areas tend to integrate the digital and green to the highest degree.

The third and final mapping, the policy roadmaps, gives an overview of which specific national policies are given an integration index value of 4,3,2 and 1. This mapping has a dedicated section on smart city policies, which in general are more ambitious when it comes to integrating digital and green in the same policy. Since smart city policies tend to cut across and combine traditional policy areas, and often also combine a range of emerging technologies, it makes sense to give this separate attention in the visual presentation[5].

INTEGRATION INDEX CRITERIA

VALUE 1: DIGITAL TECHNOLOGIES AS A MEANS OF ACHIEVING CLIMATE CHANGE MITIGATION/ADAPTATION ARE MENTIONED ONE OR A FEW TIMES BUT ARE NOT THE SUBJECT OF SEPARATE PARAGRAPHS OF TEXT.

VALUE 2: DIGITAL TECHNOLOGIES AS A MEANS OF ACHIEVING CLIMATE CHANGE MITIGATION/ADAPTATION ARE THE SUBJECT OF AT LEAST ONE PARAGRAPH OF THE TEXT OR ARE MENTIONED IN A SIGNIFICANT WAY THROUGHOUT THE TEXT.

VALUE 3: DIGITAL TECHNOLOGIES AS A MEANS OF ACHIEVING CLIMATE CHANGE MITIGATION/ADAPTATION ARE THE SUBJECT OF AT LEAST ONE SEPARATE SECTION/CHAPTER OF THE TEXT.

VALUE 4: DIGITAL TECHNOLOGIES AS A MEANS OF ACHIEVING CLIMATE CHANGE MITIGATION/ADAPTATION IS THE MAIN SUBJECT OF THE DOCUMENT.

This practice of policy mapping also makes it possible to identify any *policy lags* relating to specific policy areas. Traditionally, a policy lag is defined as the time between the onset of a societal problem or challenge, like the green transition, and the activation or impact of a policy intended to address this issue. For the purpose of this study, a policy lag is found in policy areas where the overall integration index is low.

Taken together, the three mappings provide an overview and valuable insights into the countries and policies in which there is a potential to improve the commitment to digital green transition by developing a more integrated policy approach.

[5] See Appendix F.

Mapping: EU and national policies

The mapping of policies was originally intended to include an analysis of the greenhouse gas mitigation potential of the identified policies. The original intention of the consortium partners was to base this on a calculation of mitigation potential included in policies themselves or background materials. However, this strategy met with a series of challenges around data and methodology that made it very unlikely that this approach would yield trustworthy results.

Very few of the relevant policies have estimates of the GHG mitigation potential arising from the described initiatives. Similarly, policies relevant to this study are often high-level policy documents that do not include budgets. When budgets are included, it is not always possible to separate out the "digital green" part.

On the one hand, this was an obstacle to our initial ambition, but it also proved a valuable insight on its own: currently, policies that relate to the field of digital green transition do not include – or only rarely include – estimates of greenhouse gas mitigation potential. The reasons behind this finding are unclear, but part of the explanation is that such calculations are difficult to make, and until now no compelling agreement on calculation and estimation methods has been made.

Instead, what proved beneficial was to perform in-depth readings of all selected policies to discern the degree to which the opportunities opened up by emerging digital technologies were thought to be in relation to, or as drivers towards, specific green ambitions and goals.

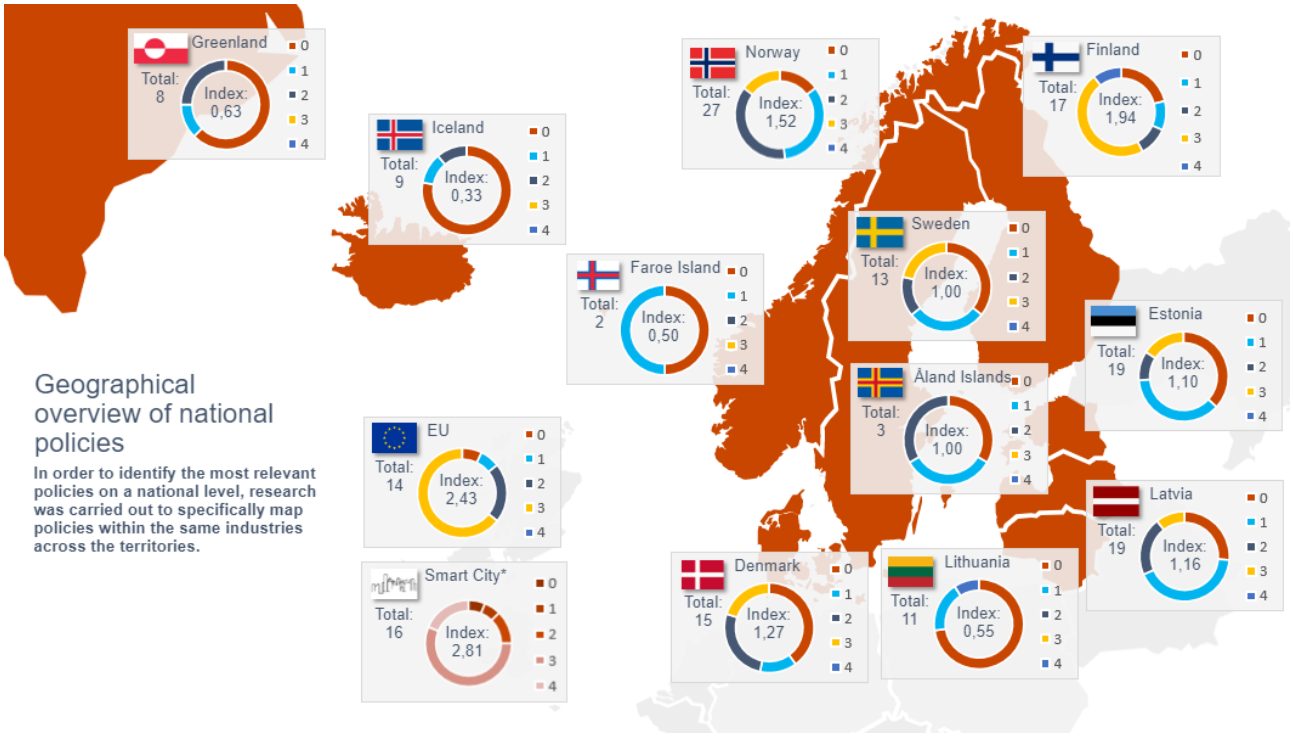
This approach delivered an overview of the general state of affairs when it comes to policies that combine "digital" and "green". A working assumption here would be that progressive and ambitious policy-making is more successful at integrating these two domains, because it better understands the potential of emerging technologies and because it is more concerned with positive environmental impact.

Integration index of national and EU policies

The following mappings provide a visual overview of the relevance of the policies in relation to the digital green transition. In the map in Figure 3, each country and the EU (policies published by official EU institutions) receives a distinct average integration index value based on an aggregate scoring of the specific policies relative to the total number of relevant policies per country.

Visualised by way of colour codes, we can see the relative distribution of policies assigned integration index values from 0–4.

Figure 3. Geographical overview of national policies.



Assessment and significance of findings

Smart city policies: With an average index value of 2.81 and a total of 16 relevant policies, the smart city is the policy area where digital technologies as a means of achieving climate mitigation have the highest degree of integration. One possible explanation for this level of integration is that most smart city policies and strategies are implicitly formulated with the purpose of applying emerging technologies (often IoT, big data and machine learning) to manage and improve energy efficiency in the urban environment.[11]

EU policies: Policies from EU institutions that are relevant to the digital green transition are generally integrated to a higher degree than national policies. Performing at an average index value of 2.43, with a total of 14 relevant policies, this indicates a widespread recognition of the importance of the contribution of digital technologies to climate mitigation, and a commitment to describing such potential in relation to specific environmental challenges.

National policies: The general trend is towards a relatively low degree of integration, with no countries performing above an index value of 2.0 on average. As seen in the mapping in Figure 3, Finland has the highest average degree of integration (1.94) followed by Norway (1.52), Denmark (1.27) and Latvia (1.16). Finland's position can be accounted

for by its many policies (more than half) that do not mention the potential of digital technologies only in general terms but dedicate distinct sections or chapters to explaining and discussing this in detail and depth.

Beyond this, any balanced assessment needs to relate the total average integration index to a consideration of the number of policies assigned a value of 3 or 4. Norway has no policies with a value of 4 but has six with a value of 3, which illustrates that policies where digital technologies are explicitly described as a means of achieving climate mitigation/adoption are fairly common, and show clear intent. But Norway's overall integration index is influenced by the vast number of policies with a value of 2. This pattern, where the majority of national policies have an index value of 2 and 3, is repeated for countries like Denmark.

Finland and Lithuania, are the only countries that have a policy with an integration index value of 4 in the analysis. It is noteworthy that Lithuania's value of 4 stems from neither a "digital" nor a "green" policy but from a broad policy of *Industry Transformation 2021–2027*,[12] which supports the argument that high levels of integration between digital technologies and environmental goals are not reserved for niche policies. In fact, this could be an example of the next phase of policy development, where digital technologies and environmental sustainability are inscribed as foundational parameters upon which policy innovation across sectors will build. What separates Estonia and Latvia from the other countries is that, although they have a high total number of relevant policies for the digital green transition, most of these show a very low degree of integration, which is reflected in the fact that many policies only briefly mention the potential value of applying digital technologies to achieve climate mitigation.

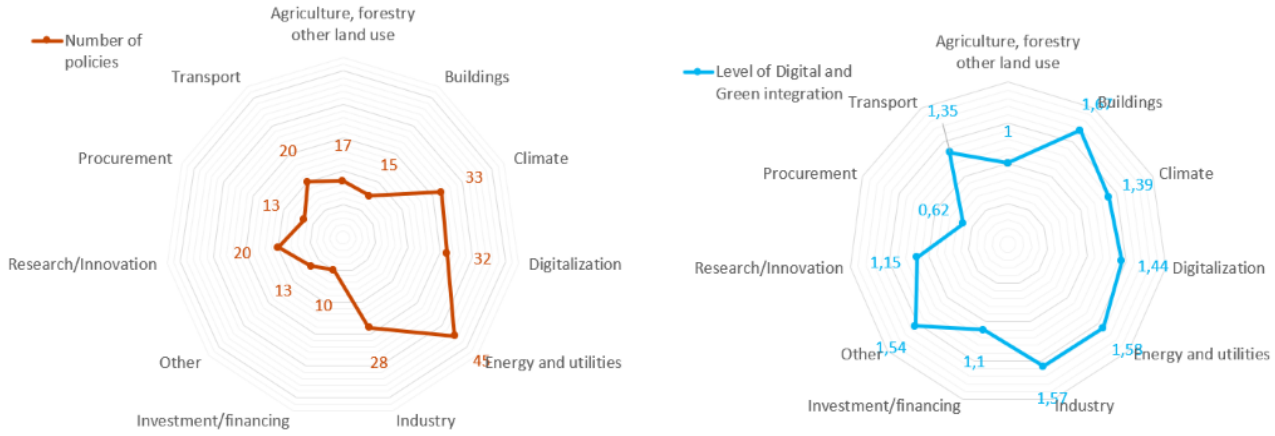
Greenland, the Åland Islands and the Faroe Islands all have relatively few relevant policies, and all are assigned a value of 1 or 2. This can be partly explained by the size of these countries in terms of government institutions and resources. On the other hand, there is clear potential to push for further policy innovation relating to digital green transition.

In the supplementary map in Figure 4, an overview of the number of national and EU policies by policy area is presented, in combination with the average integration index value per policy area.

Main take-aways from the mapping of National and EU policies:

- Very few policies across the Nordic-Baltic countries display a thorough and dedicated integration of digital technologies and climate mitigation.
- Countries like Finland, Norway and Denmark have recently developed a number of ambitious policies that reflect a growing concern with making digital technologies a primary driver for green transition.
- Across the Nordic-Baltic countries many policies have laid the groundwork recognising the relevance of integrating digital innovation and environmental impact. To further develop and mature policies, by including more specific descriptions of technology applications, relevant environmental challenges, committed goals and targets could be a natural next step.

Figure 4. Overview of national policies by policy area and integration degree.



Assessment and significance of findings

As can be seen in Figure 4, the number of current and relevant policy initiatives for digital green transition is not spread evenly across policy areas; and, as we concluded from the first overall mapping, the general level of integration is low. That being said, policy areas like energy and utilities, climate, digitalisation and industry have the highest number of relevant policy initiatives while also doing relatively well with regard to their integration index. The policy area of buildings also scores high on integration (again in relative terms), although the number of policy initiatives is rather low. Public procurement and investment/financing currently have noticeably low numbers of relevant policy initiatives and also have very low integration scores. This indicates that, historically, these policy areas have not been regarded as important enough to support and accelerate the digital green transition. This should not lead to the conclusion that, for example, green public procurement is not on the national policy agenda across the Nordic-Baltic regions, but it does reflect the reality that digital technologies do not yet play a central role in such policies.

In search of a digital green transition: Moving beyond policy

In summary, the results from the policy mapping point to the existence of a policy lag in all of the Nordic-Baltic countries. More specifically, we are here dealing with *an inside lag*, which is the time lag between initiating and activating a relevant policy. In terms of the different types of inside lag, it seems reasonable on the basis of the policy mapping to rule out a "recognition lag", given that the majority of policies treated in the analysis do assign some importance to the potential for digital technologies to contribute to climate mitigation. Instead, the low degree of integration across the mapping of policies points to a lag between "decision" and "implementation". In short, we have a recognition of a digital green potential, but the description of which technological solutions to redirect towards which selected environmental challenges is less clear. Following on from this, only rarely is there a description of how these goals should be pursued.

As a general rule, more focused and committed policies also provide for stronger positive impact. That is why the widespread policy lag identified across the Nordic-Baltic countries can be expected to lead to low or insufficient impacts relating to digital green transition. This should be noted as a primary reason to promote policy innovation in this area – and to demand a more mature and integrated approach to policy-making moving forward. Exceptions to this general picture are apparent, which should provide inspiration for further policy innovation. We will return to this issue in the last part of the study.

From this first section of the study, in which we have been concerned with the importance of current policies as they relate to the digital green transition, we move the analysis beyond a narrow focus on policy. The next stage of the study will looks more closely at a selection of societal factors that are crucial to explore when considering positions of strength and barriers to the digital green transition. Some of these factors – which we refer to as *enablers* – relate to (or are the effect of) specific policy initiatives, while others do not. Enablers of digital green transition, like green public procurement strategies or public-sector funding schemes, often have a direct policy background. Other key enablers, like green data spaces or green business accelerators, often do not.

What is important to recognise is that all such enablers of the digital green transition can be more or less directly affected by intentional policy innovation. In short, in our search for the drivers of, barriers to and potential for digital green transition across the Nordic-Baltic countries, we will move beyond the realm of policy, if only to return to it in the final section equipped with a better understanding of where and how policy innovation is relevant.

Section Two

Introduction to section two

As seen in section one of this study, the "digital" and the "green" are often not explicitly linked, despite the potential for accelerating the green transition using digital technologies. In this section of the report, we therefore take a closer look at the Nordic-Baltic region's potential for accelerating the green transition using digitalisation as fuel. Considering this, we ask:

- What are the positions of strength of the Nordic-Baltic countries and the region as a whole?
- What are the barriers and where can we do better?
- Are there good examples of integrating digital technologies and the green transition – and what are the key learnings to take away?
- How can policy accelerate the digital green transition?

To answer these questions, a methodological framework is applied to each of the countries in the Nordic-Baltic region, in which key indicators based on the enablers are measured. Based on this framework, a "country profile" for each country is presented. The country profiles form the basis for answering the first two questions above. For practical reasons, Greenland, the Faroe Islands and the Åland Islands are not included, as their size limits the information available to create full country profiles.

To examine good examples of integrating digital technologies and the green transition, key lessons learned and how policy can support the digital green transition, a series of "deep dives" has been conducted and international cases examined. In the deep dives, we take a closer look at Nordic-Baltic examples of ways the digital green transition could be accelerated. It is important to emphasise that, although in some ways the Nordic-Baltic region can be considered a green frontrunner, many other countries and regions promote the same agenda and display strong innovative capacities. In the international cases, we therefore look beyond the Nordic countries to find inspiration and solutions. Taking a bird's eye view of the countries in the Nordic-Baltic region, we also look at shared positions of strength, barriers, potential and synergies for the region as well as the potential for transferability across the Nordic-Baltic region.

It is important to explain that this report zeroes in on how policy can make a difference in terms of enabling and accelerating the digital green transition, but also to recognise that not everything pertaining to the digital green transition falls within the realm of policy.

A missing link between the digital and the green

The results of the analysis conducted in this section point to a missing link between the digital and the green, as does the mapping in section one. What's more, the deep dives and international case studies point to an old challenge, in that the lack of collaboration between professional silos in the public sector hinders the development of effective policy to accelerate the digital green transition. More often than not, successful examples of the acceleration of the digital green transition manage to bridge this divide. In many instances, this might explain the missing link between the digital technologies and environmental sustainability, across the Nordic-Baltic region. On the other hand, the analysis also reveals great potential region for digitalising the green transition: strong green and digital innovative capacity and a public sector willing to invest in the green transition. To make the most of this, the Nordic-Baltic region will have to develop new policies and improve cross-sectoral collaboration.

Structure of section two

Section two of the report is structured as follows. First, the methodology of the study is elaborated upon, as well as enablers for the digital green transition and the key indicators pertaining to each enabler. Second, each country profile is presented (from p. 34) before the study of positions of strength, barriers and potential is expanded by the deep dives (from p. 59) and a synergy mapping of the Nordic-Baltic region, taking a bird's eye view of the whole region and how the digital green transition can be accelerated (p. 76). We end section two by looking at international cases (from p. 77) and summarising learnings from these (p. 92).

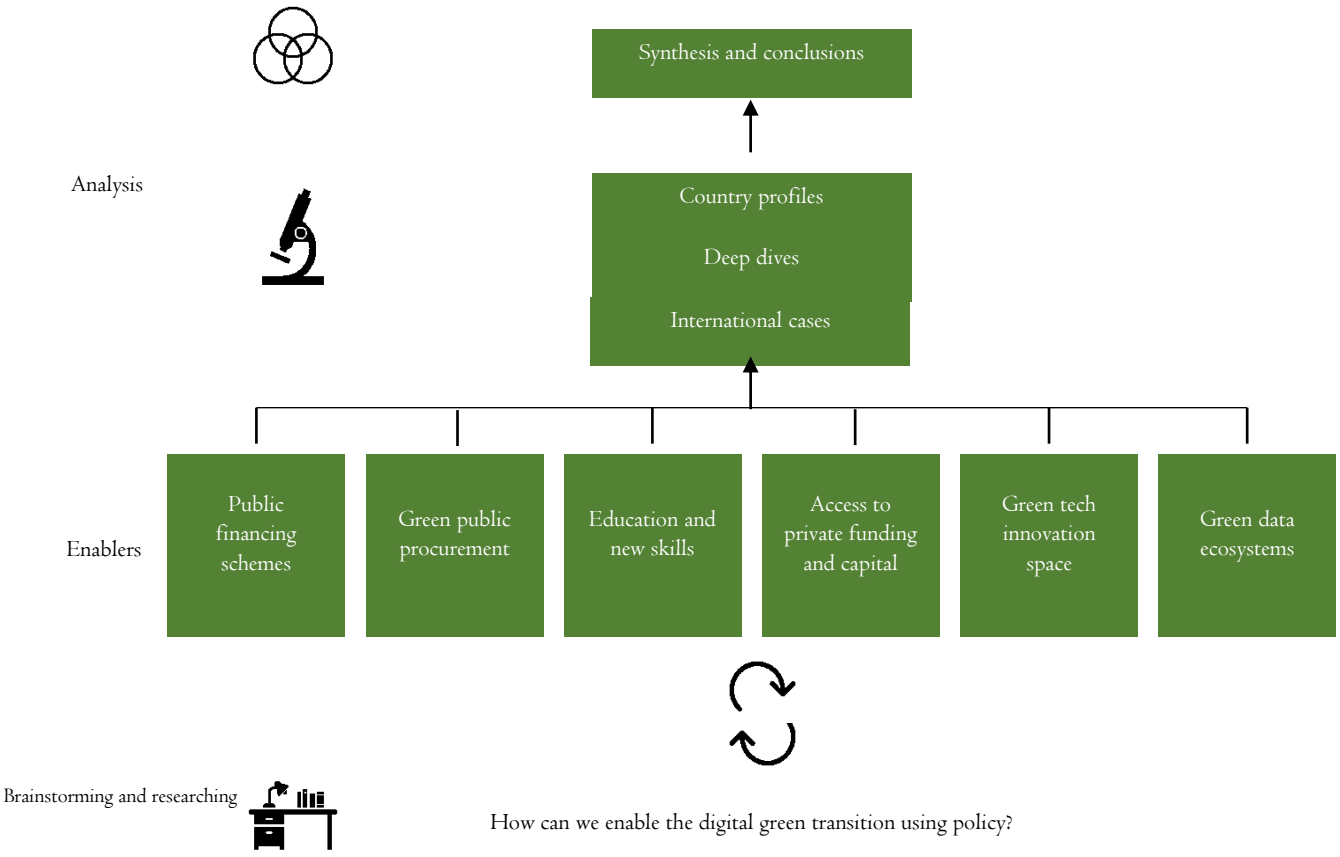
Applied methodology

This section presents our approach, and elaborates on conceptual definitions and data collection.

Approach

Via desk research and a literature review, several enablers for digital green transition were defined. The enablers were identified in an iterative process, in which we worked with a draft list of potential enablers that was consolidated during the research period, then applied to the Nordic-Baltic countries, refined and reduced to six in total. This process has led to a "country profile" for each of the countries, and the identification of relevant "deep dives" and international cases (see Figure 5). The results of this work have been synthesised and illustrated in a synergy mapping (p.76).

Figure 5. Methodological approach.



What is an enabler?

Enablers are social, economic, cultural and technological phenomena that, either by themselves or more often in combination, provide a region with an advantageous position in pursuit of the digital green transition. This constitutes an analytical tool that allows us to focus on aspects of each region that can help accelerate the digital green transition, while also highlighting policy that will potentially support it and allowing us to compare the regions across the enablers. It is important to note that no single enabler can be a shortcut to the digital green transition. We must look at the totality of enabling factors to reach a clearer picture of positions of strength, where and how to do better and how can we use policy to accelerate the transition.

Relevance criteria

During the selection of relevant enablers, we defined three criteria in choosing the most relevant to the study:

- Relevance to the field of digital green transition: Does it relate positively to the digital green transition?
- Impact of the enabler: Does it create an actual impact that can drive the digital green transition forward?
- Transferability potential: Are the Nordic-Baltic countries able to create policy based on this enabler to support the digital green transition? In other words, can they learn from each other?

For each enabler, we applied a range of selected key indicators. These are presented under the description of each enabler in this chapter.

Country profiles

In the country profiles, we apply the six enablers and analyse national positions of strength, barriers and potential. Positions of strength are factors that can give an advantage in accelerating the digital green transition; barriers are factors that actually or potentially hinder or slow down the digital green transition; and potential consists of factors and resources that can be utilised to accelerate the transition if certain policy steps are taken. When applying these terms, the line between barrier and potential is thin, as a factor can potentially be both. The guiding principle has been an assessment of whether or not, if no policy action is taken, a particular factor can hinder or slow the digital green transition (barrier) as opposed to being an opportunity to boost the transition (potential). As will become clear in the country profiles, this also means that what might have potential for one country can act as a barrier in another.

The country profiles presented in this report are a summation of the most relevant findings. For further details, references and background analysis, see Appendix D, in which each country is analysed in more detail.

Deep dives and international cases

As a result of the desk research that was conducted to define and locate each enabler in the Nordic-Baltic countries, we have come across several cases (e.g. institutions, organisations, policies) that support the digital green transition in different ways and with varying degrees of impact. These cases highlight how policy can create an impact and what some of the Nordic-Baltic strength positions of strength and opportunities are. As such, they are a useful analytical component. We also look beyond the Nordic-Baltic region for global cases to identify features and initiatives that successfully contribute to the digital green transition.

Each case framework consists of positions of strength, policy commitment, financing, value generation, barriers and a concluding section on the transferability potential to other Nordic-Baltic regions. Taken together, the cases support this study's intention to identify relevant areas of policy innovation to accelerate the digital green transition.

When examining the deep dives and international cases, three points were of particular interest:

- Policy background: Does the case originate in public policy? If so, what is the context?

- Impact assessment: Does it create, or have the potential to create, results that further and support the digital green transition?
- Transferability potential: Does it offer any lessons relevant outside of its local setting, from which other Nordic and Baltic countries can draw inspiration?

These three aspects were also the starting point when considering which cases would be most relevant to, and therefore included in, the study at hand.

Data collection and use

The data is based on desk research, interviews with relevant stakeholders and input from our community of experts and project reference group. The desk research has led to a wide range of publications, cases, statistics and indexes, which we have listed in the references. Since no single database or search engine connects all the relevant information, we have attempted to mitigate the risk of missing important information by consolidating the country profiles and cases by engaging relevant stakeholders and our community and reference group.

Enablers and key indicators

The following six enablers have been chosen, based on the relevance criteria:

1. Public financing schemes
2. Green public procurement
3. Education and new skills
4. Access to private funding and capital
5. Green tech innovation space
6. Green data ecosystems

We further define each enabler below, and elaborate on key indicators.

Public-sector financing schemes

Public investments can be a powerful driver of large-scale economic transformations. Public investments can change incentives and reallocate resources in the market away from carbon-heavy production, and invest in new, innovative solutions where traditional market actors might be hesitant. In this study we take a broad approach when looking at public funding schemes directed at the digital green transition. We look at overall government spending, strategies, and concrete investment programmes.

Key indicators

Green strategy	Government strategy for the green transition with dedicated financing.	Yes/No
Total R&D	The share of GDP invested in R&D.	% (OECD)
Green investment indicators	The share of R&D invested in environmental innovation.	% (OECD)
Green investment programmes	Publicly funded projects/programmes with green investment directed at Nordic or national projects with a minimum of €5 million in capital.	Specific programmes
Public-private investment partnerships	Public-private partnerships directed at green Nordic or national projects.	Specific partnerships

Green public procurement

The European Commission defines green public procurement (GPP) as "a process whereby public authorities seek to procure goods, services and works with a reduced environmental impact throughout their life cycle when compared to goods, services and works with the same primary function that would otherwise be procured"[13]. Considering the large amounts of public spending in the Nordic-Baltic region, GPP therefore becomes a powerful instrument, in addition to public spending, to create market demand for more digital green products and solutions.

Both the OECD and the European Commission have been working on best practices on how to integrate environmental concerns in public procurement, for example by establishing solid practices for GPP. There is considerable overlap between the two[14-16]. Condensing them, we define four dimensions for the successful implementation of GPP, which will form the key indicators for GPP in the Nordic-Baltic region, including how much the public sectors procure as a measure of the potential of GPP.

Key indicators

Share of GDP	Total annual public procurement as share of GDP.	%
Capacity-building for procurers	Availability of training and professionalisation schemes within GPP.	Yes/No
Targets	A relevant national authority with targets for the level of GPP.	Yes/No
Monitoring	A relevant national authority that measures levels of GPP.	Yes/No
Setting criteria	Available professionalised GPP criteria for use in public tenders.	Yes/No

Education and new skills

In order to spur innovation, productivity and growth, and in effect to scale up the digital green transition, it is crucial to ensure that everyone, whether specialist or non-specialist, has the right skills for a more digitalised world[17-18]. This enables innovation in a digital economy to flourish, and supports the infrastructure that companies, governments, enterprises and users rely on. Having a workforce with strong ICT skills therefore becomes an important enabler for the digital green transformation.

However, ensuring a more thorough connection between digital innovation and environmental sustainability also requires expert knowledge of the potential and solutions that integrate these fields. A key factor here is to consider the presence of higher education degrees or "digital green university programmes", which provide the future workforce with relevant competences.

Key indicators

Lifelong learning	National strategy for lifelong learning that includes a focus on digital and green skills.	Yes/No
Digital skills	Share of populace with basic or above basic digital skills.	% (Eurostat)
ICT graduates	Share of ICT graduates out of the total graduate pool.	% (Eurostat)
ICT specialists	Share of ICT specialists in the workforce.	% (Eurostat)
Digital green university programmes	Educational offers at university level within the field of digital green integration.	Specific programmes

Access to private funding and resources

At all stages of development, small and medium-sized enterprises (SMEs) and start-ups struggle more than large enterprises to access finance. To stay competitive, both start-ups and SMEs rely on external finance for innovation, digitalisation, internationalisation and upskilling. Without proper financing, start-ups and SMEs cannot scale up their solutions and contribute towards the digital green transition of the Nordic and Baltic societies.

Start-ups and SMEs are not by definition innovative, but new and small firms might be more likely to innovate and challenge existing firms when the opportunity arises. Secondly, not only do start-ups and SMEs contribute with innovation, but they also constitute most of the businesses in the Nordic-Baltic region, and the majority of the workforce is employed within them. Any transformation of how we produce and distribute goods and services will necessarily involve them. Access to private funding and capital for SMEs and start-ups therefore becomes an important enabler for the digital green transition[19-20].

Key indicators

Capital raised	Average annual finance raised by green start-ups and SMEs.	€
Incubators and accelerators	Incubators and accelerators with a green impact focus supporting business innovation with resources, advice, mentoring etc.	Specific organisations and programmes
Impact investors	Impact investors and investment foundations who invest in the Nordic-Baltic region with a focus on green impact.	Specific organisations and programmes

Green tech innovation space

New green solutions can have a direct impact on the overall environmental footprint of a sector, region or country. The uptake of solar panels, wind turbines and electric public buses are prominent examples of widespread solutions that have already had a large positive net effect on the environment. Our ability to develop new solutions and improve upon the

existing situation is therefore central to a successful digital green transition, which requires the development of new solutions. We measure the level of innovative capacity by using data on patents[6] and looking at clusters.

Key indicators

Patent to GDP ratio	Overall ratio of patents per $bn GDP. Data based on the report "Climate change mitigation technologies in Europe – evidence from patent and economic data" (European Patent Office and UNEP, 2015).	Rank in Europe
Share of environmental patents	Proportion of total patents that are within the field of environmental technologies.	% (OECD)
Sector specialisations	The two economic sectors in which most green patents are applied for. Based on the report "Regional Distribution of Green Growth Patents in four Nordic Countries: Denmark, Finland, Norway and Sweden" (Tanner et al., 2019). For the Baltic countries, the two largest export categories are used as a proxy.	Sectors
Innovation clusters	Clusters of public research institutions, private enterprises and other relevant actors that collaborate within areas relevant to the digital green transition.	Specific organisations and programmes

Green data ecosystems

Facilitating access, and using, sharing and analysing data can form the basis of increased knowledge production and innovation in the future. Therefore, better access to and management of data has enormous value. It could help unleash the innovative power of national research and business sectors to develop green solutions. Not only can it help us develop new solutions but it can also improve public services via more informed policy development, higher efficiency and better access to public services, and can lead indirectly to a greener and more digital public sector. Open data is understood as "information that can be freely used, modified, and shared by anyone for any purpose"[21-23].

Key indicators

National strategy	National open data strategy with green ambitions.	Yes/No
Data standards	Existence of official data standards for data published on open data portals.	Yes/No
Targets and monitoring	Targets and progress for open data measured by relevant national authorities.	Yes/No/Specified target/authority
Green data portals	Existence of green open data portals.	Yes/No/Specified platform
Subsets of green data	Existence of green subsets of data on open data portals.	Yes/No

[6] Patent data can be viewed as an indicator of developments in the technology market and used to identify trends in a particular field, such as green or digital areas. Patent data has its limits, though. Thousands of patents are filed each year and they are classified in different ways by different actors. Therefore, patent data from different sources cannot be compared directly, as the data and classifications differ. We rely on a classification scheme used by the OECD and two different reports.

Country profiles: Strengths, barriers, potential

This section presents each country profile separately. The country profiles summarise national positions of strength, barriers and potential for accelerating the digital green transition. As such, they display the main focus areas, whether established positions of strength, barriers or potential, towards which countries can direct their attention in the near future. The country profiles also help to answer the questions posed in the introduction to this section:

- What are the positions of strength of the Nordic-Baltic countries and the region as a whole?
- What are the barriers, and where can we do better?

These questions are interesting in themselves to policy-makers in all of the Nordic-Baltic countries but they are also intended to support the final policy recommendations formulated in section three of the report. In addition, the research conducted in relation to the country profiles has had the intended spill-over effect of identifying several cases relevant for further study, as seen later in the section, which covers five deep-dive cases in the Nordic-Baltic countries.

As mentioned, for full information about the six enablers, further references and each country, see Appendix D. Following the country profiles and deep dives, the Nordic-Baltic region is analysed as a whole and synergies mapped, on page 76. The country profiles are found on the following pages:

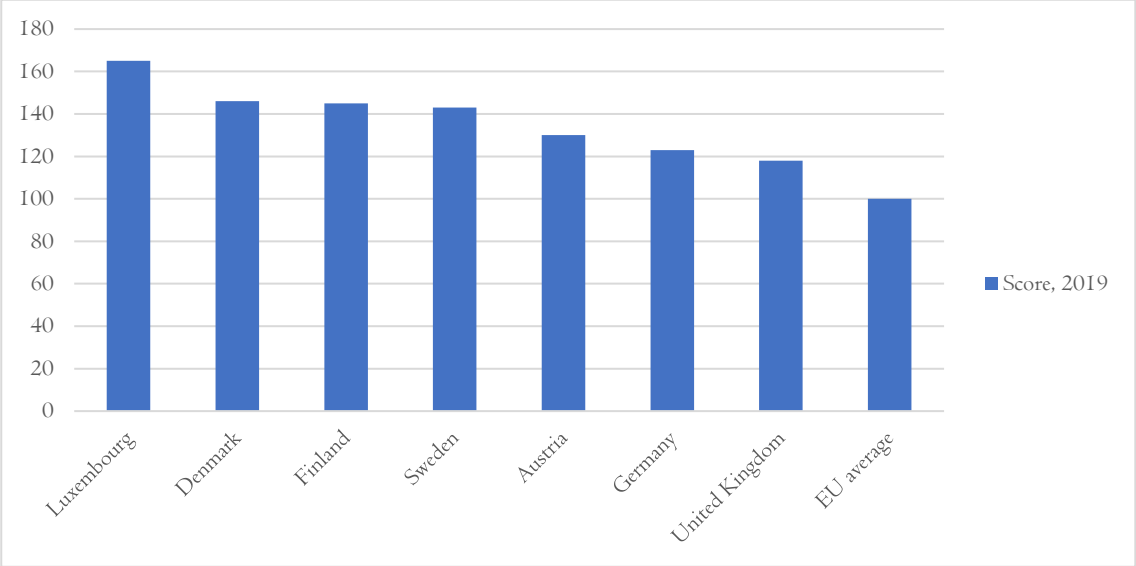
Country profile: Denmark

Strengths

Green innovation performance

The level of innovation in Denmark is high, and this is particularly true in environmental technologies, in both more global and Nordic-Baltic contexts. Almost a quarter of Danish patents were green in 2018 (see Appendix D) and Denmark ranked second on the European Eco-Innovation Scoreboard in 2019 (Figure 6). *The capacity to develop innovative new digital green solutions is very much present in Denmark and this is already taking place, thus enabling the digital green transition.*

Figure 6. Eco-leader countries on the Eco-Innovation Scoreboard, index score, 2019.[24]



Public financing schemes

The overall level of public spending on green projects is high and with ambitious green policies (like the recent "climate law"[25]) and green investment schemes, many of which directly promote digital technologies, there is a growing momentum to contribute to the (digital) green transition in Denmark. *The green programmes and the support they represent mean that both public-sector organisations and private enterprises have resources to develop and implement digital green solutions.*

Barriers

Open green data

According to a 2019 study, there were many open datasets available on 88 different platforms. The study further concluded that a range of ministries have supported open data but that it requires voluntary cooperation among state entities, and that there is no clear responsible unit for it[26]. A lack of a national strategy might explain this situation, as well as a lack of data standards, targets, and monitoring – see Figure 7. As the deep dive on Center Denmark showcases (p. 66), if it is properly used, data can generate major commercial and environmental benefits. *The lack of strategy for open data in Denmark risks jeopardising a strong green innovation performance, as new digital green solutions become more cumbersome to develop or simply not attainable.*

Figure 7. Overview of open green data in Denmark based on key indicators.*

National strategy	None identified.
Data standards	No national data standards identified.
Targets and monitoring	None identified.
Green data portals	Danmarks Miljøportal (The Danish Natural Environment Portal).
Subsets of green data	On Open Data DK, several categories of environmental data are available.

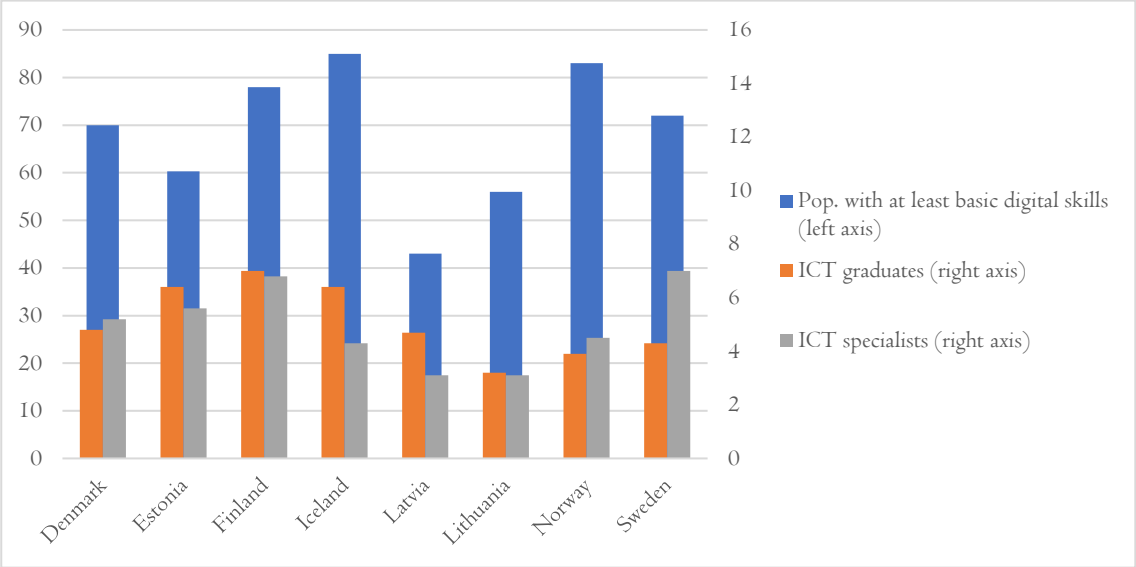
*The colours indicate where Denmark does well (green), where it is well on the way (yellow) and where more work needs to be done on open green data (red).

Potential

Strengthening skills and education

According to the European Commission's DESI index, the Danish workforce has solid digital skills. However, the basic digital skills and numbers of ICT graduates are not particularly high in a Nordic-Baltic context (see Figure 8). *To further boost green innovation and the capacity to accelerate the digital green transition, more could be done to strengthen the right skills in the workforce. One specific potential is a new strategy for adult education and training focusing on digital and green skills, as such a strategy is not in place today.*

Figure 8. Digital skills in Denmark, %, 2019.[20]



Increasing access to capital and funding

Danish green start-ups do not raise as much money as their counterparts in other Nordic countries, and they have lower ambitions in terms of how much capital they wish to raise compared to neighbouring countries[27]. This could indicate challenges in the start-up ecosystem and hinder the scaling up of innovative solutions. *Public funds could be further directed towards digital green development and collaboration with private actors to create a stronger ecosystem, which in turn might lead to more private investors with a digital green focus.*

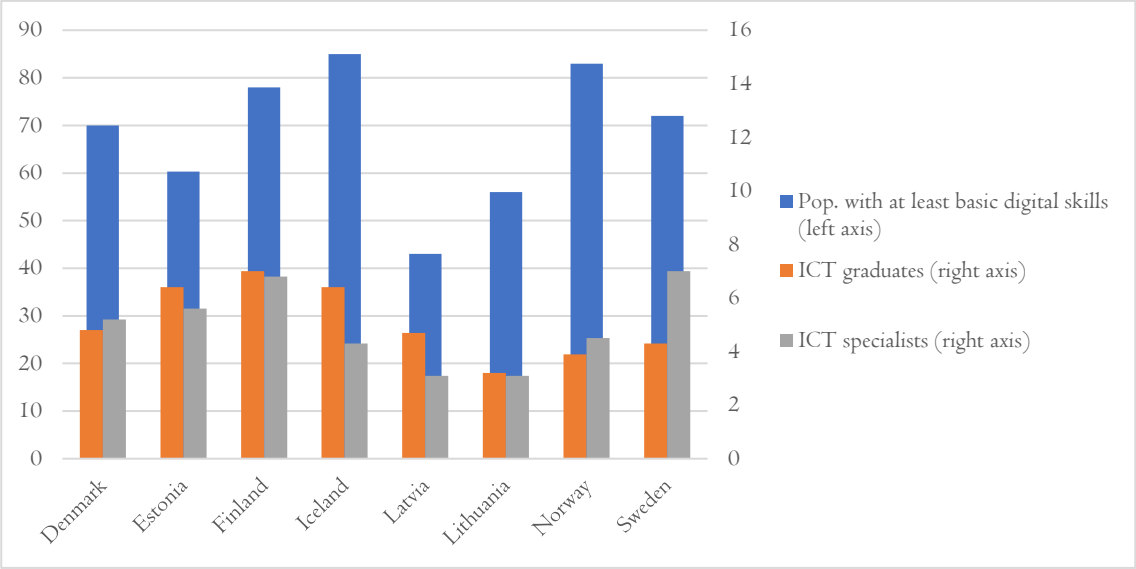
Country profile: Estonia

Strengths

Skills and education

Estonia has high levels of advanced digital skills in the workforce (see Figure 9), and several specific master's programmes addressing the need for further competences that apply digital competences to solving environmental challenges. Estonia is therefore *well prepared to accommodate an increase in demand for competences bridging the "digital" and the "green" on the labour market, thus accelerating the digital green transition.*

Figure 9. Digital skills in Estonia, %, 2019.[20]



Barriers

Open green data

Despite the existence of policy in the area, open data is still in short supply in Estonia. Due to limited data collection and provision, data reuse also remains low (see also Figure 10). The official "open by default" policy in Estonian government combined with the X-road data layered digital infrastructure should be the foundation for a richer open data ecosystem. *Greening this ecosystem with relevant climate-related data should be a high priority, and an opportunity to prove the value of a public digital infrastructure to support solutions to societal challenges and not merely cybersecurity and e-citizen convenience issues. Without this focus, new digital green solutions become more cumbersome to develop or simply not attainable.*

Figure 10. Overview of open data in Estonia based on enablers from appendix D.*

National strategy	The Green Paper on Open Data from 2014 serves as Estonia's open data policy, with guiding principles, interoperability architecture, central policy choices and an activity plan. The Digital Agenda 2020 for Estonia includes the goal of advancing the use of the national Open Government Data Portal.
Data standards	The Estonian Open Data portal displays guides to data standards for publishers and users (voluntary to apply).
Targets and monitoring	No monitoring could be identified.
Green data portals	No dedicated green open data platform could be identified in Estonia.

Subsets of green data	Estonian Open Data is the primary platform for collecting and accessing open data. The site covers a range of relevant themes and areas, with a key focus on energy, transport, environment and agriculture, amongst others.

*The colours indicate where Estonia does well (green), where it is well on the way (yellow) and where more work needs to be done (red).

Potential

Increasing private funding of start-ups and SMEs

While Estonia performs at a high level in terms of attracting private funding for start-ups and SMEs, the ecosystem for tech-driven innovation is mostly focused on fintech, cybertech and edtech. This does not mean than green impact solutions are missing from the picture, but it does seem to be an area that is only now gaining interest and momentum (see also Figure 11). *With the public digital infrastructure (X-road) and high level of private funding, more focus on green impact enterprises could be a strong starting position for accelerating the digital green transition.*

Figure 11. Overview of private funding and capital in Estonia based on enablers from appendix D.

Capital raised in the Baltics	In 2019, Estonian start-ups raised €247 million, Lithuanian start-ups raised €173 million and Latvian start-ups raised €17 million.[28]
Incubators and accelerators	Cleantech ForEst is a development powerhouse. The team built the local ecosystem with the aim of empowering research and innovation towards impactful and systematic sustainability.[29] Startup Wise Guys is a successful accelerator, and supports early-stage start-ups within its Wise Guys Sustainability programme. [30] A range of incubators supports start-ups without having dedicated "green" programmes.
Impact investors	The Good Deed Impact Fund, the first venture philanthropy fund in Estonia, is dedicated to solving complex issues in education, social inequity, public health and the environment.[31]

Strengthening GPP

While Estonia has promoted a national target of 15% GPP of total government procurement and has made explicit its intentions to expand the strategic use of procurement to achieve other policy objectives like environmental sustainability, specific goals and means have not yet been established. Also, decentralised capacity-building, training and knowledge-sharing across regions and local municipalities are ad hoc at this stage and seem to lack sufficient backing. *A clear ambition would be to set down precise objectives for GPP in relation to all product groups, and set mandatory criteria to be included in tender procedures in support of greening the economy.*

Country profile: Finland

Strengths

Public financing of research and innovation

Finland directs a relatively large amount of public funding to investments in innovation. Looking at specific programmes, the projects supported are clearly impact investments with a primary technology component, and accelerator platforms have dedicated programmes like cleantech and the circular economy, which close the gap between "digital" and "green" (see also the deep dive on p. 63.). *The green programmes and the support they represent mean that companies have resources to develop and implement digital green solutions, thereby accelerating the digital green transition.*

Committed approach to GPP

In 2016 Finland's government announced its GPP strategy, outlining its plan to structure and accelerate the practice of GPP. As part of this, Keino was established, a competence centre to boost sustainable and innovative public procurement (see Figure 12). An estimated two-thirds of Finnish invitations to tender include general sustainability aspects and around 40% include more detailed sustainability aspects[32]. *This gives Finland a strong position for utilising GPP to accelerate the digital green transition.*

Figure 12. Overview of GPP in Finland based on key indicators from appendix D.

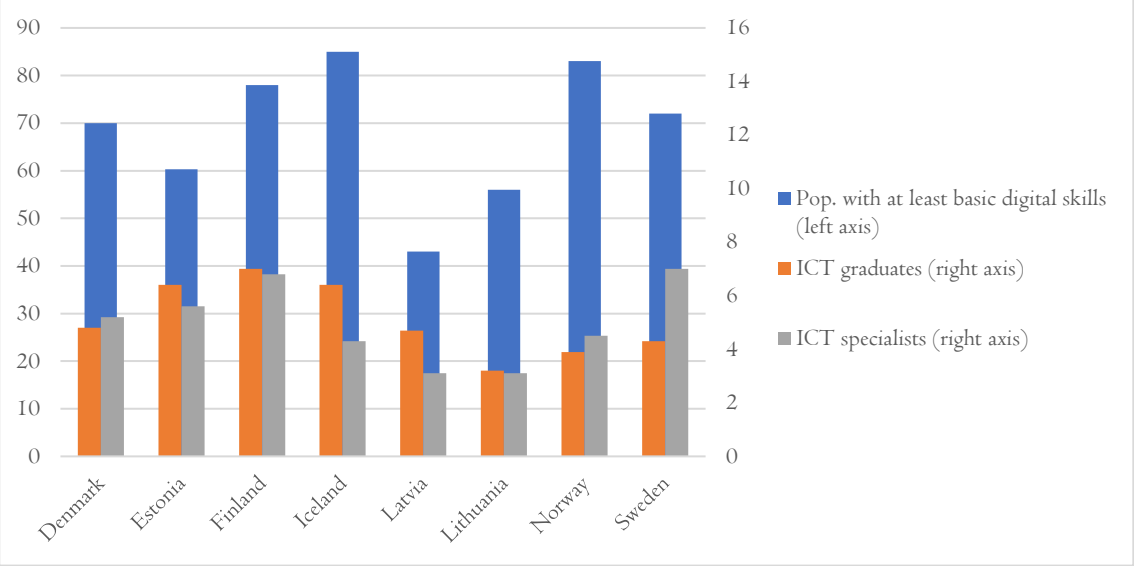
Capacity-building for procurers	The central competence centre Keino and regional platforms conduct informational campaigns and training workshops, and provide toolkits and helpdesks for public procurers.
GPP targets	There are direct measurable targets for GPP across 17 product categories, of which 12 can be said to have a dominant digital dimension.
Monitoring	The National Agency for Public Procurement monitors development, using self-reported answers via a survey at all levels of government, asking public authorities to evaluate themselves on whether or not they use environmental requirements in their tenders, contracts, purchases and related practices.
Setting criteria	Evaluation criteria and guidance for market dialogue are available for 22 product areas, of which 17 can be said to have a dominant digital dimension.

*The colours indicate where Finland does well (green), where it is well on the way (yellow) and where more work needs to be done on GPP (red).

Strong education and skills

The Finnish workforce has a very high level of skills relevant to the digital green transition (see Figure 13). This is reflected in the many ICT graduates and specific master's programmes that apply digital competences to solving environmental challenges. *This lays the ground for accelerating the digital green transition.*

Figure 13. Digital skills in Finland, %, 2019.[20]



Barriers

Lack of private funding

Public funding (or co-funding) plays a crucial role in the green innovation ecosystem in Finland; private funding, also in the realm of digital green transition, plays a smaller role. Structural access to private financing in Finland is neither at the

high end nor the low end. *This leads to a risk of slowing the digital green transition, if start-ups and SMEs cannot raise the necessary capital to scale up digital green solutions.*

Potential

Developing and maturing green data-ecosystems

Finland is in the process of building a well-functioning green data ecosystem but an apparent absence of an overall governance model for green data, with no identifiable targets or committed vision to be applied by public organisations, is slowing the process (see Figure 14). *A greater concern for how open data could support the green transition could surely benefit the digital green transition. Without this focus, new digital green solutions become more cumbersome to develop or simply unattainable.*

Figure 14. Overview of open data in Finland based on key indicators from Appendix D.

National strategy	The Finnish Open Data Policy was put into effect in 2015.
Data standards	Avoindata.fi is the primary portal for publishing and accessing open data. The portal uses a Data Catalog Vocabulary (DCAT) standard.
Targets and monitoring	None identified.
Green data portals	Syke's metadata portal provides data sets provided by the Finnish Environmental administration; however, the portal does not aggregate from many or all public entities, and data is limited.
Subsets of green data	Avoindata.fi presents relevant subcategories like Energy, Transport, Agriculture and Forestry, as well as other platforms such as The Helsinki Region Infoshare and a six-city project (Aika6).

*The colours indicate where Finland does well (green), where it is well on the way (yellow) and where more work needs to be done on open data (red).

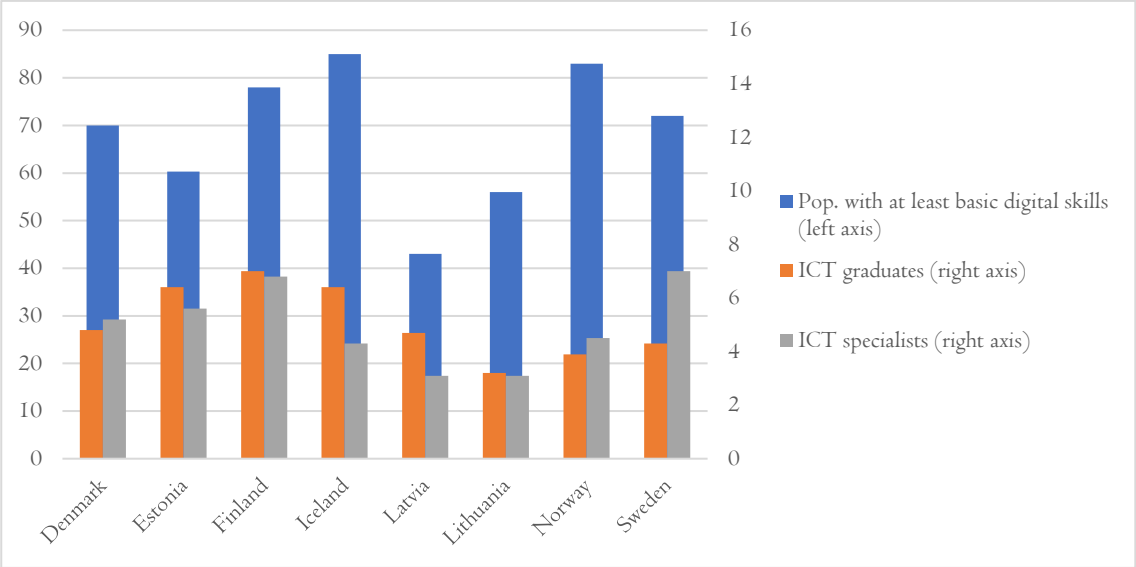
Country Profile: Iceland

Strengths

Digital skills

Iceland has a strong foundation of digital skills and a lifelong learning strategy that seems to have borne fruit. The vast majority of Icelanders have basic or above basic digital skills, and many students choose ICT study programmes (see Figure 15). The strong skills foundation *makes Iceland well prepared to accommodate an increase in demand for competences bridging the "digital" and the "green" on the labour market, thus accelerating the digital green transition.*

Figure 15. Digital skills in Iceland, %, 2019.[20]

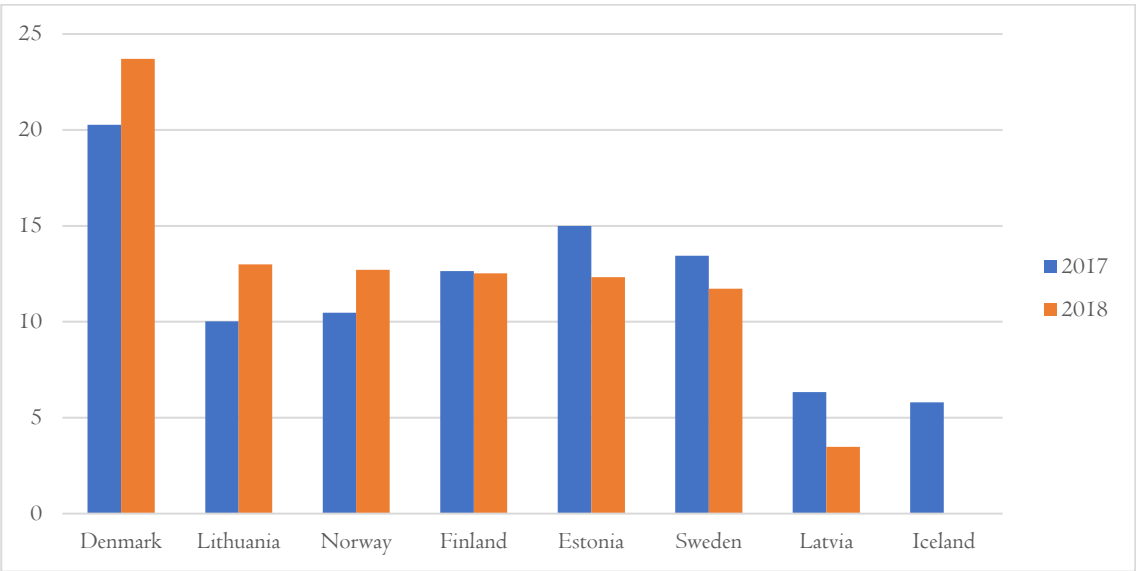


Barriers

Lack of innovative capacity

The innovation performance of Iceland is not particularly high, and the country is ranked at number 21 on the Global Innovation Index 2020[33]. One innovation cluster working within the digital green transition was identified – the Iceland Renewable Energy Cluster. The country's share of environmental patents is also somewhat low (see Figure 16). *This could slow the digital green transition in Iceland, as the ecosystem for developing relevant solutions is limited in range and scope.*

Figure 16. OECD patent indicators, environment-related technologies, % of all technologies.* [34]



*Patent data for Iceland fluctuates between a high share of around 13.4% in 2016 and a low of 1% in 2013. This is mostly a result of a low total number of patents in which small fluctuations affect the relative share a lot. Data for 2018 is not available for Iceland.

Scaling opportunities for SMEs and start-ups

Much of the capital raised for smaller companies comes from state-owned programmes. No specific business support programmes that were dedicated to green innovation could be identified. One green public investment programme was identified – the Icelandic Climate Fund, with limited grants of €1 million released in 2020[35]. *Without better access to capital the scaling of new digital green solutions will be difficult in Iceland.*

Potential

Utilising open data

In 2017, Iceland established an open data portal (opingogn.is). Neither a specific open data strategy nor targets and monitoring of open data have been identified. The lack of a strategy on open data in Iceland is reflected in what seems to be a very sporadic, voluntary practice of sharing data on opingogn.is. *The skills and platform for utilising open data are present in Iceland but more could be done on a policy level to work strategically with green open data, thus accelerating the digital green transition.*

Enhancing the use of GPP

It is still unclear what the exact ambitions for GPP in Iceland are. Officially, it is seen as a strategic tool for the green transition, but in practice Iceland still seems some way off towards utilising GPP in a focused and committed way. *There is a potential to harness the power of GPP by establishing clear, updated targets across product groups and a systematic monitoring practice.*

Figure 17. Overview of GPP in Iceland based on key indicators from appendix D.

Capacity-building for procurers	The VINN website provides GPP resources for procurers, including how to get started on GPP, conducting a procurement analysis etc.
GPP targets	The latest Icelandic policy on GPP to be identified covered the period 2013–2016 and presented an overall goal for GPP of 50% of all public procurement. No current policy or new targets have yet been developed.
Monitoring	There is no official authority monitoring GPP in Iceland.
Setting criteria	Environmental criteria established based on an adaption of EU and Swedish GPP criteria.

*The colours indicate where Iceland does well (green), where it is well on the way (yellow) and where more work needs to be done (red).

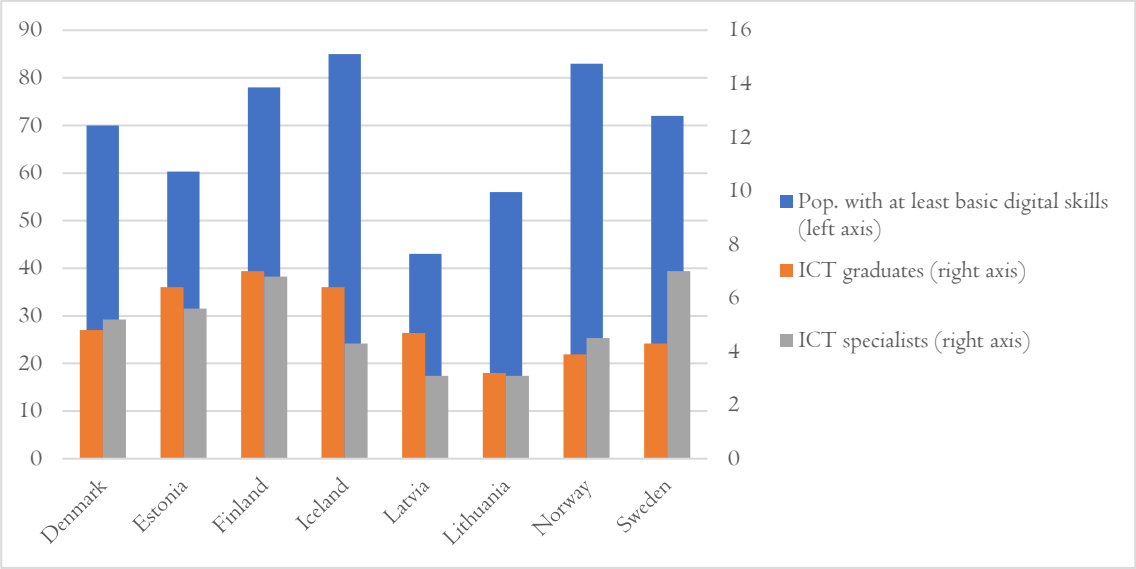
Country Profile: Latvia

Strengths

Relevant skills and education programmes

A range of ICT programmes at Latvian universities – some of which have direct relevance for the digital green transition and an above average level of ICT graduates (see Figure 18) – means that *Latvia has managed to create a source of new skills that are relevant to the acceleration of the digital green transition.*

Figure 18. Digital skills in Latvia, %, 2019.[20]



Public support for businesses and innovation

A range of incubators supported by the state work with early-stage companies, and support facilitation of investments as well as a range of digital green clusters support innovation (see Figure 19). *The public-sector support for innovation and enterprises backs the development and scaling of new digital green solutions in Latvia.*

Barriers

Small ecosystem for digital green investment

Baltic private equity and venture capital have grown quickly in the last decade, but the state remains a large investor in Latvia. As such, there is still more to be done to develop a private investor ecosystem and an investment climate with a focus on green and digital areas. *The lack of a strong ecosystem for investments means that the scaling and development of digital green solutions might happen at a slower pace in Latvia.*

Potential

Greater innovation

Latvia has a low level of R&D (although the relative investment in environmental research is high), which is also reflected in fewer innovations (see Figure 19). Despite this, Latvia generally has a strong track record in developing new green solutions, ranking eighth in Europe on CCM patents-to-GDP ratio, and green innovation is supported through different clusters. *This spells out a strong potential for digital green innovation if more resources could be invested in green research and development.*

Figure 19. Innovation in Latvia – overview based on key indicators.

Patent to GDP ratio*	8th	This position reflects a fairly strong performance, considering the few available resources for R&D compared to other countries in the Nordic-Baltics.[36]
Share of environmental patents	10.28% 2015	The share was 0% in 2016 (latest available OECD data). There is generally much fluctuation for Latvia so 2015 numbers are shown here as they are more representative of environmental patents in Latvia seen over time. [37]

Total R&D	0.64%	Latvia has a low level of R&D, both internationally and compared to the Nordic-Baltic countries.[38]
Innovation clusters relevant to the digital green transition	Yes	Green tech cluster [39] Cleantech Latvia [40] Smart city cluster [41]

Developing digital skills in the populace

The general population of Latvia has a relatively low share of basic or above basic digital skills (see Figure 18). *A dedicated lifelong learning strategy focusing on digital and green skills more broadly would better enable the implementation of digital green solutions across Latvian society.*

Developing GPP

As with their peers in the other Nordic-Baltic countries, Latvia has worked seriously with GPP for several years, and has even monitored progress based on more objective criteria than self-reported answers. However, since the introduction of GPP in Latvia and a plan to support GPP in 2015–2017, not many activities could be identified. *Given that much of the groundwork has already been done, there is a potential to reinvigorate the dedication to GPP practices to support the digital green transition.*

Country Profile: Lithuania

Strengths

Strong business support system

A range of green impact incubators and accelerators support businesses in Lithuania, particularly within tech, and many of these help facilitate access to capital for smaller businesses and start-ups (see Figure 20). *Access to these innovation and business development platforms contributes to the digital green transition in Lithuania.*

Figure 20. Digital green incubators and accelerators from Appendix D.

- The EnergyOne track is a programme designed to bring innovation to the energy sector by supporting and scaling smart energy startups.[42]
- EIT Climate-KIC (Lithuania Hub) is a Knowledge and Innovation Community (KIC) working to accelerate the transition to a zero-carbon, climate-resilient society.[43]
- The ROCKIT impact accelerator, where sustainability start-ups work on real-life challenges from industry-leading Lithuanian companies to prepare for further business scaling. [44]
- Futurepreneurs is a concentrated sustainability pre-acceleration programme for people who want to become entrepreneurs. [45]
- The SUBMARINER Network promotes innovative technology-driven approaches to the sustainable use of marine resources. It offers a cooperation platform for ventures working in the Baltic Sea Region.[46]

Barriers

Access to open green data

An open data portal was launched in January 2020 in a beta version[47]. No targets, monitoring or green data portals could be identified though (see Figure 21). *More should be done to utilise open data if the digital green transition is to be accelerated. Without this focus, new digital green solutions become more cumbersome to develop or simply not attainable.*

Figure 21. Overview of open data in Lithuania based on enablers from Appendix D.*

National strategy	No strategy for open data could be identified. The national AI strategy recommends establishing a public sector data team to oversee open data initiatives, such as the creation of the open data portal. [48]
Targets and monitoring	None identified.
Green data portals	None identified.
Subsets of green data	Datasets covering environment, energy, transport and agriculture, fisheries, forestry, and food are available at the Lithuanian open data platform (data.gov.lt).[47]

*The colours indicate where Lithuania does well (green), where it is well on the way (yellow) and where more work needs to be done (red).

Potential

Increasing innovation performance.

The general innovation performance in Lithuania is low, but much work is being conducted to improve innovation capacity. Many more innovative start-ups exist today than previously, a range of relevant clusters support this development, and the government adopted an AI strategy in 2018[48] to further enhance the innovative tech capacity. *More digital green innovations should be seen from Lithuania in future if continued support for improving innovation performance is maintained.*

Investing in the digital green transition

Compared to other Nordic-Baltic countries, Lithuania does not seem to prioritise greening the economy via existing business support platforms and public financing schemes except via the international Norway Grants programme. *Public funds could be further directed towards digital green development and collaboration with private actors to create a stronger ecosystem, which in turn might lead to more private investors with a digital green focus.*

Ambitious GPP agenda

Lithuania has set an ambitious overall goal of 50% for the level of GPP for all public procurement. There has not yet been an official assessment of whether the target has been reached and what the potential next steps are (see Figure 22).

Further elaboration and work with GPP in Lithuania, setting targets for specific product groups, focusing on capacity-building aimed specifically at promoting GPP and building systematic monitoring practices would be relevant next steps.

Figure 22. Overview of GPP in Lithuania based on key indicators from appendix D.

Capacity-building for procurers	PPO is an independent government agency in charge of the overall implementation of procurement policy and it provides capacity-building for procurers. [49]
GPP targets	The national progress programme states that 50 % of all public contracts should meet environmental criteria by 2020. Beyond the overall goal there are no specific targets, and none are identified for 2021 onwards. [50]
Monitoring	The PPO monitors public procurement procedures, collects statistics on public procurement and prevents violations, but no monitoring of GPP has been identified. [49]
Setting criteria	GPP criteria based on EU criteria.

*The colours indicate where Lithuania does well (green), where it is well on the way (yellow) and where more work needs to be done on GPP (red).

Country Profile: Norway

Strengths

Large variety of public investment schemes

Support for the green transition is strong in Norway. Of relevance here are a variety of green investment programmes presented in Figure 23. *The variety of programmes and major support they represent mean that both public organisations and enterprises have resources to develop and implement digital green solutions.*

Figure 23. Green public investment programmes in Norway from appendix D.

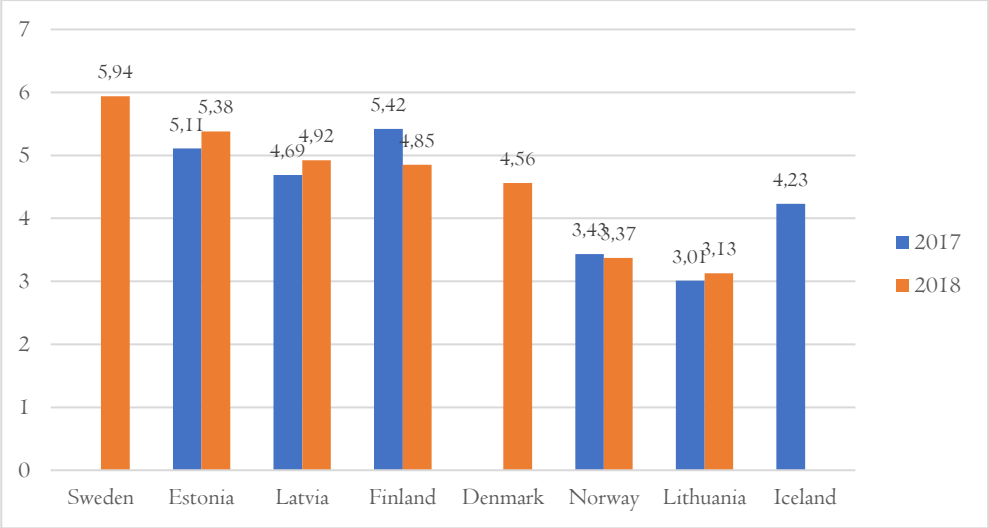
- **Enova**: Financial support and consulting for enterprises and individuals for initiatives in all sectors of industry, which contributes to a future low-carbon society.[51]
- **Klimasats**: Financial support to municipalities and regions for green transition projects that lower greenhouse gas (GHG). [52]
- **The Research Council of Norway**: Offers funds to public and private actors working to support research activities and innovation (including projects that are not specifically green). [53]
- **Innovasjon Norge**: Financial support and consulting for enterprises wishing to innovate. Not specifically digital green projects but a broader palette of which some are digital green. [54]
- **Nysnø**: Investment company owned by the state investing in enterprises that reduce GHG in a smart and profitable way; as such, Nysnø acts like a commercial actor. Nysnø focuses on five groups of technologies including digital and integrated energy systems. [55]

Barriers

Relatively small ICT sector

The structure of the Norwegian economy is such that the Norwegian ICT sector is smaller in comparison to other Nordic-Baltic countries in terms of its size relative to the total economy (see Figure 24), which is also reflected in a lower number of ICT specialists in the workforce. *This means a lower capacity to both develop and implement digital green solutions due to a lack of organisations with the right digital capacity nationally.*

Figure 24. Percentage of the ICT sector in GDP.*[56]



*Data not available for 2018 or 2017 across all countries.

Potential

Better opportunities to scale up

Green start-ups in Norway have relatively good success in raising capital for their business, but green start-ups in other countries manages to attract more capital. *Still better access to private funding and capital in Norway, combined with an already strong business support system, would enable faster scaling up of Norwegian solutions and thereby the acceleration of the digital green transition.*

Improve GPP

Norway seems to be well underway towards better use of GPP but does not yet fully utilise the potential of GPP for the green transition. Several steps have been taken, however, and work is being conducted to improve competences, capacity

and the quality of public procurement, and to establish more detailed monitoring and targets. *A continued focus on and improvement of GPP could provide a greater demand for green solutions and stimulate innovation, thus accelerating the digital green transition.*

Figure 25. Overview of GPP in Norway based on key indicators from appendix D.

Capacity-building for procurers	Digdir has published good advice on organising public procurement in public companies, has published standard agreement forms and is working on digitalising the public procurement processes in Norway. A project called "Innovative anskaffelser" offers consulting, tools and guidance on innovative procurement. [57]
GPP targets	No targets for GPP identified – but work is being conducted to create tangible targets.
Monitoring	DFØ is responsible for a monitoring and performs a maturity survey among all levels of public government looking at five dimensions of public procurement (including climate and the environment, and digitalisation and technology). [58]
Setting criteria	Criteria are available for six product categories, which is relatively few.

*The colours indicate where Norway does well (green), where it is well on the way (yellow) and where more work needs to be done on GPP (red).

Stronger innovation output

Despite the many programmes mentioned above, there is still a relatively low ratio of CCM patents-to-GDP in Norway (see Figure 26). The Global Innovation Index 2020 also shows that Norway performs well on many aspects but not on the subindex for output compared to input[33]. This could mean fewer digital green outputs from Norwegian investments and a slower digital green transition. *More consideration of this fact might create a stronger innovation output that could boost the digital green transition.*

Figure 26. European CCM inventions per GDP by country 1995–2011.[36]

Country	Rank
Germany	1
Sweden	2
France	3
Finland	4
Austria	5

Denmark	6
Switzerland	7
Latvia	8
Netherlands	9
Norway	10
Iceland	13
Estonia	19
Lithuania	28

Country profile: Sweden

Strengths

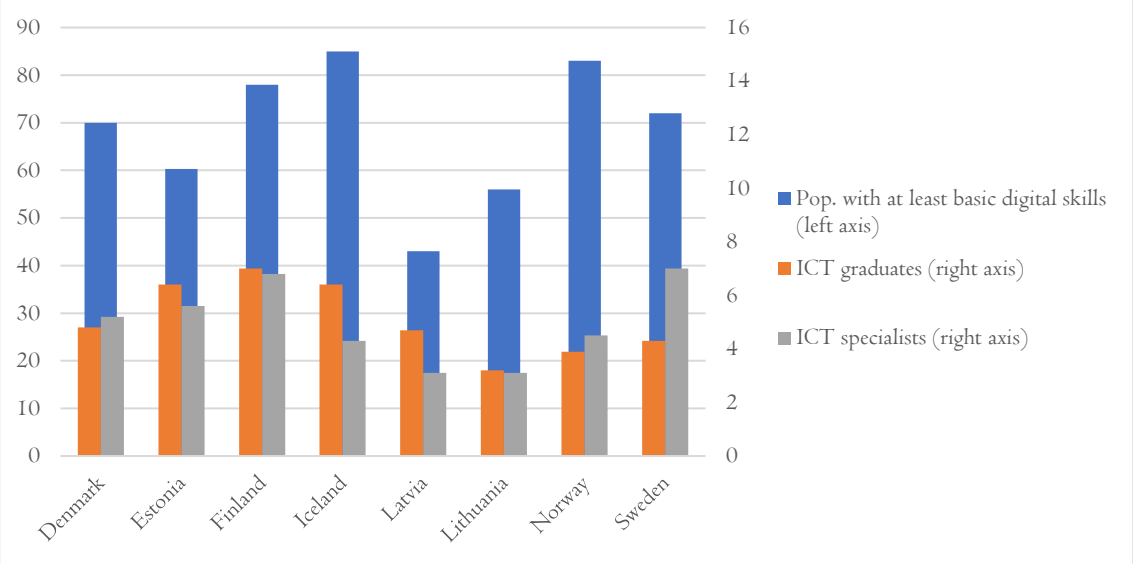
Innovation performance

Both in terms of the total sum allocated for R&D and the relative percentage, Sweden outspends the rest of the Nordic-Baltic countries[38]. This translates into a strong innovation performance in which Sweden ranks second in terms of the patents-to-GDP ratio for CCM technologies (see Figure 26). *As the digital green transition requires new solutions and linkages between technologies, the strong Swedish innovation performance can boost the development of new solutions, creating positive environmental impact.*

Strong ICT sector

The strong Swedish ICT sector is reflected in the high number of specialists in the workforce (Figure 27) and the ICT sector's high share of GDP (Figure 24). *The strong Swedish ICT sector means that skills and resources are available to develop and implement digital green solutions and potentially export them.*

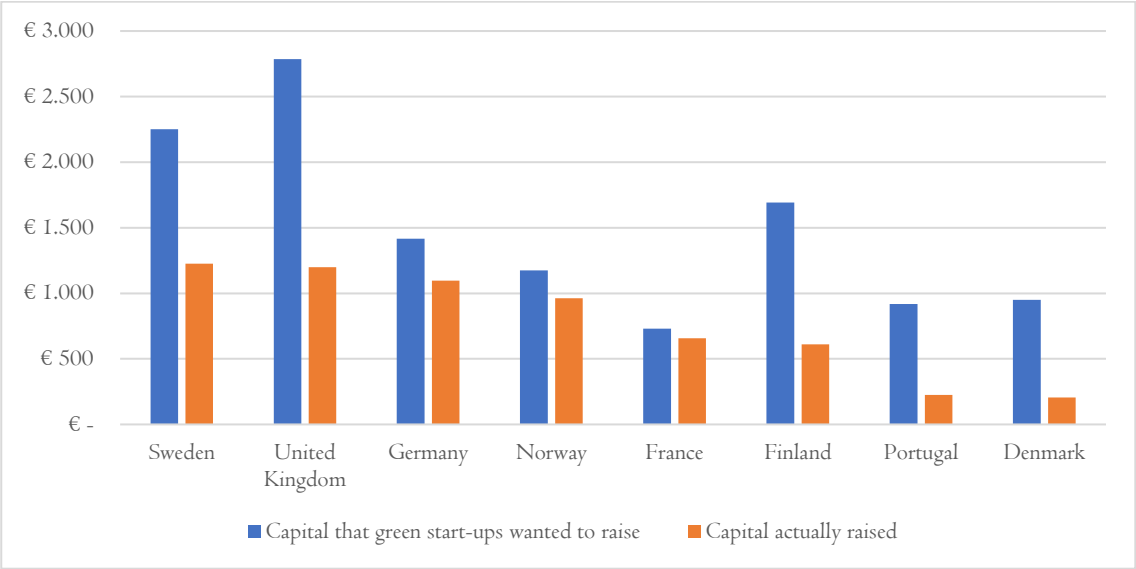
Figure 27. Digital skills in Sweden, %, 2019.[20]



Scaling solutions

Not only is a range of public investment schemes available to develop new digital green solutions, but green Swedish start-ups also manage to attract a lot of capital (see Figure 28). *This means that the resources to scale up digital green solutions are available in Sweden and thereby the resources to accelerate the digital green transition.*

Figure 28. Capital raised by select group of green start-ups, €000, 2019. [27]



Barriers

Future skills shortage

According to a study by IT & Telekomföretagen, 70,000 IT people will be needed in Sweden by 2022[59]. Looking at Figure 27, Sweden is in the "middle range" in terms of ICT training. One solution could be a focus on adult education but although the government has broad goals for adult education, these are not focused on digital and/or green competences. *The possible future lack of skills in the workforce could hamper the scaling of digital green solutions and decrease innovative capacity in Sweden.*

Potential

Utilising open data

A new national strategy and the recent establishment of a new open data portal reflect an ambition to improve Sweden's performance within open data. This is part of a broader digitalisation strategy and a plan to use artificial intelligence. Despite this, neither a specific green data portal nor specific targets or monitoring could be identified. *As such, Sweden still has the potential to boost the digital green transition through open data by committing to specific data standards, targets, monitoring and the building of dedicated green data platforms (Figure 29).*

Figure 29. Overview of open data in Sweden based on enablers from Appendix D.

National open data strategy	A strategy was published in 2019
Data standards	National principles state that public bodies should strive to make open data standardised, machine readable etc., but does not set specific standards or requirements.
Existence of an open green data portal	None identified.
Existence of open green data sets.	Green datasets within environment, energy, transport etc. are available on the Swedish open data portal.
Specific targets and monitoring of open data	The Agency for Digital Government has strategic goals but no specific targets or monitoring of these could be identified.

*The colours indicate where Sweden does well (green), where it is well on the way (yellow) and where more work needs to be done to strengthen open data (red).

Strengthening GPP

Sweden has no specific targets for GPP beyond a broad goal of public procurement that is environmentally responsible. Tools and voluntary guidelines have been developed to support GPP and training is offered along with other resources. As shown by the deep dive on GPP (p. 83), *more ambitious measures are required to fully utilise GPP as a strategic tool to boost innovation and scaling of the digital green transition.*

A view across the Nordic-Baltic region

In this section, we summarise the main findings from the country profiles and draw generalisations from them. Some of the points might be truer for one country than another but taking a bird's eye view of the entire region, the common positions of strength positions, barriers and potential for accelerating the digital green transition are presented below.

positions of strength

- Political commitment to the green transition: Across the Nordic-Baltic regions there is growing political commitment to pursuing climate goals by harnessing technological innovations. This momentum is currently being channelled into a more committed approach to developing focused digital green policies.
- Public-sector funding schemes: The Nordic-Baltic region has a strong tradition of public spending on research and innovation, which is also reflected in high levels of funding for public research in technology and environmental innovation. Several programmes that support the green transition across the region, and some initiatives that are specifically "digital green", have been identified. As such, the digital green transition is already taking place.
- Innovation performance: Looking at innovation rankings, innovative output and green solutions as shown by data on patents across the region, we find that the Nordic-Baltic region is one of the most innovative in the world. As such, the region has a strong capacity to develop new digital green solutions that can bring about a low-carbon society, and at the same time maintain employment and growth.
- A skilled workforce: This is supported by a high general skills level as well as many ICT graduates, ICT specialists and a digitally skilled populace, to fuel the development and deployment of digital green solutions.

Barriers

- Digital green educational opportunities: As mentioned, the digital skills level is high in the region, but there is a general lack of educational opportunities linking the digital and green. The specialist competences combining the digital and green will be necessary if the region is to succeed with the digital green transition.
- Lifelong learning: In general, many countries in the region lack strategies for lifelong learning and, for those that do have them, digital and/or green skills do not figure prominently. This could potentially slow down the transition, if those in the workforce having to change from industries no longer viable in a low-carbon society cannot attain new relevant skills.
- Access to private funding and capital: Though there is quite some variation across the region, the general picture is that access to private funding and capital is a challenge for many smaller enterprises in the Nordic-Baltic region, limiting the opportunities for SMEs and start-ups to scale up new digital green solutions and accelerate the transition. Many green start-ups in the Nordics do not manage to raise as much capital as in neighbouring countries, and although the numbers are growing in the Baltics, capital raised for smaller businesses remains at the lower end.
- Open green data: National digital policies or data strategies are widespread in the Nordic-Baltic region. However, only a few of these identify the potential to collect, share and support accessibility to "green" data. The triple challenge to strengthening the green data ecosystem is: insufficient collection of data; lack of central "one-stop" platforms; and a shared standard format for presenting, exchanging and utilising data. The line between open data as a barrier or a potential for the digital green transition is rather blurry. On the one hand, data acts as fuel for the digital green transition and the absence of a policy framework risks hindering the acceleration of the digital green transition. On the other hand, it should be possible by taking certain policy steps to improve upon the situation. Some of these steps are elaborated upon under potential, below.

Potential

- Increasing market demand: While most Nordic-Baltic countries have GPP policies, only a few set specific targets and have auditing bodies that commit public procurers to improving performance. Here lies a great potential to

specify how the procurement of digital solutions can optimise resource efficiency, while also making explicit what environmental standards are expected from providers of digital solutions.

- **Scaling solutions through public-private partnerships:** To increase scalability, more initiatives that combine public and private funding could be promoted. This can be done by providing state-backed loans, which solution providers (businesses and entrepreneurs) must seek private capital to match. Challenge owners (for example, public foundations) should also have to comply with clear criteria that promote the development of more mature and "fit to market" solutions.
- **Working strategically with and promoting the use of open data:** The Nordic-Baltic region still lags behind in terms of open data, especially in working strategically with how open data can support the digital green transition. Developing and promoting open data strategies linking the digital and green would be a good start, as would finding ways to compensate public organisations and businesses that are publishing data at a cost. This could accelerate the use of open data for the digital green transition.
- **Ensuring data interoperability:** More could also be done to enhance convenience in the form of standardised and user-friendly data submission forms for public data platforms. Looking forward, there is large potential for supporting interoperability across platforms and the Nordic-Baltic regions by developing common standards for presenting and sharing green data. This would make it easier for Nordic and Baltic companies to find and access relevant data from different countries to power digital and green innovations.

Deep dives: Nordic-Baltic cases explored

This section now moves on to take a more in-depth look at specific relevant cases. The work on identifying positions of strength and challenges from the country profiles has assisted us in selecting five regional cases suitable for a deep-dive analysis. These cases highlight how policy can create an impact and what some of the Nordic-Baltic positions of strength and opportunities are. As such, they are a useful analytical tool. By exploring specific cases beyond the reach of desktop research and consulting with experts and leaders directly involved in the organisations central to each case, we get a more nuanced picture and more qualitative insights into background and context, which provides for a stronger understanding of the strengths, challenges and "hidden potential" related to the five cases.

The selection criteria for the deep-dive cases are:

- Policy background: Does the case originate in public policy? If so, what is the context?
- Impact assessment: Does it create, or have the potential to create, results that further and support the digital green transition?
- Transferability potential: Does it offer any learnings relevant outside of its local setting, from which other Nordic and Baltic countries can draw inspiration?

The deep-dive cases included are:

AI Sweden: Applying AI in practice [60-62]

Introduction

AI Sweden is a cross-sectoral national collaboration platform for AI supported by the public and private sectors and academia. The overall purpose of AI Sweden is to accelerate the use of AI in Sweden to benefit society at large and increase the competitiveness of Swedish enterprises. In this deep dive a closer look is taken at how applicable AI solutions can be developed and how they can be linked to the green transition.

Digital technical components

There are three main components to the work of AI Sweden, of which one can be considered a digital technical component – the Data Factory. The Data Factory is essentially a data portal and computational power run by AI Sweden and available to members, which works as the foundation for developing and testing AI solutions. As such, the purpose of the Data Factory is to function as a testbed to train algorithms and run applicable AI projects. The Data Factory will be central to this deep dive as this is where most lessons can be learned. The other two components are capacity-building and an AI start-up programme (incubator and accelerator).

Why is this a position of strength?

AI Sweden gathers together resources, knowledge, people and initiatives across Sweden in one national centre with the right infrastructure to enhance the use of AI, applying it in practice to solve problems and develop new business opportunities via the Data Factory. Without the Data Factory and the many involved partners working on solutions, the potential for applying AI in practice would be smaller, simply due to the lack of resources and coordination. In addition, the general AI capability of Sweden and opportunities to link AI applications to the green transition, according to a report conducted by AI Sweden[63], is relatively strong. A range of research environments with the potential to combine AI and climate change is present in Sweden.

Policy background

Part of the Swedish government strategy on digitalisation in 2017 was to make Sweden a frontrunner for digitalisation and enhancing digital innovation and competitiveness; and a later strategy from 2018 focused on AI with the National Approach for Artificial Intelligence. This led to the establishment of AI Sweden in 2019, between a number of actors, with the Swedish innovation agency Vinnova as financier and a variety of local, regional and other national public authorities, academia, and a range of private companies such as Ericson and Volvo. AI Sweden was not established to reduce CO2 emissions but has recently started to include the green agenda and will in the coming years work more intently on utilising AI in the service of the climate in areas such as logistics (supply chains), energy systems and greening data infrastructure.

Financing

Vinnova funded the establishment of AI Sweden to the tune of approximately €2.9 million for the period 2018–2021. Around 100 partners also contribute financing for operations, the development of the Data Factory and the 30–40 employees of AI Sweden.

Delivery mechanisms

The focus of this deep dive is the Data Factory which delivers value for partners in four ways. First, it provides the technical infrastructure by providing storage and computational power to partners and projects, enabling the training of AI algorithms. Second, the relevant datasets needed by the infrastructure are donated by AI Sweden's partners. Examples of datasets include Swedish highway data and data on Baltic seabirds. Third, competence and compliance on data and the infrastructure are provided by AI Sweden, via legal and infrastructure expert groups. Finally, there is a testbed, Edge Lab, where partners can test their AI solutions and link devices to the AI Sweden infrastructure.

Edge Lab is part of AI Sweden's strategic focus on decentralised AI and federated learning, for example by using multiple decentralised devices as opposed to a centralised system storing all information in one place. The challenge is therefore to train algorithms locally in single devices. The centralised system is easier to engineer but much more prone to privacy issues and, as a result, legal restrictions. The strategic focus on decentralised AI will expand the opportunities for applying AI but will also create a stronger demand for collaboration among stakeholders as data is spread across locations. This is also where AI Sweden has an important role to play, connecting a variety of relevant actors nationally across the country.

Value creation

As AI Sweden is a relatively new organisation there are as yet no impact assessments or KPIs, and there are no numbers on the potential for reducing CO2 emissions using concrete AI applications. However, more than 100 organisations are partners today, and see value in collaborating on AI via AI Sweden.

Barriers

In the report on AI and its relation to climate change mitigation, several barriers to linking AI and the green transition in Sweden are identified: a lack of competence-bridging AI and climate change; a lack of financial resources and meeting arenas; and finally, access to high quality data. Interestingly, apart from lack of financial resources, these are also barriers to the broader agenda of accelerating the digital green transition in the Nordic-Baltic region, as we have seen previously in this report. Other barriers include making sure that the data used and collected is green, as the training of algorithms requires large amounts of energy and data space. If renewable energy sources are not used to power AI, its development can cause a lot of pollution.

Transferability to other Nordic and Baltic countries

On researching this deep dive, several lessons that could be relevant across the Nordic-Baltic region came to light. First, to link the digital and the green from the outset, which is related to the lesson of being mission-driven, making the green transition the guiding star when creating policy or establishing new organisations. Without it the direction and development of digital solutions might not aid the climate. Second, in a complicated field such as AI, without a long-standing tradition of development and deployment and where access to data is central to success, to gather all the relevant actors nationally, including public, private and academic. Without everyone on board, less data, specific skills and opportunities might be available to enterprises. Finally, federated data holds a huge potential for developing and deploying AI without compromising privacy.

Business Finland: Developing digital green solutions

[64-67]

Introduction

Technical and digital solutions within sustainable development have been supported through various public sector organisations in Finland. This case will provide insights into how one of the larger, long-running policy programmes is helping to accelerate digital green transition in Finland.

Business Finland is the public organisation for innovation funding and trade, travel and investment promotion, and is directed and funded by the Finnish Ministry of Employment and Economy. It plays a central role in developing smart digital green solutions in Finland. This case will show how Business Finland supports domestic companies in developing digital green solutions for both the local and global markets. For several years, Business Finland has been launching programmes with the purpose of prompting businesses to benefit from large-scale market transitions, including the green transition.

Business Finland programmes

The Business Finland programmes help Finnish and international partners solve common challenges. The programmes aim to mobilise a critical mass of actors to build joint offerings from Finland in strategic sectors where Finland has a stronghold. Each programme lasts between four and six years. The first programmes were launched in 2006, so Business Finland helps to develop and match local digital green solutions with attractive foreign markets. Business Finland provides funding for several types of projects including research, market research, innovation, public procurement, support for export and FDI.

Figure 30. Business Finland Programmes 2020.

The selection of themes for the programmes is suggested by Business Finland, but a board with representatives from the private and public sector and academia reviews all suggestions before the programmes are decided. This is based on research into trends in market transitions and a deeper understanding of strategic important themes affecting the future of businesses in Finland. Figure 30 shows the latest projects and how they fit in strategically with sustainable development.

Low-carbon solutions have been high on the agenda since the start of the programmes, which is especially due to EU policies, which Business Finland follows closely. According to a study carried out for Business Finland[67], regulation has been a major driver for shaping the low-carbon solutions from the early 2000s. Finland has been quick to implement EU regulation and with national policy support (including Busines Finland), Finnish companies often have a competitive edge as forerunners in low-carbon solutions. In the beginning, the focus was on energy efficiency, but demand for low-carbon solutions remained low until the 2010s when it became a strategic business priority.

Value creation

More than 150 Finnish companies have been involved internationally through the programmes. Across the programmes, low-carbonisation of society has been an enabler for developing digital solutions, and global policies to reduce carbon emissions and tackle climate change have created a global market. However, the focus on global market needs and the fit with Finnish positions of strength has been at the core of the success of the programme.

Barriers

Nordic-Baltic solutions are advanced compared to many foreign markets. A good example is energy and water, where the Nordic countries in particular have district heating, energy systems and advanced water infrastructure. Foreign markets often lack such infrastructure, having invested differently, which is a barrier for the export of Nordic-Baltic solutions. According to Business Finland, there is a need to look at how these advanced systems can be integrated both locally and in foreign markets with a different existing infrastructure. This is also the case for digital green transition solutions.

Business Finland itself also points out that AI solutions need to be more practical and connected directly to societal challenges. If not, they often end in R&D and out-of-reach solutions, with no or less focus on implementation and real impact.

Transferability to other Nordic and Baltic countries

The combination of the development of sustainable digital solutions and intensive market research *before* starting the innovation programme is a key lesson, as many new public funded technology programmes (in general) end up in researching and testing without a buyer for the end product or digital solution. The programmes work with domestic companies of all sizes and research institutes, use the public sector to create testbeds, and create markets through support for procurement and the research needed to understand new technologies and solutions. The orchestration of cross-organisational resources and commitment to market research and testing is a key feature that can inspire others.

Business Finland sees two major needs where Nordic-Baltic collaboration can be an important factor. One is a joint offering through partnerships, which help to reduce the risks of investing and developing digital green solutions. The other is to support the development of less advanced markets to be ready for green digital transition solutions. This could take the form of a combination of development aid and innovation projects for markets where Nordic-Baltic solutions could support their digital green transition.

Center Denmark: Smart energy solutions in Denmark

[68-73]

Introduction

Center Denmark was established in 2018 as a partnership between technical universities, energy suppliers and the Danish transmission company (Energinet). The idea was to create a data portal for research and development of commercially viable solutions for the management of the energy system. The background was finding solutions to the still increasing share of renewable energy in Danish energy supply, much of which is dependent on the wind (which is not stable across time), thus increasing the need for smart energy management. Today an increased variety of public and private sector partners are engaged in Center Denmark: municipalities, heating, gas, water and industry companies, clusters, technological institutes and others.

Digital technical components

The data portal functions as a sandbox environment for developing and testing digital solutions for the intelligent management of the Danish energy system, including the heat, gas, electricity and water sectors. These solutions can require different technologies, such as AI, machine learning, IoT and so on, depending on the problem at hand. A data portal is not a unique service. What makes it unique in this case is that it delivers real time data and has a two-way set-up that can both send and receive data, particularly by coupling different sector data on electricity, water, heat and gas.

An example of how Center Denmark can support digital green solutions is in the balancing of production and consumption of energy, which fluctuates on both the consumption and production side according to the weather and time of day. By automatically lowering or increasing consumption based on production using algorithms, it is possible to create a much more efficient energy system and utilise renewable energy sources to a much higher degree. More concretely, when the wind is strong but demand low it would be possible to start waste management facilities automatically where waste has accumulated, to fully utilise peak periods in energy production.

Why is this a position of strength?

Normally an undertaking such as Center Denmark would be hampered by the need for competing energy suppliers, transmission, heating and water companies and universities to work together. In other words, sector coupling. This is notoriously difficult and takes time to set up effectively. It requires people who know the ecosystem and relevant actors, and that all participating actors can agree and align their interests. But sector coupling is exactly what makes CD a powerful case for the successful development of digital green solutions. This allows for the development of smart energy solutions that can utilise the flexibility not just in the energy grid but also within the systems for heating, water and gas, expanding the capacity and effectiveness of smart energy solutions.

Policy background

In 2018, 61% of the total Danish energy supply consisted of renewable energy, of which a large share originated from wind turbines. This is a challenge for business as usual in the energy supply system. Normally, energy supply attempts to meet a given demand based on forecast models of consumption. This has become increasingly difficult as production relies on wind and sun. The background for Center Denmark was therefore to find solutions to that challenge. Even though there is no formal policy background, Center Denmark and previous likeminded projects arose with public funding for collaboration and research.

Financing

Center Denmark is a non-profit enterprise foundation and has received funding from Innovation Fund Denmark and the EU for specific projects. Other revenue streams include consulting on digitalisation in the energy sector and payment for access to the data portal.

Delivery mechanisms

The key delivery mechanism is securing successful sector coupling, which in turn means getting the right actors together. There are too many to mention here but as previously stated they cover several sectors, research and both public and private actors. This might sound simple but is often a difficult exercise, particularly when several actors across sectors are involved.

Center Denmark also works on scaling solutions through an incubator. The ambition is to create, grow and scale up new companies that develop new solutions for the intelligent management of the energy system based on the Center Denmark data portal.

Value creation

The Technical University of Denmark has previously documented large CO2 reductions and energy savings through intelligent energy management. By using a model predictive control (MPC) algorithm (which today is hosted by Center Denmark) and testing it in the heating of water in a recreational area consisting of holiday homes, it led to a 15% reduction in CO2 emissions. It is estimated that using the MPC algorithm across Denmark could make savings of €108 million annually by more efficient energy use – and in turn lower CO2 emissions, if applied to not just to water but to other sectors as well.

The Technical University of Denmark has also documented that the use of an intelligent data management system can provide both short-term energy storage capacity (from 30 minutes up to 18 hours) and long-term/seasonal capacity by linking wastewater systems, supermarket refrigeration, district heating, cooling systems and more, through a platform like the one established by Center Denmark.

Barriers

A large part of the funding for Center Denmark is temporary and tied to specific projects. To remain relevant, it requires data delivery to the platform, which in turn is based on voluntary participation by relevant actors in the different sectors. One of the greatest barriers to the continued development of intelligent energy systems solutions is therefore the lack of a national framework for energy data, which could establish an obligation for sectors to contribute with relevant data. Finally, intelligent management of the energy system could be supported by a CO2 tax, which would send price signals to consumers that would incentivise the use of digital solutions that lower CO2 emissions, thereby strengthening the market for digital green energy solutions.

Transferability to other Nordic and Baltic countries

In general, the Nordic-Baltic region has a high degree of renewable energy in its energy supply, which might lessen flexibility in the system, as supply becomes more dependent on the weather. More intelligent energy management solutions could therefore boost the digital green transition in all countries, but this requires green data ecosystems that provide the data needed and allows for the establishment of data portals. As such, the lesson provided by Center Denmark is that establishing a data portal that links energy and utility sectors and actors, as shown above, has the potential to create major CO2 reductions.

Green public procurement in Finland: The case of Keino [74-76]

Introduction

Most of the Nordic-Baltic countries have worked systematically on improving their capacity to utilise GPP to achieve green policy goals, but what we found in the analysis of the region was that there is still major potential for better use of GPP in service of the green transition. In this deep dive we therefore look at the approach to GPP in Finland, and what we can learn from Keino. Keino is a network-based competence centre for sustainable and innovative public procurement. It consists of six member organisations representing a variety of sectors and ministries in Finland: Motiva; the Association of Finnish Local and Regional Authorities; VTT Technical Research Centre of Finland Ltd; the Finnish Funding Agency for Innovation – Business Finland; the Finnish Environment Institute SYKE; Hansel Ltd; KL-Kuntahankinnat Ltd; and the Finnish Innovation Fund Sitra. The first six are still part of the consortium and responsible for Keino.

Digital technical components

GPP is not in itself digital green but it is vital in ensuring the pull effect of the market for new digital green solutions. The focus of this deep dive is therefore on how to strengthen GPP in general rather than the specific digital technical components.

Why is this a position of strength?

In Finland, an estimated two-thirds of invitations to tender include general sustainability aspects and around 40% include more detailed sustainability aspects, which makes for a very progressive GPP agenda (see also the country profile for Finland on p. 41) These results can be attributed to a combination of strategic goals, clear targets and sufficient resources dedicated to helping public procurers. Keino has played an important role in creating this impact and making GPP a driver of green transition in Finland. As such, Keino and GPP in general represent a Finnish strength position.

Policy background

In 2016 the Finnish government announced a GPP strategy. As part of this strategy Keino was established in 2018 to increase GPP and innovation, to support the active use of public procurement as a management tool by the public sector and finally to ensure public procurers have ample opportunity to learn from one another.

Financing

The Ministry of Economic Affairs and Employment finances Keino. It has limited this to three years (running until the end of 2021), with the possibility of an extension. Keino is currently awaiting further financing to continue its work after 2021.

Delivery mechanisms

Overall, the two main approaches to supporting GPP for Keino is through capacity-building and direct support for public procurers. Capacity-building takes place in various ways such as buyer groups for sharing best practice and knowledge. Here, Keino aims to work mostly with frontrunners – actors who are ambitious about improving performance within GPP. The idea is to scale up lessons and new ways of doing things learned from working with frontrunner actors and communicate information about best practices to other relevant public-sector actors. In addition to this, some higher education institutions provide degrees and courses on public procurement but Keino also offers online and offline events and courses for public-sector purchasing bodies. This recognises the many skills needed for GPP, such as budget and pricing expertise, operational procurement competence, expertise in procurement law and others.

Keino also gives more direct support to public procurers, but does not offer single public entities support on their tenders, as this would interfere with the market for private consulting on public procurement. Instead, Keino is sustaining a national-level change agent network that provides local contact points for Keino across Finland to bring activities and support closer to public procurers locally, help conduct market dialogues and provide studies and knowledge; it has a range of experts to support public buyers.

Value creation

There are no direct measures or official key performance indicators (KPIs) for Keino, and it would be hard to measure what share of the Finnish implementation of GPP is due to Keino. Given that capacity-building and monitoring are important factors in implementing GPP and these have been part of Keino's work, we can assume that Keino has played a positive role in implementing GPP in Finland.

Barriers

Keino is focused on overcoming three primary barriers. The first is to establish the necessary capacity and skills to fully utilise GPP across the entire public sector. The building of skills and capacity is essential to GPP but also a barrier to the further implementation of GPP if it is not present. The challenge is that public procurement often takes place in a municipal or regional setting, both of which have a certain amount of autonomy. GPP might not be high on the agenda, or the right skills for GPP might not be a priority. The second is in implementing a new role for public procurers, and changing the mindset of civil servants who have been used to doing things in a certain way for a long time. Fully implementing GPP requires a new and more strategic role for public procurers, and that role cannot be implemented in a single day. Finally, many public tenders are within the professional "silos" of municipal, regional, and state bodies, with the health sector focusing on its needs, the education sector focusing on its needs and so forth. Going green often requires a broader perspective than that found within the silo of a department, ministry or the like. The structure of the public sector and how public tenders are made can therefore be a barrier to fully utilising GPP.

Transferability to other Nordic and Baltic countries

For all of the countries in the Nordic-Baltic region it is relevant to ask whether the respective public procurement systems have strategic capacity at all levels of government and, if not, how this can be built, since the strategic use of public procurement is necessary to fully utilise GPP. Keino is an example of what working systematically with building this capacity can look like and how to overcome some of the barriers mentioned above. By being a cross-sectoral organisation and an independent actor outside a specific policy field, Keino can work with public procurers across the professional silos and policy levels. Other Nordic-Baltic countries could consider the Finnish experience and how it might apply to them.

Smart City Sweden and digital green transition in Sweden [77-87]

Introduction

This case describes two initiatives launched by several Swedish ministries and agencies in collaboration with various partners. The focus will be on the strategic innovation programme, *Viable Cities,* an initiative with the mission to speed up the transition to climate-neutral cities by 2030. The ambition is to strengthen Sweden's role in the development of smart sustainable cities by building on the country's strengths in research, innovation, and entrepreneurship. The second initiative, *Smart City Sweden,* has the clear goal of exporting Swedish green solutions and sharing good practice examples from various companies and cities.

Jointly, the two initiatives ensure green transition through digital solutions – combined with other non-digital tools – and ensure that the solutions can be scaled up nationally and internationally to meet EU and national political targets.

Digital technical components

There are no specific digital components in the initiatives, but Viable Cities projects aim to solve urban challenges with new or existing technologies and Smart City Sweden ensures that the solutions are shared internationally and exported. It is the Swedish companies and research institutions' positions of strength that are used to solve the complex challenges in the cities.

A general digital topic in Viable Cities is the importance of interoperability between digital platforms, existing open standards (e.g. EU standards) and data-sharing. This is incorporated on a project-to-project basis, but lessons are collected and shared to create input to common guidelines. This is an essential foundation for digital green transition towards climate-neutral cities. Without securing interoperability, the value of data and cross-institutional collaboration decreases as coordination and transaction costs escalate.

Why is this a position of strength?

The two cases pull together several aspects *accelerating the digital green transition* – from funding and solving challenges that lead towards climate neutrality, to knowledge-sharing and exports, based on Swedish know-how and the positions of strength in smart city solutions.

In an interview with Smart City Sweden, positions of strength such as waste solutions, mobility, the built environment and green solutions in general were mentioned, based on what foreign delegations ask to explore in Sweden. Smart City Sweden displays cases based on key positions of strength through the strategic innovation programme, including Viable Cities, Drive Sweden[85] and RE:Source[86]. In this case, we will only focus on Viable Cities, but it is also worth looking at the other two programmes (see links in footnotes).

The ambition for Viable Cities is to strengthen Sweden's role in the development of smart and sustainable cities through the strengths of the country's research, innovation and entrepreneurship. This is to be done in partnership with other leading countries and cities to establish Sweden as a competence centre for smart and sustainable cities.

Policy background

The overall policy background is Sweden's commitment to the EU Green Deal and the SDG Agenda 2030, and the important role of the cities in achieving this target.

As the first EU member state, Sweden signed Climate City Contracts[87], which are contracts between cities (nine currently) and four government agencies (The Swedish Energy Agency; Vinnova (the Swedish Agency for R&D); Formas (the Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning); and The Swedish Agency for Economic and Regional Growth) and Viable Cities Sweden. Climate Contracts 2030 involves mutual efforts to shift the pace of climate change with the goal of cities achieving the sustainability goals in Agenda 2030. Vinnova and Formas are financing 17 strategic innovation programmes in areas of strategic importance for Sweden, and both create the preconditions for developing sustainable solutions and services to address global challenges and increase Sweden's competitiveness.

Viable Cities is collaborating with the Smart Built Environment, Drive Sweden and IoT Sweden programmes, representing other Swedish positions of strength. Smart City Sweden is using solutions from the same programmes, plus RE:Source, to promote Swedish green solutions internationally.

Financing

The Viable Cities initiative has a €100 million budget funded by the Swedish Government. The budget will be used over a 12-year period to support cities in their green transition towards climate neutrality. The funding is seen as support to find new innovative solutions to complex challenges. Cities are also encouraged to find other funding channels, such as the EU research programme "Horizon Europe", which assists EU cities in their green transition, or national/international funding opportunities.

Delivery mechanisms

Viable Cities has several ways to support the digital green transition of cities. At the highest level there are two main focus areas – *Knowledge & Innovation* (from research to demonstration) and *Support & Coordination* (such as roadmaps, new policies and standards, competence development, sharing of good practice and entrepreneurship).

The cities are problem-owners, and Viable Cities funds calls for collaboration between academia, companies and cities on anything from studies, pilots, tests and POCs to scalable solutions.

Value creation

Viable Cities aims to accelerate the green transition in cities by addressing some of the barriers experienced. The objective is both to create solutions and services the cities can implement, and to create the conditions that make this possible. It is still too early to show the results, but the signatures of nine cities on the climate contracts is a very important first step, as it requires the cities to work actively on the matter, and to provide new opportunities for funding.

The cities also help to describe the challenges, which include anything from physical problems in the cities, to the barriers to developing, implementing and scaling the solutions developed. The programme supports all aspects (with funding) and also shares the lessons learned with other cities in Sweden and abroad.

Barriers

As it is currently early in the process, the real barriers are yet to be explored. However, it has been mentioned that the most difficult part is to implement and scale up the solutions; in other words, to move beyond testing and demonstration. Therefore, it is expected that it will take time to see the results in terms of actual solutions to climate challenges, until many of the political, legal, competence and process-related barriers are resolved. Therefore, Viable Cities is spending a large amount of resources on aspects other than "just" the solutions. It can prove valuable to follow this programme, as it is the largest public-sector Nordic-Baltic project directly funding cities towards scaling and digital green transition projects.

Transferability to other Nordic and Baltic countries

Viable Cities and Smart City Sweden are already involved in transferring knowledge and solutions to other cities and countries. Smart City Sweden is showcasing the Swedish smart city solutions and promoting these internationally. Viable Cities is taking part in another Nordic project, the Nordic Transition Partnership, which is partly funded by Nordic Innovation. The aim of the project is to share best practice and also to offer tools and roadmaps providing guidance for climate-smart investments in the cities. The partners are Tampere, Reykjavik and Smart Innovation Norway.

This case could be a good example of what is needed to develop smart city solutions supporting the digital green transition. Funding is a major issue for cities, so this is a positive step towards removing this barrier. There is a long way from the high-level targets of the EU Green Deal to implementing solutions in the cities. This case shows some important steps to realising the potential of the smart city through taking advantage of the nation's key strengths. These include:

- Clear strategy from policy to delivery of solutions to exports
- Collaboration across agencies/ministries (the smart city is cross-sectoral in nature)

- Commitment from everyone from national to local stakeholders (national strategy and funding to Climate City Contracts)
- Focus on city challenges, but more importantly addressing the challenges hindering the development and implementation of digital green solutions
- Funding to support the cities in their Digital Green Transition
- Return of investment through securing and exporting Swedish solutions.

Transferability potential across deep-dive cases

The Nordic-Baltic cases covered in the previous section all have different features, strengths and barriers. In the context of digital green transition, considering what others can learn from, or be inspired by, it becomes necessary to synthesise and summarise key findings related to the *transferability potential* in the cases. Some features to learn from include:

- Tie policy initiatives and digital technology strategies to concrete societal challenges to create focus and secure testbeds, users and procurers for the solution. One way of doing this is to make policy initiatives mission-driven, formulate targets and follow up by performing impact assessments.
- Build cross-regional data frameworks creating incentives to collect, share and use data resources. This also addresses the need for open data standards that support interoperability across platforms, but potentially also across countries and the Nordic-Baltic region. Creating a strong green data space[7] does not necessarily imply a single central data portal that collects and stores all relevant data. Applying a decentralised approach, where several platforms are interconnected, however, does call for a common standard to secure interoperability and convenience.
- Build strategic GPP capacity beyond the administration of tenders and do this by establishing a third-party neutral organisation that can cut across public sector silos, collaborating with frontrunners to identify and scale up best practices.
- Design policies for digital green transition that are cross-sectoral and cross-institutional by default, which means they can only be delivered through partnerships and collaboration, and resist "lock-in" from one institutional owner.
- Be a frontrunner! As the deep dive on Business Finland shows, being quick to implement EU regulation with national policy support can give companies a competitive edge as frontrunners in low-carbon solutions.

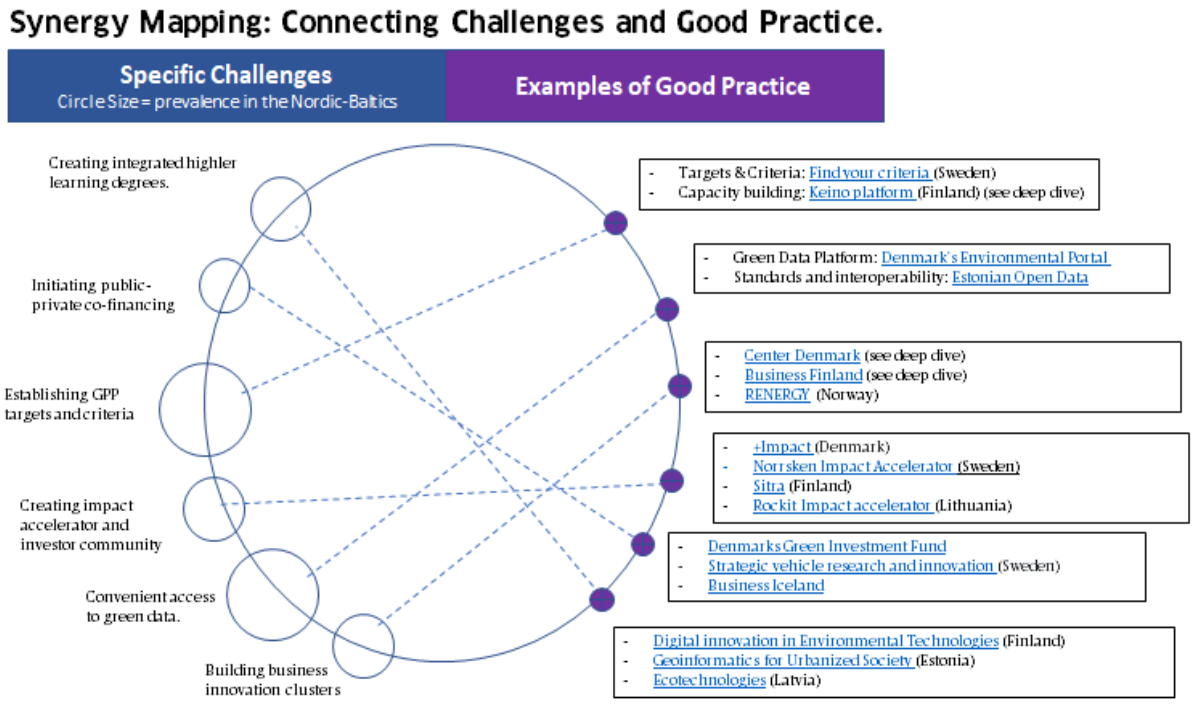
In summary, these points should be considered key lessons. Some of them will be given new perspective by looking at four international cases, chosen as examples of ambitious and successful projects that contribute directly to the digital green transition in their respective countries. These will be considered after the information on synergy mapping on the next page.

Synergy mapping: Connecting challenges with good practice

Beyond the summarised findings above, there lies a potential, based on our previous analysis of country profiles and cases, to be more concrete and illustrate the various challenges identified with examples of good practice taken from the Nordic-Baltic countries.

[7] There is also potential to align Nordic-Baltic initiatives in this area with the European Strategy for Data. For more information see https://digital-strategy.ec.europa.eu/en/policies/strategy-data

Figure 31. Synergy mapping.



The analysis of positions of strength, barriers and potential has led to an understanding of the broader challenges that cut across and indicate several of the countries, while also uncovering a wealth of good practice examples from which to learn. Of course, these positive initiatives that can provide inspiration are not spread evenly across challenges for digital green transition. Also, in some areas like open green data, the examples of good practice are only partial. Of the referenced cases in the synergy mapping above, for instance, Denmark's Environmental Portal is an example of an open data platform explicitly dedicated to green and environmental data. Nonetheless, it has apparent shortcomings pertaining to the number and quality of datasets that are presented.

This is the case with many of the good practice examples highlighted that show promise and excellence in one area while lacking other features.

This raises the point of *transferability*, which we have used as a guiding criterion of relevance across the country profiles, deep-dive cases and international cases. The synergy mapping in Figure 31 represents a first explication of transferability, that is, the first attempt to synthetise and show which strengths and promising initiatives can inspire others and lay the ground for new practices and initiatives that contribute to the digital green transition across the Nordic-Baltic countries.

International cases

This part of the study relates the Nordic-Baltic positions of strength in a wider European and global context. Here, we provide insights on good practice from EU member states and countries outside the EU by considering four cases. The final selection of the cases was based on data gathered earlier in the study, additional desktop research and interviews with key experts and stakeholders from the selected countries. The table below shows the title and geography of the four cases, plus the key topics related to the project.

The four cases

Title	Geography	Key topics	Page
The role of AI in the green transition	Japan	Use of AI Data-driven policy and instruments Mission-orientated policies Circular economy/value chain	78
Digitisation of green public procurement	EU – selected member states	Green public procurement	83
Pre-commercial procurement for smart cities in Ireland	Ireland	Pre-commercial procurement Smart city Public-private partnerships From pilot to implementation	85
Food waste recycling – "Pay as you throw"	South Korea	Data-driven policy and instruments Mission-orientated policies Circular economy/value chain	89

After the four cases have been presented, we sum up the analyses from the cases and provide an overview of learnings in policies, projects and practices that can serve as inspiration for the Nordic-Baltic countries (p. 92).

AI in Japan: The role of AI in the green transition

Introduction

This case describes the role of AI in Japan's approach to the digital green transition and more general transformation of its society. The AI Technology Strategy was launched in 2017 as the second national strategy on AI in the world, after Canada.

The case provides an overview of the new *mission-orientated research and innovation policies* in Japan. This new policy focus is implemented through the Cross-ministerial Strategic Innovation Promotion Program (SIP), which is a national programme led by the Council for Science, Technology and Innovation (CSTI) and anchored in the Cabinet Office. This case shows the importance of the policy structure and the role AI plays in solving societal challenges, including the digital green transition.

Policy background

Figure 31 provides an overview of the new mission-orientated policy structure in Japan, and shows the strategic orientation, policy coordination and policy implementation.

Figure 31. Overview of policy structure.

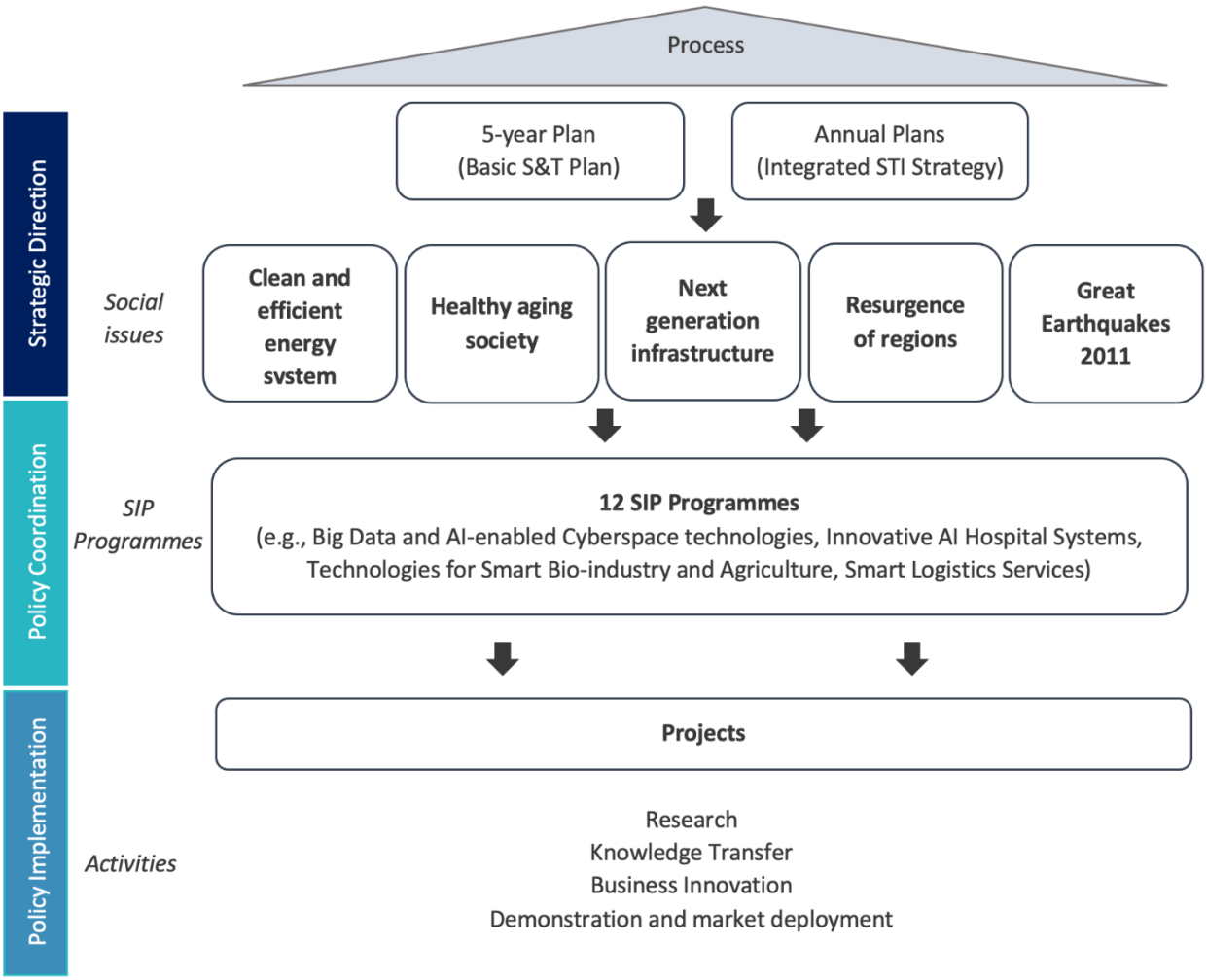


Figure 31 shows that the strategic orientation is based on a five-year plan and major themes, including identified societal issues. The SIPs provide policy coordination across government through 12 selected programmes with different, but

often interlinked, focus. A large number of projects are funded and implemented in these programmes through four overall activities: *research; knowledge transfer; business innovation;* and *demonstration and market deployment.*

As part of a new five-year plan, Japan recently launched Society 5.0[88], which is a Japanese concept of a super smart society. Society 5.0 aims to improve the challenges Japan is facing. AI, IoT and big data are important ways to overcome challenges in Japanese society and at the same time address global challenges. In the following section, there will be examples of how AI, IoT and big data are included in the SIPs and the role they play in addressing some of the main challenges in Japan.

The five-year plan and the SIPs are governed and coordinated by the CSTI[8], which is responsible for the interdisciplinary management to realise scientific and technological research. The SIP Governing Board, together with external experts, support the SIPs and appoint programme directors. The SIP is not governed by formal missions but by cross-sectorial programmes within which partners define an R&D plan.

Cross-ministerial Strategic Innovation Promotion Program (SIP)

To solve its societal challenges, Japan launched the Cross-ministerial Strategic Innovation Promotion Program (SIP) in 2014 as part of its previous five-year plan. The aim of the programme is to promote research, innovation and demonstration activities in an integrated way across ministries, with a major focus on end-to-end activities from laboratories to early application. In the delivery of the programmes, partners from the public sector, research and industry participate, and the strong Japanese tech-industry plays a major role in the SIPs.

In the current five-year plan, there are 12 SIPs[89] with different themes, all aimed at solving societal challenges. The digital green transition is a major component, including climate change, energy security and food security.

The role of AI in the SIPs

Society 5.0 and the underlying importance of AI as its pillar has been moving from being a vague concept to becoming a mainstream political agenda central to the Cabinet's growth strategy. The AI ecosystem is coordinated by the Cabinet Office, guided by the CSTI and the Strategic Council for AI Technology.

AI is included in most of the 12 SIPs. In some of them it is the primary focus, in others it is a tool for developing new insights and solutions within a specific area. The following links provide brief examples (topics, structure, activities, completed milestones etc.) of SIPs and explain how AI plays an important role:

- *Big data and AI-enabled cyberspace technologies [90]*
- *Innovative AI hospital systems [91]*
- *Technologies for smart bio-industry and agriculture [92]*
- *Smart logistics services [93]*

The examples also clearly show the complexity and work needed to get to a point where AI can be used as a tool for new innovative solutions. This includes the collection of data across many different areas in the public and private sectors, the infrastructure to handle and share data, and the development of applications.

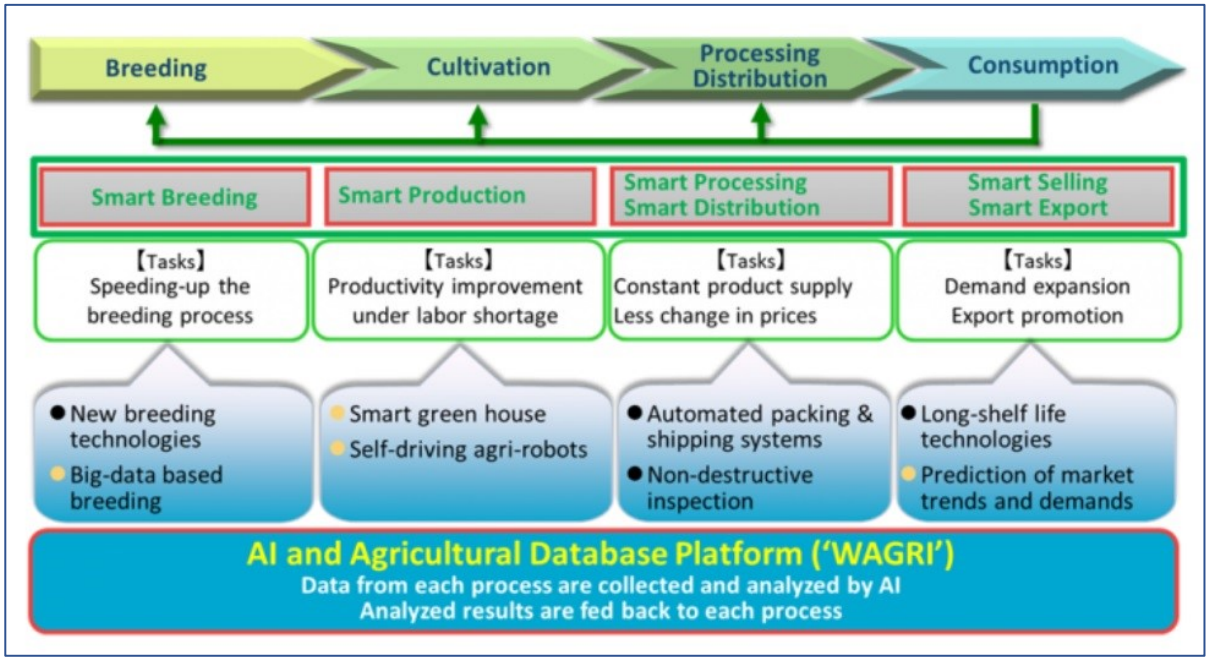
An example of a SIP, where AI and big data play a horizontal role and where digital green transformation is a major theme, is *Technologies for smart bio-industry and agriculture.* One of the sub-themes in this SIP is "Smart Food Systems", where several of Japan's societal challenges are mentioned.

Smart Food System

[8] The CSTI is chaired by the Prime Minister and has 14 members including the Chief Cabinet Secretary and several ministers, as well as academic and industry experts.

The Japanese government is working towards the realisation of "food sustainability" by using next generation bio-industry and agriculture technologies. The aim is to collect and use data (AI) at each stage of the food value chain: breeding; cultivation; processing/distribution; and consumption. It has created a model case called the "Smart Food System", aimed at the emergence of food-related business beyond the framework of each industry.

Figure 33. Overview of the AI and Agricultural Database Platform.



Some of the themes relating to digital green transition and AI are:

- Streamlining of farming/improvement of farm management efficiency
- Reduction of food loss and waste
- Value-added ingredients and food
- Development of primary industry by increasing exports
- Reusing or recycling of unused parts of waste and farm products after consumption.

The Smart Food System is closely interlinked with other SIPs, including smart logistics and AI-enabled cyberspace technology programmes to create the Smart Food Value Chain.

An AI and agriculture database platform called WAGRI was already developed in 2017 by the National Agriculture and Food Research Organisation (NARO). It provides data on weather, soil, satellite imagery, growth and so on. The agri-food sector can utilise data to further improve productivity and profitability. This agricultural data is analysed by AI, and then used to optimise a series of processes from breeding, agricultural production, processing and distribution, to consumption. In the future, it is expected to contribute to the entire Smart Food Value Chain by collecting and linking market information and consumer needs.

Value creation

The new mission and cross-ministerial policy structure and the introduction of the SIPs have created a focused and flexible policy system for science and technology projects in Japan. The mission-orientated policies, anchored in societal challenges, help to focus R&D in AI to create solutions in close collaboration with research institutions and the industry.

Japan has taken a pragmatic approach and a long-term vision for AI to solve several legislative, economic, and societal issues – including environmental. The government therefore invests heavily in technological R&D and AI, which has created a strong tie between the public and private sectors.

Another interesting approach is that the Japanese government is looking at the society as a whole, and entire value chains. Japan has created a number of interesting systems through public sector initiatives, including data platforms collecting important information on key policy areas and using AI to analyse the data for new solutions and insights.

It is still early to measure the value of these developments, but the broad perspective and large investment in both R&D and solutions related to AI and the green transition, will make it interesting to follow the developments in the country's digital green transition.

Transferability to the Nordic and Baltic countries

Japan has a different approach to AI from the Nordic-Baltic countries and many other European countries. The strong technology-based industry in Japan plays a key role in AI R&D and implementation, whereas research institutions play a larger role in the Nordic-Baltic countries.

This case is a good example of how to approach the practical implementation of AI and technology through working with societal challenges. The Japanese government has created a baseline with large platforms, collection of data and AI tools, which can be used to develop solutions to address the challenges.

Furthermore, Japan is developing solutions across entire value chains, which create many opportunities in the long run. Here the different stages can be improved individually (energy efficiency, better use of resources, logistics, recycling) and, as data is eventually collated across the entire value chain, then cross-sectoral solutions are easier to develop due to new insights.

Key lessons from Japan for the Nordic and Baltic countries:

- Creating a foundation and a platform for AI: AI is only useful when it is fuelled by relevant and good quality data. Japan has spent significant resources acquiring data and building platforms to handle the data across different policy areas. This is done in sectors with both challenges and national strengths. The data sources are from both the public and private sectors. It would be beneficial to develop a joint "green" dataspace in the Nordic countries, but with associated national platforms (due to regulations and other restrictions). One level is how to handle public/private data-sharing, but also share examples on what data are needed to develop AI based solutions with the "green" sector.

- Digital solutions, value chains and silos: The case shows the complexity of digital green transition and AI. Sourcing of data is needed across value chains and silos. In Japan, the national government is the driving force behind digital solutions for collecting, storing and sharing data across value chains and silos. The case suggests that the national governments across the Nordic and Baltic region need to find new digital solutions to ensure cross-sector collaboration. This is a major task, so, as in Japan, a joint Nordic and Baltic sector focus (such as food/food waste) could be beneficial from a cross-national learning perspective. The circular economy is the focus in Japan and here data and AI play an important role for predictions needed to handle materials and waste across the value chains.

- Mission-orientated policies to solve societal challenges: In Japan, the government recently changed to mission-orientated policies. The case suggests identifying key performance indicators (KPIs) and targets and *then* creating policy programmes across agencies and ministries. This is closely related to the previous point, but the case shows that the end results are a driver for action. The Nordic and Baltic countries should identify common targets in the green transition and describe KPIs.

GPP in the EU: Digitalisation of green public procurement

Introduction

Public procurement amounts to an average of 14% of the GDP in the EU[13], thereby offering a huge opportunity to deliver significant impact on sustainability performance by the inclusion of environmental, social and economic criteria in public tender documents. At the same time, the digitalisation of public procurement (or eGPP) can help drive efficiency and effectiveness in public procurement processes and it is considered one of the cornerstones in the "once-only principle" in the EU's Digital Single Market strategy[94]. This case highlights the potential for eGPP practices to become more widespread and create positive impact.

Policy background.

Public procurement is subject to two EU directives adopted from 2014:

- Directive 2014/24/EU on public procurement [95]
- Directive 2014/25/EU on procurement by entities operating in the water, energy, transport and postal services sectors. [96]

The deadline for EU countries to put the new rules into national law was April 2016 except regarding eGPP, for which the deadline was October 2018.

The policy framework for green public procurement (GPP) is anchored in the communication document "Public procurement for a better environment"[97], defining GPP as "a process whereby public authorities seek to procure goods, services and works with a reduced environmental impact throughout their life cycle when compared to goods, services and works with the same primary function that would otherwise be procured". In short, since 2018, EU countries have been obliged to implement eGPP criteria but, as seen below, the specific integration of GPP and environmental sustainability is performed by the specific member states.

Opportunities

The digitisation of green public procurement offers a series of opportunities to improve sustainability performance, thanks to more efficient use of resources, less bureaucracy, better and faster communication and stronger integrity of institutions. In these ways, it offers opportunities in the environmental, social and economic areas of sustainability:

- *Savings of natural resources, time and money*. By digitalising documents and processes, society saves paper and time/money for bureaucracy and communication.
- *Less risk of corruption*. Digital technologies enable increased transparency across the procurement process, giving less room for local arrangements and protectionism. Likewise, use of things like blockchain, for instance, enables safer sharing of information.
- *SME participation*. With less bureaucracy, more transparency and the communication of call for tenders on electronic platforms, SMEs are given better access to the tender process and, along with that, better opportunities for sustainable growth to the benefit of business and society as a whole.
- *Better access to affordable, sustainable products and services*. By streamlining public procurement with digital technologies, transactional costs are reduced and prices of the end product can be lowered. Furthermore, as the market for sustainable products is growing, suppliers are incentivised to innovate more sustainable products. This makes the supply of sustainability products and services grow. The potential positive sustainability impact

is significant – especially in markets where public purchasers command a significant share of the market such as public transport, construction, health services and education.

- *Better quality of sustainable products*. The use of digital technologies such as algorithms and the automatisation of the procurement process can help identify the best tender (the one meeting most of the green award criteria) and thereby lead to increased quality of products and services.

Exemplary cases

Within the EU, *Portugal* is recognised as the first country to implement mandatory e-procurement. Portugal had already launched its public e-procurement platform in 2009[98]. The platform considers both economic and environmental criteria. From a GPP perspective, *the Netherlands* is considered to exemplify global best practice[99]. GPP criteria were first introduced there in 2005. The 2012 Procurement Law confirms the country's Social Responsible Procurement Policy, including a range of sustainability criteria. The sustainability award criteria are available online at https://www.mvicriteria.nl/en. In the city of *Vienna*, the local government has worked with GPP since 1998, when it established the ÖkoKauf (EcoBuy) programme to stimulate the procurement of green products and services. They are applying a "Baubook" that specifies environmental criteria for buildings, including the use of substances, production of building materials, indoor air emissions and the disposal of waste. The platform uses the digital eco2soft tool to calculate the CO2 emissions for individual building products and entire building designs[100].

Lessons for Nordic and Baltic policy-makers

- Work across the policy areas. To be effective, policy-makers need to take an integrated approach to economic and sustainable procurement criteria and collaborate across economic, green and social functions when designing the eGPP systems.
- Use eGPP as a tool to achieve sustainable progress in related areas such as SME participation, more transparency, increased efficiency and reduced risk of corruption.
- Avoid competing platforms, which prevent a one-stop shop experience and raise operational costs.

Ireland: Pre-commercial procurement for smart cities

Introduction

One of the largest obstacles to using new technologies in digital green transition in cities is to progress from test/pilots to implementation. The City of Dublin was one of the first to work with the smart city concept to solve complex societal challenges. Its experience has led to a new collaboration with a national funding agency, resulting in new partnerships with national agencies and cities, and new internal processes.

This case primarily describes how the national Small Business Innovation Research (SBIR) initiative, managed by Enterprise Ireland[101], has supported Irish cities to implement smart city solutions related to digital green transition.

Irish stronghold in ICT used for digital green transition in cities

Through various policies and investment in ICT research centres, Ireland has become a leading global technology hub for large ICT companies. This has also led to a strong start-up scene for ICT-related companies. The SBIR programme supports many of the small Irish ICT companies and start-ups to enter the market for smart city projects.

There is no focus on particular strengths or technologies, but the SBIR programme is exploring how small local and international companies – through technologies – can solve the city challenges in Ireland.

Part of the green transition in the cities takes place through the different challenges identified by the Irish cities and other public sector bodies. Many of these challenges have a significant environmental aspect, such as flooding challenges, "last mile delivery", water quality, cycling challenges (increasing the use of cycling), mobility hub and others[102-105].

Policy commitment from national to local level – SBIR

SBIR is a national funding initiative managed by Enterprise Ireland (EI)[106-107] – a publicly owned, business development agency – in cooperation with those public institutions that seek to innovate. The aim of SBIR is to drive innovations across the public sector through competitive challenges for technology companies. It is a pre-commercial procurement (PCP[9]) initiative that allows public institutions to seek out high-tech, low-cost solutions for complex regional problems.

A key element is that the eligibility criteria for the cities to apply for SBIR funding require the cities to describe the challenge in detail:

- It should address an "unmet need", where no existing "off the shelf" solution is readily available for purchase. The city must demonstrate that it has researched potential solutions in the market, and point to why existing solutions are sub-optimal in addressing the challenge.

- It should have the potential to benefit Irish citizens.
- The city must commit a minimum budget of €100,000 to the challenge.
- The city must assign a dedicated project team to manage the challenge.

Meeting the above criteria requires that the cities spend time understanding the challenge and drawing up a business case. As an example, the smart city team in Dublin, *Smart Dublin*[3], has organised workshops with over 100 operational staff to identify priority areas with no obvious solution. It submits these priority areas to the SBIR process if there are no obvious solutions to the challenge.

The commitment from internal staff and the development of a business case are, according to City of Dublin, key to moving from testing to implementation. The close co-creation process between problem-owners and the companies provides lessons for all parties involved and the business case shows the value if a solution is developed.

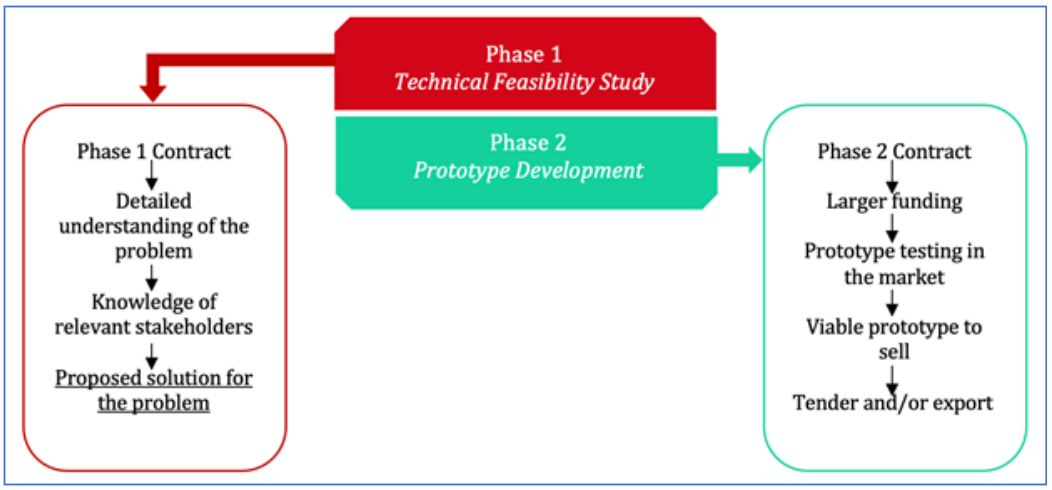
Delivery and financing of SBIR

The challenges identified by the cities are published online as open calls. Here, SMEs or start-ups can apply and compete for the available funding. It is based on 50/50 funding (match funding), where Enterprise Ireland provides the same amount of money as the public partner (cities or other) is willing to provide for a given challenge.

The programme is a two-phased development approach. The first phase is the initial **Technical Feasibility Study** and the second is a **Prototype Development** stage (see Figure 34).

Figure 34. Development approach.

[9] The European Union define PCP when it involves the purchase of research by a Government entity which is undertaken with the objective of stimulating innovation that the contracting authority or some other party may benefit from at a later stage, when goods or services not currently available are developed from the outcomes of the research.



The *Technical Feasibility Study*, which normally lasts up to four months, is a phase 1 contract, typically worth €20,000 to €30,000. Between two and four companies will be awarded a phase 1 contract. After the companies present the proposed solution, an evaluation process will take place and between one and three companies will be awarded a phase 2 *Prototype Development* contract. The prototype development will normally result in an implementation of the solution and will last up to six months. Funding for this phase is normally in the region of €40,000 to €75,000 and is expected to result in a commercial product or service. After the two phases, it is up to the city authorities to run a tender and/or for Enterprise Ireland to support the export of the solution to other cities outside Ireland.

Barriers and solutions to the implementation of smart city solutions

The SBIR programme has addressed several barriers to the implementation and export of smart city solutions. Three main issues addressed are *funding shortages*, *lack of internal business cases and commitment* and *export barriers*.

Funding shortages are a real issue in many cities. It is easy to find funding for testing and demonstration where the technologies are presented in a mock-up or in a small, dedicated test-area – typically a street. It is more difficult to find funding for pre-commercial procurement processes where the solutions are tested at scale. The match-funding from the SBIR programme has enabled cities to test the solutions in larger scale in urban areas where the challenges are, and not in pre-defined test areas for all smart city solutions. This enables results to be reviewed in real time in the areas facing the challenge. This has also attracted third party funding.

Many cities *lack a business case and internal commitment.* In order to obtain funding from the SBIR programme, there are certain elements the cities need to comply with. First, they have to describe the challenge in detail and draw up a business case. Second, the cities need to commit staff to work with the companies on their solutions. Third, cities are strongly encouraged to work with other cities or stakeholders on the same challenge, which creates both more funding for the cities and a larger potential market for the companies.

One major *barrier for exporting solutions* tested in cities, is that they are rarely implemented at scale to show the benefits of the solution. Without the ability to show real results, it is difficult to export. From a city authority perspective, it is still a long process from testing to implementation at scale. Cities still need to provide a full tender, despite having been through a long process with SBIR or similar. However, SBIR helps companies to get their solutions tested in the market and then also to export these. In the SBIR projects, a few of the solutions have been exported to cities outside Ireland, even if the solution is not procured by the Irish cities.

Finally, there is a strong partnership between cities in Ireland, where several of them join forces in the SBIR challenges and results are also shared with other cities in Ireland and abroad. The All-Ireland Smart Cities Forum[108] is an example of the good collaboration between the cities. It is the connection between the members of the Smart Cities

Forum and the national SBIR programme that is interesting. The formulation of challenges takes place between the cities in close dialogue with the national government (funding source). The guidelines from SBIR help the cities to describe the challenges in a way where it is easy to measure the impact of the solutions, and the SBIR programme provides the much-needed additional funding.

The main points of value creation from the SBIR programme are:

- Cities are forced to commit time to co-create with companies in the process.
- Cities need to develop a clear business case to get funding and add value.
- Cities need to join forces with each other or other stakeholders to get funding.
- There is knowledge-sharing between cities in Ireland.
- There is the creation of a market and export of solutions.

What can the Nordic and Baltic countries learn from the Irish experience?

Many of the challenges receiving SBIR funding are related to the digital green transition in cities. The cities in Ireland and Northern Ireland have been good at identifying common challenges and jointly entering an SBIR challenge[104]. The requirements from SBIR have ensured that some of the barriers have been removed (business case, commitment to co-creation, funding, implementation, exports) and this has proved successful for both the cities and the companies. The Nordic and Baltic countries already have strong city networks, such as the Nordic Smart City Network[109], but it would be beneficial to apply the criteria and process from SBIR across the cities in the Nordic and Baltic countries. Some collaboration and knowledge-sharing are already taking place between Ireland and the Nordic countries in the Nordic-Irish Smart City Partnership[110], and this could provide an opportunity to take the SBIR approach further as it is based on EU procurement law.

The Viable Cities programme in Sweden (see the deep-dive case) is a good example of a potentially relevant funding source that could be used in a similar way to the SBIR programme. A joint co-funding programme with similar guidelines and demands as SBIR could be an interesting project across the Nordic and Baltic countries, using existing strongholds such as the Nordic Smart City Network.

South Korea: Food waste recycling – "Pay as you throw" [111-121]

Introduction

In 1995, South Korea, and in particular the capital Seoul, transported 98% of its food waste to landfills, creating major issues with the limited space in South Korea while wasting a valuable recycling resource. Today, South Korea recycles 95% of its food waste into compost, animal feed, methane gas or solid fuel. Moisture squeezed out of biodegradable bags is used for biogas and bio-oil.

This case shows how, through policies, regulation, digitalisation and citizen-focused projects, South Korea has managed to become a leader in food waste recycling.

Regulation and policy as the driver of change

To realise the goal of food waste recycling, South Korea has made a series of policy interventions. These include the Waste Management Law enacted to encourage the "three Rs", reduce, reuse, recycle (1986); and the Act on Resource Saving and Recycling Promotion (1992), which introduced the concept of "polluter pays" by requiring the purchase of designated rubbish bags and establishing a fee for waste.

In 1999, the Korean Ministry of Environment (MOE) introduced a waste disposal verification system, which at the time consisted of paper vouchers. MOE began devising new digital solutions and systems to solve the problems associated with paper vouchers (time consuming, fraud, etc.) and to keep track of the waste disposal process in real time. As a result, Allbaro, an online waste disposal verification system, was developed in 2001. In 2005, dumping food in landfills was banned, and in 2013 the government introduced compulsory food waste recycling using special biodegradable bags, and prohibited dumping of garbage juice into the sea. At the same time, the "pay as you throw" system for food waste went into effect.

Today, the legal framework regarding waste and material management is well-developed and comprehensive. It has an integrated approach with clear policy instruments, targets, information tools and investments in recycling and waste treatment. Food waste is part of a broader policy to minimise landfill with untreated waste, maximise the cyclical use of materials in the economy and encourage the recycling of waste materials into high value products. The stated goal is to move away from a waste- and materials-oriented approach towards a life-cycle-based "circular economy" approach, and to establish an efficient resource circulation society.

The digital elements

The introduction of Allbaro was an important digital element to accelerate the recycling of food waste. Allbaro is a web-based online information system through which waste transfers, treatment processes and process results are reported and managed in real time.

Allbaro digitalises the entire management of the waste disposal process in real time, from when the waste is collected to when it is re-used. This includes registering of waste handover information (type of waste, amount, date of handover) online or automatically through radio-frequency identification (RFID)-based technology. This is done both at individual level (local people have to buy RFID rubbish bags and pay a fee based on the weight of the food waste) and at company level (using a similar system). This enables the administrative bodies to oversee who disposes of the waste and the amount of waste, and this information is then processed by the central management organisation (K-eco) The information gathered in real time is helping to optimise transport, recycling plants and their customers.

The accumulated waste-related statistics information is stored in the Allbaro system and used for annual statistical reports on waste management. Based on this data, the government is able to make improvements to the existing system and expand it further (aiming for a circular economy), and this provides a crucial basis for waste-related policy.

Implementation of the system – citizens' perceptions

In the early stages of the implementation of Allbaro, participation was rather low. This was to a large extent caused by the voluntary nature of the system and the perception that it was more complex than the existing processes. Making the system compulsory helped to spread its use, as did the government's continuous promotion of and improvements to the system. Training and promotion have been delivered by the government, but importantly also by NGO's support the green transition agenda.

Barriers to the system

One of the main issues is related to the food culture in South Korea, "banchan", where numerous side dishes are served with almost every meal. This creates a great deal of food waste, and this is still an issue, despite the high level of recycling. At times, even the recycled products cannot be used.

It is difficult to engage people. Changing habits around getting rid of food waste on a voluntary basis is hard. Measures making it compulsory have been necessary, but campaigns from government and NGOs promoting the good cause, together with training in the use of the system, have also been key to its success.

Value creation

Through comprehensive, long-term and constantly progressive frameworks, regulations and policies, South Korea has achieved one of the best waste management systems in the world. There has been a massive reduction in food waste and the recycling rate is as high as 95%. Other benefits include:

- Solution that can be patented and exported
- Massive reduction in food waste (95% recycling rate)
- Savings for the public sector, businesses and citizens
- 60% of the cost of maintaining the RFID and recycling systems comes from fees paid by households for food waste and garbage bags
- CO2 reductions (less food waste, fewer collection trips, re-use of material)
- Rise in recycling initiatives and urban farms (using the fertiliser or compost)
- The digital part of the green transition has been vital in the success.

What can the Nordic and Baltic countries learn from the Korean approach?

South Korea's different culture and legislation (such as GDPR) make it difficult to copy the example directly. Forcing citizens to go to the shop to buy RFID-tagged bags and use this as a tax system is unlikely to be contemplated in the Nordic and Baltic countries.

However, the case still represents both a policy and a digital learning aspect. On the policy side, a wide range of connected policy interventions has made it possible to create a system that heavily increases the recycling of food waste (and other waste materials). This is also combined with a clear mission to reduce food waste.

Investment in digital solutions has been key to controlling the food waste process, in terms of monitoring (fraud), to reduce waste (juice) and to inform the value chain stakeholders from waste collection to recycling plants about the type and amount of waste coming in. Many of the solutions are part of the financing, and the export of the solution is also bringing in revenue. From a Nordic and Baltic perspective, it is key to look at digital solutions can be used to collect and manage data from the user to the buyer of the recycled food waste. The information on the type and amount of waste, and the date of handover, can be used to optimise several processes and generate valuable insights. Although other types

of incentive systems for local people and businesses need to be created to increase food waste recycling, solutions like the RFID system can still be implemented.

The re-use of food waste has also sparked several local projects such as urban farming. In Seoul, eco-friendly urban farming has exploded, and they are using the food waste as compost. Local councils are also providing financial grants to support urban farms. All of the above supports the green transition and has provided large reductions in CO2.

Lessons from the international cases

This section summarises the key lessons learned from the international cases. Five take-aways have been identified that policy-makers should consider when drawing up policies to support and accelerate the digital green transition. In general, what we find is that the most value is generated when policy-makers target opportunities at the systemic level, taking an integrated and holistic approach to the digital, green transition of society.

1. Be mission-driven. Mission-driven projects/targets define the most effective policies for digital green transition. The cases show how mission-orientated policies have set the foundation for larger digital investment in green transition projects (especially in Japan and Korea). The policies are devised to target specific, well-defined, measurable problems. New technologies like AI, 5G and blockchain still need to have significant applications and results, but part of the reason for this is that it requires a large digital infrastructure across silos and sectors to achieve this. The Nordic and Baltic countries have similar targets for green transition, and a similar culture, so a common set of clearly defined targets/missions could encourage joint projects for the digital needs and investments to achieve these targets.

2. Define what success looks like. Clear, well-defined criteria for success facilitate targeted actions, and focus policies and system design on shared objectives. Examples are found in the EU green public procurement cases where the City of Vienna is applying a "Baubook" that specifies environmental criteria for buildings, including the use of substances, production of building materials, indoor air emissions and the disposal of waste. Similarly, the Dutch government is integrating sustainability criteria in its digital public procurement system. Specific examples of sustainability criteria that may be included in eGPP to specify the requirement for desired products and services include (this list is non-exhaustive): emissions of pollutants into air, water and soil; energy efficiency; water consumption; noise pollution; affordability and availability to end-users; useability for disabled people and minorities.

4. Make policies work across value chains. In the pursuit of systemic change, it is worth considering the entire value chain of solutions and involving both public and private stakeholders. The success of the Korea food waste case is built on including the entire value chain, from the waste "owner" to the stakeholder recycling the waste. In Japan, the policies for the food system take everyone into account, from production to re-use. A full view of the value chain from the start will accelerate the green transition and related results.

5. Think about data from the outset. Digital green transition, including AI, is dependent on data and the data needs to be of good quality. Digital systems are no better than the weakest link. Gaps in data hinder full digitalisation. Policy-makers therefore need to think about the information (data) needs, how to collect data and how to ensure good quality data across different stakeholders. The international cases demonstrate that establishing a quality data structure from the beginning is an essential success factor. A good example is the Korea case, where food waste recycling was accelerated after the introduction of a digital platform and new data to provide an overview of waste flow. In Japan, they have ensured that data is collected from the start across value chains in their Strategic Innovation Program (SIP), to enable the green digital transition and use of AI in the future.

Section Three

Introduction to section three

As seen in section one, there is an apparent policy lag where environmental challenges co-exist with digital innovations, but many current policies do not successfully integrate the two dimensions. The analysis in section two delivered insights into the basic enablers of digital green transition, the potential that traverses the Nordic and Baltic countries, cases of successful policy enactment and a range of examples of good practice by which to be inspired. The purpose of this section is to identify, prioritise and qualify areas of relevant policy innovation for the digital green transition in the Nordic-Baltic countries, resulting in a list of policy recommendations for the Nordic Council of Ministers and its stakeholders.

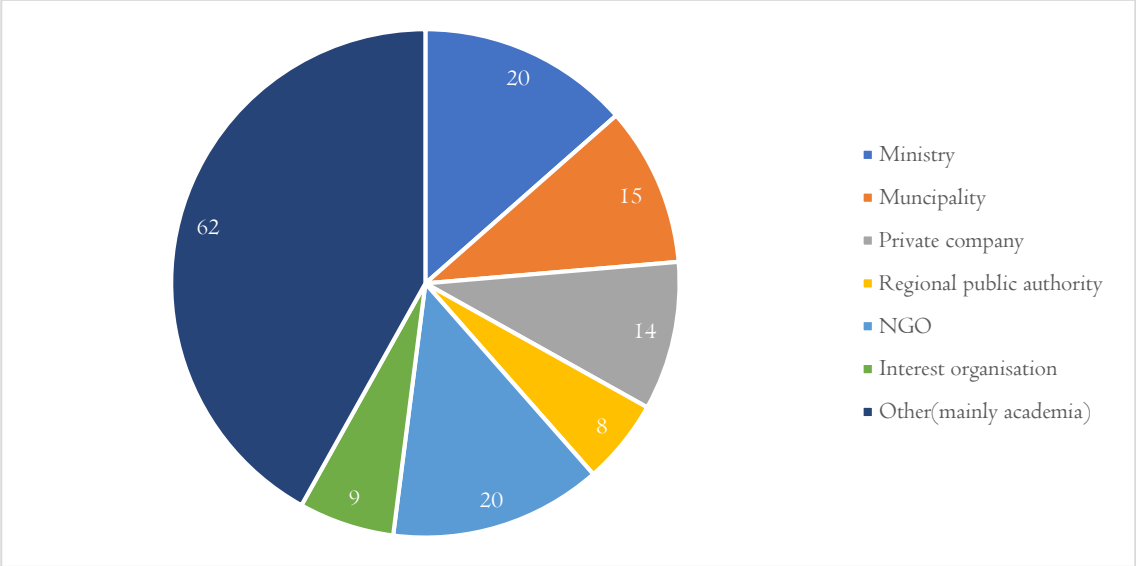
Section three is structured as follows. First, the methodological background is presented, then the results and findings are illustrated and elaborated upon. Section three ends with the final list of policy recommendations.

Section three methodology

The work in this phase started by translating the previous mappings, selected findings from country profiles and case studies into a preliminary list of possible policy initiatives that are deemed suitable to support the digital green transition across the Nordic-Baltic region. This produced a list of 21 potential policy initiatives across five policy areas. The next step was to design an impact and feasibility survey with the purpose of having experts and professionals contribute to the prioritisation and final selection of policy recommendations.

To this end, the community of stakeholders was asked to participate, and to increase the response rate an additional group of experts and stakeholders across the region was identified and contacted. The 148 respondents were spread across the Nordic and Baltic countries, covering academia, state, local government and interest organisations (see Figure 35).

Figure 35. Number of respondents based on sector, total 148.



Since the point of study is to accelerate the digital green transition, respondents were asked to consider each policy initiative with regard to the potential impact of a given policy and its feasibility. This is how "feasibility" and "impact" were presented to the survey respondents:

> *Feasibility* describes how easy or difficult it is to do something – in this case to develop and implement the specific policy in question. We ask you to consider the practicality of each policy initiative and make an overall assessment, with regard to factors such as economic, institutional, technical and cultural feasibility.
>
> *Impact* describes the degree of commitment leading to beneficial initiatives, that is expected from implementing the specific policy in question. We ask you to assess the expected impact of each policy initiative in considering how this could affect public institutions as well as private companies.

In addition, respondents were asked to apply all assessments, whether related to feasibility or impact, over the medium term (between two and five years).

To make sure that respondents had knowledge of the particular policy areas of interest, all were initially asked which of the following areas were within their area of expertise and experience, and were only asked questions related to the chosen area(s): 1) GPP; 2) open data; 3) funding for research and innovation; 4) education, competences and skills; and 5) smart city strategies and solutions. All of the five policy fields covered all enablers from phase 2 except one – access to private capital. The available policy formulations for this enabler were limited to supporting incubators and accelerators, and further recommendations could cross into legal frameworks covering incentives and taxation schemes, which is outside the scope of this report. Incubators and accelerators were therefore formulated into policy recommendations under 3) funding for research and innovation, and the enabler with "access to private capital" was not included as an independent area for policy initiatives.

A final remark on the formulation of the policy initiatives as they were presented to the respondents, is that the individual policy recommendation had to strike a balance between specificity and generalisability. On the one hand they could not be too specific, as the entire Nordic-Baltic region had to be covered and there are therefore different starting points, resources and traditions. On the other hand, they had to be applicable as a starting point for implementing and developing concrete policy.

Findings from the stakeholder survey

In this section we present the results of the survey conducted among the community of experts and other relevant professionals and experts identified. We begin by taking a general view of the results before diving into the specific policy areas and results.

Public policy is an engine for the digital green transition

When asked to rate how important public policy is for the digital green transition on a scale from 1 to 10 the average score was 7.8, indicating a strong belief among the respondents in the ability of public policy to create the necessary impact and drive the digital green transition. This result should take into account the strong representation of public sector professionals amongst the respondents (approximately 30%, not including academics). That being said, public policy has a high rating across respondent groups and for the experts and professionals working within the field policy is an important tool in achieving digital green goals.

Validation of policy areas and relevance of recommendations

Overall, the suggested policy initiatives presented in the survey scored highly (above 6 on average) with regard to impact as well as feasibility. These results also confirm the relevance of the chosen policy areas and the specific recommendations presented. Had the policy suggestions not been relevant we would have expected much lower impact ratings.

Even though the average rating across policy recommendations is high, in the upper half of the scale (1–10), we took an approach in which a difference of 1.5 or 2.0 was considered a large difference between two given policy recommendations. This tactic is also reflected in the analytical commentary related to the respondents' assessments of the policy recommendations.

Implementing digital green policies is challenging

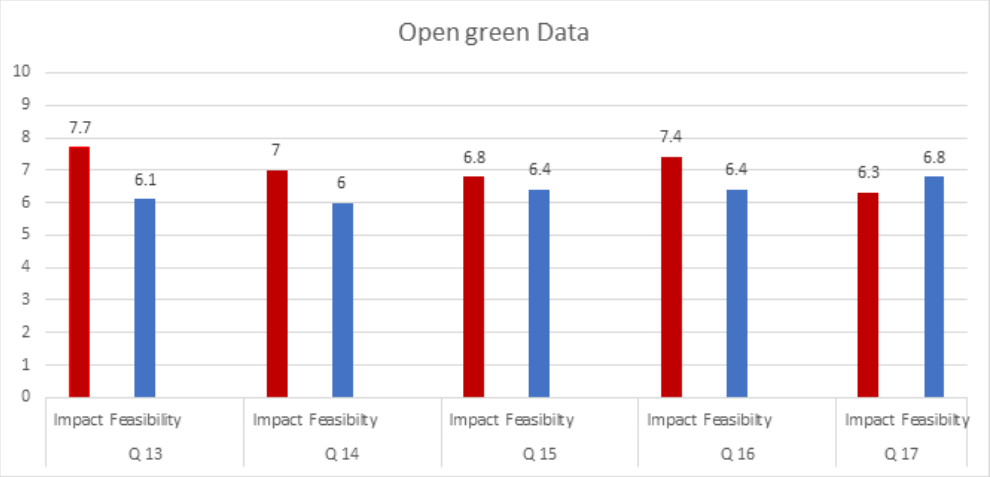
In general, the respondents rated impact higher than feasibility, indicating challenges when it comes to effectively implementing otherwise sound policies to accelerate the digital green transition. As respondents in general hold a strong belief in public policy this should not deter policy-makers from utilising policy instruments to accelerate the digital green transition.

Policy area: Open green data

We asked respondents to consider five policy recommendations for open green data and assess them. The recommendations are based on the enabler for open green data and the case of Center Denmark.

Q13. Defining and enforcing national data standards for all public open data.
Q14. Supporting interoperability across platforms and the Nordic-Baltic regions by developing common standards for presenting and sharing green data.
Q15. Establishing a national open data portal dedicated to data relevant to the green transition.
Q16. Creating a national framework that encourages/incentivises private actors to share data relevant to the green transition.
Q17. Establishing a Nordic-Baltic cooperation platform for sharing knowledge, best practices, tools, etc.

Figure 36. Results from survey – open green data.



The results of the survey are presented in Figure 36. In general, the respondents rate the impact of most policy recommendations as being relatively high, with national data standards (Q13) and creating incentives for private companies to share data (Q16) having the greatest impact. A few respondents rate the impact of these policy suggestions at the lower end but in both instances most of the respondents score the policies very highly (value 8, 9 and 10). Feasibility values average significantly lower scores for the two policy suggestions, implying that both policy initiatives are easier said than done.

In the case of establishing national open data standards, the survey findings underline that this is a widespread concern; and as we have seen in the country profiles and in the comments made by some survey respondents, policy innovation in this area can be inspired by the EU Directive on Open Data and the Re-use of Public Sector Information. That being said, the relatively low feasibility score for creating national standards presumably implies that this is a difficult exercise to implement successfully. In the case of creating formal frameworks that incentivise private enterprises to collect and share "green data", we saw that this challenge was also prominent in the case of Center Denmark (see the deep dive on p. 66). This is an area where no strong solutions have been detected in the course of this analysis, and a challenge that will ultimately demand regulatory sandboxing to support policy experimentation to work out a viable way forward. The key, as one respondent comments, is "understanding the value proposition for companies" if they are to dedicate resources to this end.

What the results also indicate, is that supporting interoperability across data platforms and the Nordic-Baltic regions (Q14) is of grave concern. Again, feasibility values for this initiative are comparably lower, and as indicated in the

comment section "interoperability is a key factor, but hard to materialise due to large investments already made". Put differently, interoperability is much easier to achieve if it has been a design principle from the beginning; and adding it onto multiple data platforms, like the already existing national data portals, built with different digital architectures, presents barriers. As seen in the case of AI Sweden there is potential to pursue a federated database approach over centralised systems, which can still display a common user interface (for all Nordic-Baltic users) while maintaining decentralised datasets within the countries.

In the case of assessing the potential for establishing a national open data portal dedicated to data relevant to the green transition (Q15), the impact value is not high. Some respondents have concerns that existing platforms of this kind have already proved insufficient. Another point made is that there is no need to build a separate portal for climate-related data. Rather, resources should be directed towards providing existing open data portals with subdivisions for green data.

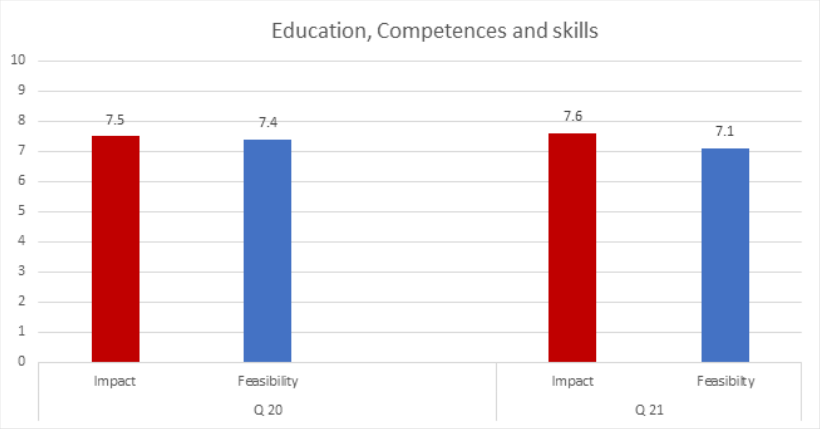
The final policy initiative on establishing a Nordic-Baltic cooperation platform (Q17) is rated as having the lowest impact. However, comments indicate that this should not be regarded as a low priority going forward and done well it can provide valuable impact, for example by identifying specific "green missions" with related data areas that can attract cross-regional commitment and knowledge-sharing practices.

Policy area: Education, competences and skills

We asked respondents to consider and assess two primary policy initiatives under the policy area of education, competences and skills. The proposed initiatives are based on the enabler for education, competences and skills applied in the country profile.

> Q20. Digital green university programmes to train graduates who are specialised in green solutions using digital technologies.
> Q21. Adult education and training schemes to reskill and upskill the workforce with both digital and green industry skills.

Figure 37. Results from survey – Education, competences, and skills.



The results of the survey are presented in Figure 37. In general, the respondents rate the impact of both policy recommendations as being very high, with impact and feasibility scoring practically the same for Q20 and impact slightly higher than feasibility for Q21. Interestingly, several comments indicate that even though historically higher learning and reskilling or upskilling have been directed towards societal challenges, the level of strategic capacity-building in relation to the green transition has not yet matured. This could present a barrier to the acceleration of the digital green transition as the development and uptake of digital green solutions will require new skills in the workforce. This was also seen in the country profiles in section two when looking specifically at the degree to which higher education institutions are successfully developing programmes integrating digital and environmental disciplines, which differs significantly from country to country.

Several respondents in the survey make the point that the success of such education and training is dependent on some primary "pull factors", like the availability of jobs that could take full advantage of these competences, which again "depends on change in industry profiles" as one commenter states. On the other hand, jobs are also created by people with new or alternative competences coming into organisations and finding new opportunities to innovate and scale up environmentally beneficial services and products. It is worth noting that this type of co-dependency is already being addressed in some, albeit few, initiatives that fully integrate digital and environmental learning and competences. One such example is the Nordic Innovations programme for Nordic Sustainable Business Transformation, which supports businesses to implement circular business models by developing skills, tools and competence for their employees.

Policy area: Funding for research and innovation

Five questions were posed to the experts and stakeholders relating to research and innovation based on two enablers: public financing schemes; and green tech innovation space. In addition, learnings from the cases of Center Denmark, Business Finland and smart cities in Ireland, have also been integrated.

Both impact and feasibility remain high for policies covering research and innovation, and the country profiles in section two show that most Nordic-Baltic countries have many of these policies in place, especially accelerators, incubators and clusters, though not necessarily within the digital green area.

Q24. Collaboration between academia, industry, and government to develop digital green solutions such as innovation clusters.

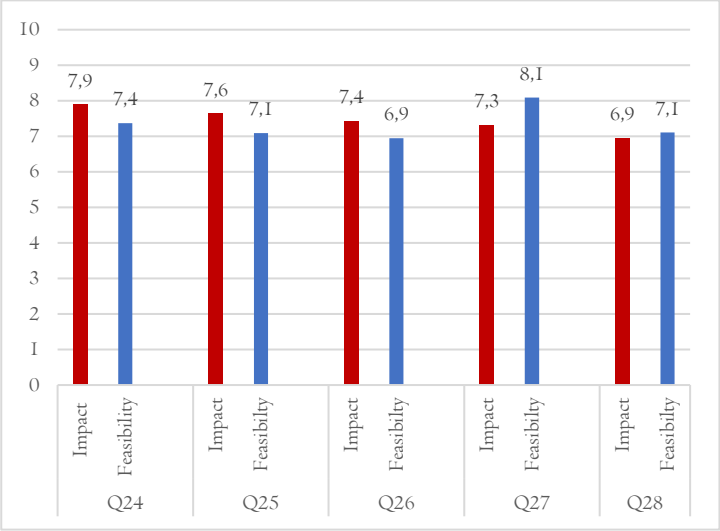
Q25. Publicly funded innovation projects or programmes in which public and/or private actors can apply for grants to create digital green solutions for more specific problems that the public sector might wish to solve.

Q26. Public-private investment partnerships in which public funds are used to match private capital and drive innovation directly related to digital green transition.

Q27. Publicly supported incubators and accelerators that support start-ups and SMEs in attracting capital and general business development.

24. Q28. Establishing a Nordic-Baltic cooperation platform to support and accelerate start-ups working on digital green solutions.

Figure 38. Results from survey – Funding for research and innovation.



Innovation clusters (Q24), in particular, are thought to have a strong impact and be relatively feasible to implement. From the country profiles, we also know that clusters are present in all Nordic-Baltic countries, but that the degree to which digital green elements are included or the primary interest of a cluster, varies. Commentaries from respondents point out that collaboration or a cluster is not enough in itself. It requires the right goals, leadership and the overcoming of professional silos, among other things.

The same could be said for publicly funded innovation projects (Q25); the potential impact is high but, according to some of the respondents, it needs cross-border collaboration, to be clearly focused and not risk "death by pilot".

Public-private investment partnerships (Q26) are thought to be the least feasible, and comments suggest that this could be due to the difficulties of the two sides working together, that it requires the right (collaboration) skills, and that capital is not always available. Not many such partnerships were identified as part of phase 2 either.

As with clusters, publicly supported incubators and accelerators (Q27) are prevalent across the Nordic-Baltic region and according to the respondents are a very feasible policy option with a positive impact. Although incubators and accelerators can be found in all countries, the digital green agenda might not play an important role across the region. According to some comments, it is also important to keep the entire ecosystem of enterprises in mind, not only individual companies, to create actual impact.

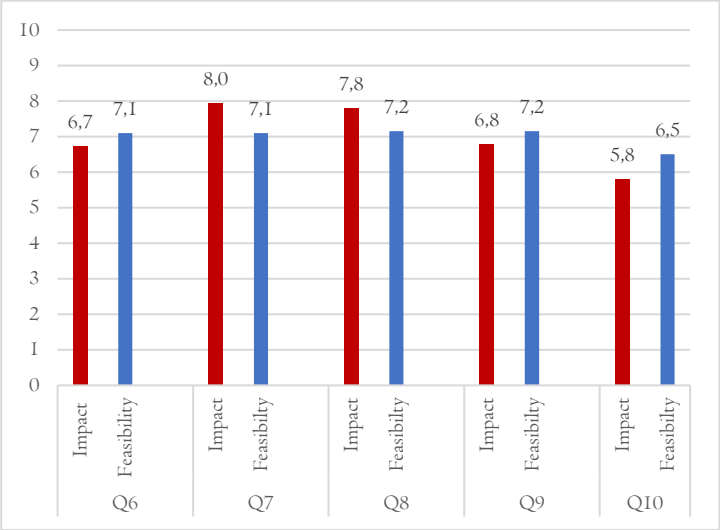
The final policy recommendation is establishing a Nordic-Baltic platform (Q28), which is rated as having the least impact of the five, with some respondents questioning "What is the added value?" and "Sounds like it would not create anything concrete". Other comments also explain that there are well-established national, or even international, platforms like UNOPS, and that it is hard to see the need for a specific Nordic-Baltic platform.

Policy area: Green public procurement

We asked respondents to consider five policy recommendations for GPP. The recommendations are based on the enabler for GPP, the deep dive on GPP in Finland and eGPP in the EU. Setting up the monitoring of and targets for GPP, in particular, is estimated to have a high impact but with a large difference between impact and feasibility, especially for Q8.

> Q6. Establish an independent organisation with cross-sectoral expertise that can support the public sector with knowledge, best practice, and tools for green procurement.
>
> Q7. Establish green public procurement overall targets as well as specific targets for relevant product groups, locally, regionally and/or nationally.
>
> Q8. Monitoring the level to which green criteria are included in public tenders at local, regional and national levels.
>
> Q9. Conducting capacity-building at all levels of government to ensure skills in the public sector relevant to implementing green public procurement.
>
> Q10. Establishing a Nordic-Baltic cooperation platform for sharing knowledge, best practices, tools, etc.

Figure 39. Results from survey – GPP.



The results of the survey are presented in Figure 39. In general, the respondents rate the impact of most policy recommendations as being relatively strong, with targets (Q7) and monitoring (Q8) of GPP having the greatest impact. A few respondents rate the impact of these policy suggestions at the lower end but in both instances around a third of the respondents give impact a value of 10. Feasibility values average slightly lower for the two policy suggestions, indicating that more respondents believe them to be strong options for improving GPP but that it might be difficult to achieve within their country. Here, around a fifth or less of the respondents give feasibility a value of 10. When comparing these results with the country profiles (see Appendix D), it is striking that, although it could have a strong impact, few countries have targets, and monitoring is mostly based on self-reported answers and not objective data. This points to the need for a more systematic and data-driven approach to GPP.

What the results also indicate is that capacity-building, either in the form of an independent organisation (Q6) or training of public procurers (Q9), has less impact. Capacity-building is the most widespread activity identified in the country profiles within GPP, however. The results might have something to do with the nationality of the respondents.

Only a few experts and stakeholders from Finland answered the GPP questions, although the Finnish experience with Keino (see the deep dive on p. 69) might mean that, had more respondents been Finnish, the impact and feasibility could have been rated differently due to their experience in their own country.

The final policy suggestion on establishing Nordic-Baltic cooperation platform (Q10) is rated as having the lowest impact and feasibility. Commentaries indicate reasons such as there being an already existing European platform and Nordic-Baltic platforms that could integrate GPP as a topic, instead of creating a new one. This should also be viewed with consideration of the international case on GPP in the EU (see p. 83) to avoid competing platforms, which prevents a one-stop shop experience and leads to increased operational costs.

Policy area: Smart city strategies and solutions

We asked respondents to consider four policy initiatives relating to smart city strategies and solutions, which are based on the cases of Smart City Sweden (see p. 72), smart cities in Ireland (see p. 85) and the South Korean "smart" waste system (see p. 89). Each policy initiative was introduced by a short section explaining the background and context to the specific formulations in the initiative.

Q31: Smart city and digital solutions accelerating green digital transformation are cross-disciplinary in nature and if delivered in silos the full potential is not reached. In several of the use cases for this study, we saw that policy interventions were organised across ministries and other public sector organisation from strategy to funding and delivery. This has led to larger budgets and made it easier to work across sectors.

Policy suggestion: Commit smart city strategies to be managed and delivered as cross-organisational initiatives.

Q32: To avoid "death by pilot" and create market opportunities for green digital transformation solutions, there is a need to test the potential market. In some cases, this has been done requiring public "challenge owners" to focus on market research, ensure implementation to showcase results, and collaboration with national export agencies. This has led to the export of solutions despite the challenge owner themselves not procuring the final smart city solution.

Policy suggestion: Commit public smart city "challenge owners" to secure "fit to market" of final solutions.

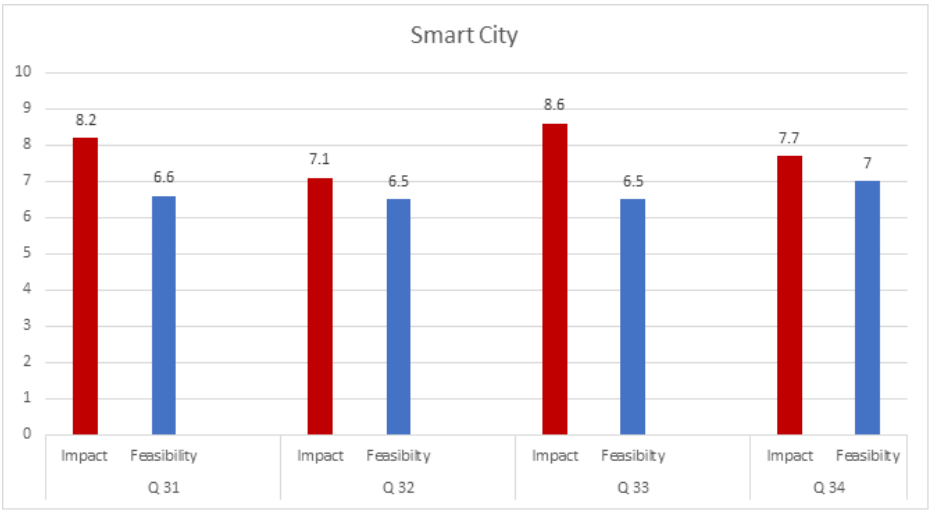
Q33: Single mobility solutions, waste solutions and open data portals are all interesting smart city projects, but often fail to lead to important results as they are part of a larger complex city system and only address a small part of the system. The circular economy, integrated mobility solutions, waste recycling and use of open data need a more systemic approach. There is a need to focus on the entire value chain when working with digital solutions in an urban context, if measurable green transition is to be achieved.

Policy suggestion: Promote smart city strategies that identify the full value chain and integrate all relevant stakeholders in the development of solutions.

Q34: Most of the policy interventions have a strong focus on national sector strengths and participation of start-ups. The mix of horizontal digital skills from start-ups and larger companies combined with more traditional strengths has created innovative solutions for cities and other stakeholders in the green digital transition. Some policy interventions also try to attract world leaders to co-create solutions with local companies and the public sector.

Policy suggestion: Make an attractive environment (testing, funding, market focus, access to knowledge etc.) that supports the export of green smart city solutions by matching local companies with larger international or sector specific companies.

Figure 40. Results from survey – Smart city strategies and solutions.



In particular, the cross-organisational ownership of strategies (Q31) and the integration of the full value chain of stakeholders (Q33) are thought to have a very strong impact. However, in both cases feasibility is valued significantly lower, which could attest to the historic challenges of delivering on multi-stakeholder and systemic approaches to policy development in this field. This is also reflected in the comments section, where such initiatives are deemed "hard but effective" and "challenging to coordinate", often because "leaders aren't too interested in sharing their mandates/power to their resources/assets", as one respondent remarks. The relatively low feasibility-value for committing smart city strategies to integrate the full value chain could reflect that this ambition is also hard to operationalise in terms of a concrete "hard" policy. As seen in the case of the Irish smart city programme and the South Korean "smart" waste system, however, this can be done if it is made explicit as a committed condition for the design and subsequent development of smart solutions.

What the results also indicate is that policy initiatives that commit public challenge owners to secure "fit to market" (Q32) are scored lowest among the proposed initiatives. One explanation for this is indicated in the comments section, where some respondents voice a concern that "fit to market" becomes "research to invoice". This means that public funding should not be directed exclusively at solutions for which there is an apparent market, as these would be funded by the private sector. Adding to this concern, another point being made is that public challenge owners should strike a balance where "high risk, high return" type of pilots are funded, while demands for "fit to market" should be introduced at a later stage. That being said, the majority of commenters see "fit to market" as a reasonable prerequisite for the public funding of smart city solutions in the future.

Concerning the suggestion to build an attractive test and innovation environment that matches local companies with larger international or sector specific companies (Q34), several commenters voice their scepticism, citing the lack of evidence that matching large companies and start-ups leads to any successful outcomes, that "big companies can get real territorial, and just use the small companies for brain gain". Others question the basic premise: "To what extent are the green solutions a growth and export strategy or a strategy for sustainability? They may go together, they may not", one commenter explains. The suggestion scores relatively high on feasibility, perhaps because this has been done earlier, to some extent, but the push back from some commenters should remind policy-makers that there can be drawbacks if incentives, resource- and profit-sharing, IP rights and so on are not made very clear in these partnerships.

Selection of final policy recommendations

The following section presents the final selection of policy recommendations to accelerate the digital green transition in the Nordic-Baltic regions. The operation of prioritising and producing the final list of recommendations is guided by the following criteria:

- High impact and feasibility (based on survey findings): Does the policy recommendation in question have a relatively high score when impact values and feasibility values are taken together?
- Degree of relevance to the Nordic-Baltic region: The extent to which the policy recommendation addresses the cross-regional barriers and/or enhances positions of strength identified in phase 2 (see p. 57).
- Administrative and legal viability: Do the relevant national agencies have the authority and the resources (staff, skills, money, expertise) to implement the proposed policy? In addition, there should be a consideration of whether the recommended policy initiative is legal or implies that statutes need to be amended or enacted.

The final selection of policy recommendations is based on these guiding principles considered together.

POLICY DRIVE 1:

HARNESS THE VALUE OF OPEN GREEN DATA

POLICY RECOMMENDATIONS:

1. Support interoperability across platforms and the Nordic-Baltic regions by developing common standards for presenting and sharing green data.
2. Create a national framework that encourages/incentivises private actors to share data relevant to the green transition.

Purpose of the initiative

Although many Nordic-Baltic countries have national open data portals, the degree to which these include sufficient climate related datasets, and secure convenient accessibility to use and share data, varies greatly.

Improving this will strengthen innovation of new digital green solutions for private as well as public organisations and, if proper policies are implemented, accelerate the digital green transition across the Nordic-Baltic region.

Initiative target groups

The primary groups at which this initiative is directed are national data portals that can contribute to securing interoperability between the various open data communities (and their digital platforms) in the Nordic-Baltic countries.

In addition, the initiative addresses the need to create the appropriate incentives for private companies to collect and share data relevant to climate change mitigation.

Support initiatives for Nordic-Baltic countries

In the case of supporting interoperability by developing common standards for presenting and sharing green data, policy innovation in this area can be inspired by the EU Directive on Open Data and the Re-use of Public Sector Information.

Creating national frameworks that incentivise private actors is another challenge that, in the short term, can be approached with non-regulatory measures, such as providing the basis for the use of APIs for simpler and more automated access to and use of green data sets. In addition, developing standard contract terms for business-to-government data-sharing can prove fruitful. Other measures that let companies brand themselves as "open green data contributors" could be considered, and national data portals could be designed to show which companies are contributing datasets to specific projects and innovations.

POLICY DRIVE 2:

FUND DIGITAL GREEN COLLABORATORS AND INCUBATORS

POLICY RECOMMENDATIONS:

1. Support committed collaboration between academia, industry and government to develop digital green solutions such as innovation clusters.
2. Publicly co-funded green impact incubators and accelerators that support start-ups and SMEs in attracting capital and general business development.

Purpose of the initiative

As is evident in this study, the Nordic-Baltic countries display many relevant initiatives that drive innovation across sectors. Many have organised network clusters, where academia, industry and government partner (for example in a "triple helix" model) to test, scale and build "fit to market" solutions. Several countries also have well established start-up incubators and accelerator programmes.

What we should see more of is the creation of clusters, incubators and accelerators dedicated to entrepreneurs working on digital innovation for the sake of positive environmental impact.

Improving this will also create more obvious platforms for cross-regional collaboration across the Nordic-Baltic countries.

Initiative target groups

The primary groups at which this initiative is directed are green impact innovators, entrepreneurs and SMEs in the Nordic-Baltic Countries.

Secondary target groups will be existing innovation networks, business clusters and impact accelerators with a potential to launch dedicated digital green impact programmes.

Support initiatives for Nordic-Baltic countries

The Nordic-Baltic regions can build from a strong innovative capacity and a skilled workforce, as well as a strong tradition of collaboration across the private and public sector. This should make the policy recommendation outlined here particularly feasible.

Concrete inspiration and learnings can be extracted from the cases of Center Denmark and Business Finland presented earlier in this study. Additional capacity-building can be sourced from organisations like Cluster Excellence Denmark and the Enterprise Europe Network.

Inspiration from relevant and well-established incubators and accelerator programmes can be found in Sitra, Norrsken and +Impact.

POLICY DRIVE 3:

DIGITAL GREEN COMPETENCES FOR ALL

Purpose of the initiative

The levels of skills and education in the Nordic-Baltic region is high overall but with increased efforts it is possible to ensure the foundation for a strong Nordic-Baltic position within the digital green area. This requires even further skills development and, more specifically, strategic competence-building with a committed focus on integrating digital and environmental disciplines and competence areas.

POLICY RECOMMENDATIONS:

1. Digital Green university programmes to train graduates who are specialised in green solutions using digital technologies.
2. Adult education and training schemes to reskill and upskill the workforce with both digital and green industry skills.

With this initiative, the Nordic-Baltic countries recognise that a skilled workforce, from highly specific expert training to more operational skills, is vital for the digital green transition.

Initiative target groups

The primary groups at which this initiative is directed are higher learning institutions, students, employers and employees.

A secondary target group will be institutional providers of continued learning and public reskilling programmes. In addition to these, trade unions can also be considered direct stakeholders.

Support initiatives for Nordic-Baltic countries

A good place to start is to explore the existing programmes that successfully integrate digital and environmental disciplines in the Nordic-Baltic countries (the full country profiles in appendix D).

In addition, new research is currently being conducted to map the "green jobs" of the near future to determine the skills demand they will create. Organisations like the European Centre for the Development of Vocational Training publish yearly reports to this end. Also, niche programmes directly related to specific sectors and "green" reskilling potential like https://www.greenskills4vet.eu/ provide insights and tested learnings.

POLICY DRIVE 4:

PUTTING GREEN PUBLIC PROCUREMENT FIRST

POLICY RECOMMENDATIONS:

1. Establish a national independent organisation with cross-sectoral expertise that can support the public sector with knowledge, best practice and tools for green public procurement across the professional silos of the public sector.

2. Identify and set overall green public procurement targets at a national level supplemented by specific targets for relevant (digital) product groups set at a local and/or regional level. Follow up by establishing a systematic monitoring process with external auditing based on objective data and not self-reported answers.

Purpose of the initiative

Given the large amounts of public spending in the Nordic-Baltic region, green public procurement becomes a powerful instrument to transition public sector spending towards an environmentally beneficial composition.

In addition, harnessing the potential of green public procurement in a more systematic way should be pursued to create a strong "pull effect" on the market for digital green solutions, thereby incentivising private enterprises to enhance innovation of digital solutions that contribute to climate change mitigation and provide documentation for these positive impacts.

In terms of public institutions and procurers, this initiative should provide a shared awareness, commitment and knowledge of best-practice to guide the professionalisation of green public procurement moving forward.

Initiative target groups

The primary groups at which this initiative is directed are public institutions and public procures in the Nordic-Baltic Countries. In cases where countries have existing green public procurement organisations, the policy recommendations will also affect and support these.

Secondary target groups will be organisations representing the interests of private companies delivering solutions and products to the public sector, like national chambers of commerce and sector-specific business organisations.

Support initiatives for Nordic-Baltic countries

The suggestion of establishing a cross-regional collaboration platform for green public procurement is considered of lesser importance by respondents in the Expert Community Survey.

Instead, policy-makers can direct their attention towards existing organisations and practices, as shown in the cases of Keino (FI) and eGPP (EU), to extract learnings for promoting targets, monitoring and capacity-building.

Other resources and a collection of good practices can be found https://ec.europa.eu/environment/gpp/case_group_en.htm and http://www.oecd.org/gov/public-procurement/green/

POLICY DRIVE 5:

MAKE SMART CITIES DELIVER MULTI-STAKEHOLDER VALUE

Purpose of the initiative

Several Nordic-Baltic countries and major cities have formal smart city programmes and initiatives. Given that smart cities are "born digital" and related to goals like energy efficiency and the circular use of resources, this is an area with vital importance for the digital green transition.

POLICY RECOMMENDATIONS:

1. Commit smart city strategies to be managed and delivered as cross-institutional programmes across public agencies and ministries.
2. Set criteria for smart city strategies to identify the full value chain and integrate all relevant stakeholders in the development of solutions.

Developing smart city policies to have a greater impact means designing and implementing them with contributions from a broader range of direct and indirect stakeholders, organising them across public institutions and authorities to avoid silo lock-in, and innovating solutions with an obligation to identify and involve service providers that are relevant to the full life cycle of a given resource and the smart solution developed.

Initiative targets groups

The primary groups at which this initiative is directed are public smart city strategists, planners and challenge owners.

Secondary target groups are other public service providers that can potentially interact with or add value to the end solutions.

A final target group are private companies delivering partial solutions and services to public smart city programmes and missions.

Support initiatives for Nordic-Baltic countries

Policy-makers can direct their attention towards existing platforms and organisations that hold valuable resources, guides for good practice and forums for knowledge-sharing. Amongst these, the Nordic Smart City Network and the Viable Cities programme have comprehensive materials, while other regional platforms like https://smartclean.fi/ and https://smartenergydih.eu/ give insights into specific projects and solutions.

References

[1]: Elkington, John(2020). Green Swans: The Coming Boom in Regenerative Capitalism. First edition. New York: Fast Company Press, 2020.

[2] Elemental, 'What is good technology" at http://elemental.technology/good-technology/

[3] Peters, B. G. (2015). *Advanced Introduction to Public Policy*. Edward Elgar. p. 3.

[4] Hausmann & Rodrik (2003): *Economic Development as Self-discovery*

[5] European commision, 'European green deal' at https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/actions-being-taken-eu_en

[6] European policy centre(2020), "Towards a green, competitive and resilient EU economy: How can digitalisation help? at: https://www.epc.eu/en/publications/Towards-a-green-competitive-and-resilient-EU-economy-How-can-digital~35bfc4

[7] Vision 2030. Nordic Council of Ministers. https://pub.norden.org/politiknord2020-728/#45598

[8] Eric Brynjolfsson & Andrew McAfee, *The Second Machine Age – Work, progress, and prosperity in the time of brilliant technologies.*

*[9]*Nordregio(2019), "Governing the Digital Transition in the Nordic Regions", accessed at https://nordregio.org/publications/governing-the-digital-transition-in-the-nordic-regions/

[10] Gartner.com(2018), 5 Trends Emerge in the Gartner Hype Cycle for Emerging Technologies at https://www.gartner.com/smarterwithgartner/5-trends-emerge-in-gartner-hype-cycle-for-emerging-technologies-2018/

[11] European commission, "smart cities" at https://ec.europa.eu/info/eu-regional-and-urban-development/topics/cities-and-urban-development/city-initiatives/smart-cities_en

[12] Lithuanian ministry of finance, at https://finmin.lrv.lt/lt/aktualus-valstybes-finansu-duomenys/ateities-ekonomikos-dnr/veiksmo-igyvendinimo-koncepcijos

[13] European Commission, *What is GPP,* https://ec.europa.eu/environment/gpp/what_en.htm, accessed

[14] OECD, 2015(a), *Going Green: Best Practices for Sustainable Procurement,* https://www.oecd.org/gov/public-procurement/publications/Going_Green_Best_Practices_for_Sustainable_Procurement.pdf

[15] OECD, 2019(a), *Government at a Glance 2019*, https://doi.org/10.1787/8ccf5c38-en.

[16] European Commission, 2016, *Buying green! A handbook on green public procurement,* https://ec.europa.eu/environment/gpp/pdf/Buying-Green-Handbook-3rd-Edition.pdf

[17]Entreprise Ireland, "Research and innovation", accessed at https://www.enterprise-ireland.com/en/Research-Innovation/SBIR-Ireland/

[18] Entreprise Ireland, "A Guide for the irish public sector", accessed at https://www.enterprise-ireland.com/en/Research-Innovation/SBIR-Ireland/News/SBIR-Guidance-Notes.pdf

[19] OECD, 2019(b), *OECD Skills Outlook 2019. Thriving in a Digital World,* https://www.oecd-ilibrary.org/sites/df80bc12-en/index.html?itemId=/content/publication/df80bc12-en&_csp_=53a91137adce4a3a859955ebb548509c&itemIGO=oecd&itemContentType=book

[20] European Commission(b), *The Digital Economy and Society Index (DESI),* https://ec.europa.eu/digital-single-market/en/digital-economy-and-society-index-desi, accessed

[21] European Commission, 2015, Creating Value through Open Data, https://www.europeandataportal.eu/sites/default/files/edp_creating_value_through_open_data_0.pdf

[22] European Data Portal https://www.europeandataportal.eu/en

[23] The Open Data Institute, https://theodi.org/, accessed

[24] European Commision, "THE ECO-INNOVATION SCOREBOARD AND THE ECO-INNOVATION INDEX", accessed at https://ec.europa.eu/environment/ecoap/indicators/index_en

[25] Danish ministry of climate, Energy and utilities, accessed at https://en.kefm.dk/news/news-archive/2019/dec/during-the-cop-denmark-passes-climate-act-with-a-70-percent-reduction-targetws-page-eng

[26] Berntzen, Lasse & Johannessen, Marius & Andersen, Kim Normann & Crusoe, Jonathan. (2019). "Parliamentary Open Data in Scandinavia". Computers. 8. 65.

[27] Greentech Challenge, *The Danish Ecosystem for Startups in Green Energy and Environmental Technology(2019)* at www.greeninnovationgroup.com/wp-content/uploads/2019/08/GTC_Startup_Ecosystem_Analysis_Light.pdf

[28] Start-Up Wiseguys, "Baltic Start Up Scene 2019/2020", accessed at https://startupwiseguys.com/wp-content/uploads/2020/12/Baltic_Startup_Scene_report_2019_2020-Startup_Wise_Guys-EIT_Digital.pdf

[29] Cleatech forEST, at https://www.cleantechforest.ee/

[30] Startupwiseguys, at https://startupwiseguys.com/

[31] Good deed foundation, at https://www.heategu.ee/en

[32] European Commmission, 2020, *National GPP Action Plans (policies and guidelines),* https://ec.europa.eu/environment/gpp/pdf/200311_GPP_NAPs_March_2020.pdf

[33] Global Innovation Index, "2020 report", accessed at https://www.globalinnovationindex.org/gii-2020-report#

[34] OECD, "Patent indicators", accessed at https://stats.oecd.org/viewhtml.aspx?datasetcode=PAT_IND&lang=en

[35] Rannis, "Úthlutun úr Loftslagssjóði" https://www.rannis.is/frettir/uthlutun-ur-loftslagssjodi

[36] European Patent Office and UNEP, 2015, *Climate change mitigation technologies in Europe*, https://www.epo.org/news-events/in-focus/sustainable-technologies/clean-energy/europe.html

[37] OECD, "Patent indicators", https://stats.oecd.org/viewhtml.aspx?datasetcode=PAT_IND&lang=en

[38] OECD, "Gross domestic spending on R&D" dataset, https://data.oecd.org/rd/gross-domestic-spending-on-r-d.htm

[39] Estonian Smart city cluster, at http://smartcitylab.eu/

[40] Estonian Digital Construction cluster, at https://estoniandcc.com/

[41] Estonian ICT Cluster, at https://www.itl.ee/en/estonian-ict-cluster

[42] EnergyOne track, http://acceleratorone.co/#/accelerator

[43] EIT- Climate KIC, https://vilniustechpark.com/eit-climate-kic-hub-lithuania/

[44] Rockit Impact accelerator, https://www.impact.rockitvilnius.com/

[45] Futurepreneurs, at https://futurepreneurs.eu/

[46] The Submariner, at https://www.submariner-network.eu/

[47] Lithuanian government, "Open Data", accessed at https://data.gov.lt/

[48] Lithuanian Government(2018), "Lithuanian Artificial Intelligence Strategy", accessed at: http://kurklt.lt/wp-content/uploads/2018/09/StrategyIndesignpdf.pdf

[49] Public Procurement office, at https://vpt.lrv.lt/en/

[50] OECD, "Improving Lithuanias public procurement system"(2019) at https://www.oecd.org/governance/public-procurement/publications/C1-improving-lithuania-public-procurement-system.pdf

[51] Enova, accessed at https://www.enova.no/

[52] Miljødirektoratet, "klimasats - støtte til klimatiltak" accessed athttps://www.miljodirektoratet.no/klimasats

[53] The research council of Norway, accessed at https://www.forskningsradet.no/en/

[54] Innovasjonnorge, accessed at https://www.innovasjonnorge.no/

[55] Nysnoinvest, accessed at https://www.nysnoinvest.no/

[56] Eurostat, Percentage of the ICT sector in GDP, https://ec.europa.eu/eurostat/databrowser/view/isoc_bde15ag/default/table?lang=en, accessed 05/01-2020.

[57] Digdir, "Fra støtte til strategisk premissgiver? Om utvikling og organisering av anskaffelsesfunksjonen" accessed at https://www.digdir.no/offentlige-anskaffelser/fra-stotte-til-strategisk-premissgiver-om-utvikling-og-organisering-av-anskaffelsesfunksjonen/1203

[58] DFØ, "Om DFØs arbeid med offentlige anskaffelser", accessed at https://www.anskaffelser.no/om-oss

[59] IT & Telekomföretagen, "The IT skills shortage A report on the Swedish digital sector's need for cutting-edge expertise" https://www.almega.se/app/uploads/sites/2/2018/06/ittelekom_rapport_brist_pa_it-kompetens_eng_webb.pdf

[60] AI Sweden, accessed at www.ai.se/en

[61] Interview with Head of project portfolio Johanna Bergman

[62] Interview with Head of Communications and Public Affairs Mikael Ljungblom.

[63] Victor Galaz, Erik Wilson, Maria Schewenius, Sverker Janson(2021), "AI I klimatets Tjänst", accessed at https://www.ai.se/sites/default/files/content/ai_i_klimatets_tjanst_210209_-_this_is_it.pdf?utm_source=punktse&utm_medium=link&utm_campaign=download_aiklimatfeb

[64] Interviews with Helena Sarèn, Head of Smart Energy, Business Finland

[65] Interviews with Kaisa Hernberg, Senior Director, Public Affairs and Communications, Business Finland

[66] Business Finland, at https://www.businessfinland.fi/en/for-finnish-customers/home

[67] Business Finland(2020), "Finland on the road to a carbon-neutral society - Business Finland's role in promoting low-carbon solutions" accessed at https://www.businessfinland.fi/4a5a87/globalassets/finnish-customers/02-build-your-network/bioeconomy--cleantech/alykas-energia/bf-ja-vahahiilisyys-impact-brief_2020.pdf

[68] Interviews with Bolette van Ingen Bro, Director and ECEI Assessor, Cluster Excellence Denmark,

[69] Henrik Madsen, Professor at Technical University of Denmark and Norwegian University of Science and Technology and board member of Center Denmark

[70] Søren Skov Bording, Director, Center Denmark

[71] Center Denmark, accessed at https://www.centerdenmark.com/

[72] Energistyrelsen, accessed at www.ens.dk/service/statistik-data-noegletal-og-kort/noegletal-og-internationale-indberetninger

[73] Centre for IT-Intelligent Energy Systems, accessed at www.smart-cities-centre.org

[74] Interview with Isa-Maria Bergman, Director, Circular Economy and Sustainable Public Procurement, Motiva

[75] Keino, "About Keino", accessed at https://www.hankintakeino.fi/en/about-keino

[76] Keino, "Sustainable public procurement" accessed at https://www.financeministersforclimate.org/sites/cape/files/inline-files/Session%203%20Finance%20Minister%20Coalition%20for%20Climate%20Action_Finland%20procurement_0.pdf

[77] Interview with Smart City Sweden: Rebecca Larson, Communication Manager.

[78] Viablecities, https://en.viablecities.se/om-viable-cities, accessed february 2021

[79] Viablecities, "Transition lab", https://en.viablecities.se/viable-cities-transition-lab, accessed february 2021

[80] Viablecities (2018), "Programbeskrivning för viablecities - det strategiska innovationsprogrammet för smarta och hållbara städer".

[81] Viablecities(2020), "Press release: The first Climate City Contracts in Europe signed in Sweden today)

[82] Smart city Sweden, https://smartcitysweden.com/, accessed February 2021

[83] Nordic transition partnership, https://www.nordictransitionpartnership.org/, accessed February 2021

[84] Vinnova, Cooperation for sustainable innovation, https://www.vinnova.se/en/m/strategic-innovation-programmes/, accessed february 2021

[85] Drivesweden, accessed at https://www.drivesweden.net/

[86] Re:source, accessed at https://resource-sip.se/om-resource/resource-in-english/

[87] Vinnova(2020), "Contracts for the climate transition of cities" accessed at https://www.vinnova.se/en/news/2020/12/contracts-for-urban-climate-change/

[88] Government of Japan, "Society 5.0" accessed at https://www8.cao.go.jp/cstp/english/society5_0/index.html

[89] Government of Japan, "Cross ministerial strategic innovation promotion program", p. 4-5, accessed at https://www8.cao.go.jp/cstp/panhu/sip_english/p4-5.pdf

[90] Government of Japan, "Cross ministerial strategic innovation promotion program", p. 10-11, accessed at https://www8.cao.go.jp/cstp/panhu/sip_english/p10-11.pdf

[91] Government of Japan, "Cross ministerial strategic innovation promotion program", p. 46-47, accessed at https://www8.cao.go.jp/cstp/panhu/sip_english/p46-47.pdf

[92] Government of Japan, "Cross ministerial strategic innovation promotion program", p. 34-35, accessed at https://www8.cao.go.jp/cstp/panhu/sip_english/p34-35.pdf

[93] Government of Japan, "Cross ministerial strategic innovation promotion program", p. 50-51, accessed at *https://www8.cao.go.jp/cstp/panhu/sip_english/p50-51.pdf*

[94] European Commision, "shaping the digital single market" accessed at https://ec.europa.eu/digital-single-market/en/shaping-digital-single-market

[95] Directive 2014/24/EU of the European Parliament and of the Council of 26 February 2014 on public procurement and repealing Directive 2004/18/EC Text with EEA relevance, accessed at https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32014L0024

[96] Directive 2014/25/EU of the European Parliament and of the Council of 26 February 2014 on procurement by entities operating in the water, energy, transport and postal services sectors and repealing Directive 2004/17/EC Text with EEA relevance, accessed at https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32014L0025

[97] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions Public procurement for a better environment {SEC(2008) 2124} {SEC(2008) 2125} {SEC(2008) 2126}, accessed at https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52008DC0400

[98] European Parliament(2018), "Systems and e-Procurement - Improving Access and Transparency of Public Procurement", accessed at https://www.europarl.europa.eu/RegData/etudes/BRIE/2018/618990/IPOL_BRI(2018)618990_EN.pdf

[99] Global efficiency intelligence, "CURBING CARBON FROM CONSUMPTION THE ROLE OF GREEN PUBLIC PROCUREMENT", accessed at https://www.climateworks.org/wp-content/uploads/2019/09/Green-Public-Procurement-Final-28Aug2019.pdf

[100] Baubook, accessed at https://www.baubook.info/eco2soft/?SW=27&lng=2

[101] Enterprise –ireland, "Small business innovation research Ireland", accessed at https://www.enterprise-ireland.com/en/Research-Innovation/SBIR-Ireland/News/SBIR-Guidance-Notes.pdf

[102] Smart dublin, 'Gully monitoring co creating solutions to manage flood risk' accessed at https://smartdublin.ie/gully-monitoring-co-creating-solutions-to-manage-flood-risks/

[103] Smart dublin, "Last mile delivery SBIR challenge: innovating urban challenges", https://smartdublin.ie/trialling-and-testing-innovative-solutions-to-last-mile-delivery-challenges-in-dublin/

[104] Smart belfast, 'Phase two of last mile delivery challenge' https://smartbelfast.city/story/last-mile-delivery/

[105] Smart Dublin, "Smart mobility hub" accessed at https://smartdublin.ie/smart-mobility-hub-sbir-challenge-sustainable-mobility-innovation/

[106] Entreprise Ireland, "Research and innovation", accessed at https://www.enterprise-ireland.com/en/Research-Innovation/SBIR-Ireland/

[107] Entreprise ireland, "A Guide for the Irish Public Sector 2019", accessed at https://www.enterprise-ireland.com/en/Research-Innovation/SBIR-Ireland/News/SBIR-Guidance-Notes.pdf

[108] All ireland smart cities forum, accessed at https://smartcitiesireland.org/

[109] Nordic Smart City Network, accessed at https://nscn.eu/

[110] All Ireland Smart Cities Forum, accessed at https://smartcitiesireland.org/nordic-irish-partnership/

[111] Ministry of Environment Korea Environment Institute, Republic of Korea, Korea Environmental Policy Bulletin(2008), Issue 1, Volume VI, accessed at https://wedocs.unep.org/bitstream/handle/20.500.11822/9044/-Korea%20Environmental%20Policy%20Bulletin%20-%20Allbaro%20(Online%20Waste%20Disposal%20Verification%20System)-2008Allbaro%20(Online%20Waste%20Disposal%20Verification%20System)_KEPB2008.pdf?sequence=3&amp%3BisAllowed=

[112] Korean environmental cooperation, 'Waste management' at https://www.keco.or.kr/en/core/waste_operation/contentsid/1982/index.do

[113] NYCfoodpolicy(2020), South Korea Recycles Food Waste in Effort to Become Zero-Waste Society at https://www.nycfoodpolicy.org/food-policy-snapshot-south-korea-food-waste/

[114] The straits times(2016), 'South Korea cuts food waste with 'pay as you trash' at https://www.straitstimes.com/asia/east-asia/south-korea-cuts-food-waste-with-pay-as-you-trash

[115] *OECD, Environmental Performance Reviews: Korea 2017 Chapter 4 at https://www.oecd-ilibrary.org/sites/9789264268265-11-en/index.html?itemId=/content/component/9789264268265-11-en*

[116] Down to earth(2019), 'Ten zero-waste cities: How Seoul came to be among the best in recycling' at https://www.downtoearth.org.in/news/waste/ten-zero-waste-cities-how-seoul-came-to-be-among-the-best-in-recycling-68585

[117] Inteligentliving, 'South Korea Has Almost Zero Food Waste, Here's How'(2019), at https://www.intelligentliving.co/south-korea-zero-food-waste/

[118] World economic forum, 'South Korea once recycled 2% of its food waste. Now it recycles 95%', at https://www.weforum.org/agenda/2019/04/south-korea-recycling-food-waste/

[119] Ju, Munsol & Bae, Sung-Jin & Kim, Jae & Lee, Dong. (2016). Solid recovery rate of food waste recycling in South Korea. Journal of Material Cycles and Waste Management.

[120] CGTN(2020), 'Seoul unveils plan to create 1m urban farmers' at https://news.cgtn.com/news/2020-10-24/Seoul-unveils-plan-to-create-1m-urban-farmers-UQG8jAGUY8/index.html

[121] ABCnews, 'South Korea's food waste reduction plans feature urban farming and modern garbage bins' at https://abcnews.go.com/International/south-koreas-food-waste-reduction-plans-feature-urban/story?id=62480905