

Innovation and Sustainable Development in the Nordics

Five determinants of Finland and Sweden's preparedness for the
green transformation

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Preface

Many international organizations, governments, corporations, universities, and civil society organizations regard innovation as one of the most successful responses to the world's biggest economic, social, and environmental concerns [1]. It opens the door to new potential solutions for problems concerning climate change, growing inequality, or the depletion of natural resources. The transition towards sustainable and resilient systems involves innovations and alternative solutions to the existing problems across sectors, challenging the traditional models of the 20th century. However, a good concept alone does not constitute an invention capable of transforming our present system into a more contemporary and sustainable one. As a result, it is critical to create legal and economic conditions that encourage businesses, government agencies, and societal actors to invest in innovation for the sake of scaling up solutions that accelerate the systems transition as a whole.

The Nordic countries' vision is to be the world's most sustainable and integrated region by 2030, one that is environmentally friendly, competitive, and socially responsible [2]. These countries are particularly noteworthy for their lofty ambitions in the areas of digital solutions, circular bioeconomy, and low-carbon transition to climate neutral societies. They aim to accomplish this vision by utilizing innovation to create a sustainable welfare state. Sweden for example was named the EU's innovation leader in 2020 by the European Innovation Scoreboard, having held the position for several years in a row, following Finland, Denmark, and the Netherlands [3]. Additionally, Finland and Sweden were among the world's leading innovators in 2020 [4], ranking among the world's top five most prosperous countries [5].

This paper seeks to better understand how the Nordic countries use innovation to move the green transition forward and handle sustainable development challenges. Sweden and Finland are highlighted as examples due to their outstanding international performance in being both - sustainable and competitive. By doing so, we seek to shed light on some reasons why we think that some Nordic countries are well prepared to use innovation for sustainable development. The report is mainly based on the analysis of institutions and policy documents, like official communications, or goal and target settings, but also newspaper articles.

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Introduction

The United Nations have designated the current time as the "decade of action," in which solutions for sustainable development across multiple global challenges, including climate change, inequalities, and financing gaps, must be accelerated [6]. The COVID-19 pandemic and its impact on all 17 so-called "Sustainable Development Goals" (SDGs) demonstrated how quickly a crisis in one sector can turn into multiple crises affecting several human and socioeconomic spheres. The consequences demonstrated a greater urgency than ever before for systemic progress, taking into account social, economic, and ecological challenges. Thus, the strategic goals can serve as a guide for a transformational green recovery that aims to rebuild better and re-establish a healthy environment. In Europe, the European Commission's Green Deal points the way for a transformation towards a modern, resource-efficient and competitive ("green") economy, achieving three goals in particular [7]:

- Net-zero emissions of greenhouse gases by 2050
- An economic growth that is decoupled from resource use
- No one will be left behind in the transition

During this transformation process, innovation can be viewed as an endeavour to alter an entire system, including the market environment and social context [8]. According to Schumpeter's ideas, innovation comprises entrepreneurs' "new combination" of new or existing information, resources, or equipment for commercial purposes in the economic domain, resulting in "creative destruction" of the system [Schumpeter, 1934, p. 65, cited in: 9]. Thus, for Schumpeter the "process of creative destruction" is an "of industrial mutation [...], that incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one" [10, p. 83].

Unlike inventions, which can be defined as concepts or prototypes that do not always have a commercial purpose, actual innovation describes the spread and influence of these concepts across the economy [11]. These processes are designed to commercialize ideas in order to meet new difficulties and to increase overall competitiveness and economic growth [12][9]. As a result, innovation policy has the potential to be a highly successful tool for fundamentally restructuring the economy, for example by transitioning away from fossil fuels to tackle climate change [13]. The EU Green Deal is an example of a policy that attempts to guide the EU's economic transformation in the direction of a more sustainable future.

The Nordic region, consisting of Denmark, Finland, Iceland, Norway and Sweden as well as the autonomous regions of Greenland, the Faröe Islands and Åland Islands, would if

combined constitute the 11th largest welfare economy in the world [14]. Together they have recognized the importance of transforming towards sustainable systems and defining their strengths in order to benefit from the process. As countries with significant natural capital, such as forests, aquatic ecosystems, and arable land, and a general proclivity for positive change, concepts such as the bioeconomy or renewable energy production generate widespread interest across sectors.

The Nordic countries' joint vision [2]

"We in the Nordic countries – Denmark, Finland, Iceland, Norway, Sweden, the Faroe Islands, Greenland and Åland – are determined to lead the way and find good solutions for the future. We listen to our young people and we agree with them that the time has come for concrete climate action. [...]"

The solutions exist – they are right in front of us. Sustainable energy production and climate neutrality, green transport and investments, the bioeconomy and the circular economy. There is no single solution, but many, and in many areas all at once. The green economy is based on innovation, creates jobs and ensures competitiveness."

The Nordic countries take a pioneering role in the sustainability transition by setting ambitious targets that exceed the requirements of the EU Green Deal [2]. For example, Finland wants to become climate neutral already by 2035 instead of 2050 [15]. Thus, the Nordic countries are an interesting example to look at when assessing the transformation towards a new, green economy. In this study, we will examine the path taken by the Nordic nations in shifting the system toward sustainable development.

Combining Nordic strengths - turning challenges into advantages

In 2019 the Nordic Council of Ministers¹, the official body for intergovernmental cooperation in the Nordic Region, set up a vision to **make the Nordic region the most sustainable and integrated region in the world by 2030** [16]. This includes raising the level of ambition and the prioritization of challenges around the environment and climate. Under the [Presidency of Finland](#) in 2021 a historic redistribution of the Council's budget of approx. EUR 130 million was made to achieve a balance between the three

¹ The **Nordic Council of Ministers** was established in 1971 as a reaction to the Helsinki Treaty in 1962 [18] [19]. It is divided in 10 ministerial councils covering different sectors, like labour, gender equality or environment and climate, twelve Nordic institutions and the three Baltic offices [20]. The Council consists of Denmark, Finland, Iceland, Norway and Sweden, while the autonomous regions of Greenland, the Faroe Islands and Åland are practically represented equally to the other members.

pillars of strategic priorities: a green, competitive and a socially sustainable Nordic region [17]. A long-term strategy for the 2021-2024 budget has been adopted in order to be able to implement the long-term goals defined in the 2020 [action plan for the Nordic region](#) [16]. The 2020 action plan involves, for instance:

- Involve the business community in the work with the green transition in the Nordic region to a greater extent, through strengthened partnerships between public and private actors.
- Invest in more initiatives that support the safe use of digital technology, such as 5G, artificial intelligence and computerized solutions.
- Strengthen the bioeconomy in the Nordic region as a driving force for growth and green transition.

A set of 45 [indicators](#) supports following up and monitoring of their progress towards the actions described, including the three strategic priorities.

The Nordic testbed network [21]

One practical example of the Nordic added value is the **Nordic testbed network** that supports the co-creation of solutions that aim to foster the digital transformation in the Nordic bioeconomy. Nordic Forest Research (SNS), Nordic Agri Research (NKJ), and the Nordic Council of Ministers' working group on fisheries administer the Nordic Testbed Network, which is linked to projects such as the North Digital Declaration and the Nordic Bioeconomy Program. The Nordic Testbed Network is based on the SNS and NKJ-led Smart Farming Centre project 'Digitalisation in the Nordic bioeconomy', which identified testbeds as a critical component of improving the Nordic bioeconomy's profitability and competitiveness in 2018.

Example box 1: The [Nordic testbed network](#) [21]

Nordic engagement for global goals

Following a report by the Nordic Council of Ministers [22], **all Nordic countries are actively engaged in implementing Agenda 2030 and demonstrate strong climate-related political commitment at the highest political level.** For example, the Nordic countries themselves cite high ambitions to support global climate ambitions. In 2019, Finland, Iceland, Sweden, Norway, and Denmark signed the Declaration on Nordic Carbon Neutrality, committing to work toward a carbon-neutral region together [23]. Also, the Nordic ministers express their full support for the Conference of the Parties (COP) presidency and COP26 to achieve the most ambitious outcome of the international climate conference [24]. As part of the Declaration on Nordic Carbon Neutrality, the

countries **set goals that go beyond the goals defined in the EU green deal** (see table 1). However, some of the Nordic’s actions are not fully consistent with these objectives and thus casts doubt on their sincerity [25].

Table 1: Climate targets in the Nordics

Country	Climate Targets and examples of contradictions
Denmark	Committed to reducing emissions by 70% from 1990 levels by 2030 [26] and being climate neutral by 2050 [27]
Finland	Will be carbon-neutral by 2035, and the world’s first fossil-free welfare society [15]
Iceland	Aims to become carbon-neutral by 2040 [26] and cut greenhouse gas emissions by 40% by 2030 under the Paris Agreement [28].
Norway	Aims to reduce greenhouse gas emissions by at least 50% to 55% from 1990 levels by 2030 [29] and to become a low-emission society by reducing emissions by 80-95% by 2050 [26].
Sweden	Aims to reach net zero emissions by 2045, and after 2045 achieve negative emissions [26] [30]. By 2030, emissions from Swedish activities should be at least 55% lower than in 1990, and at least 73% lower in 2040.

Given the actions planned on a regional level, it becomes clear that in the view of the Nordics, economic and ecological sustainability are not mutually exclusive, but can ensure future Nordic competitiveness if properly combined.

The discourse of Nordic innovation for sustainable development follows the logic of a **green growth economy**, maintaining the normative path of “growth” of current economic policy in the transformation towards a green economy [136]. Due to the fact that the idea of green growth or green economy is theoretically ambiguous [31], the purpose of this study is to shed light on innovative processes in the Nordics that reveal in what ways the region’s green transition is being executed. The Nordic countries have chosen a path of regional diplomacy and innovative solutions to approach common challenges of sustainable development. A report by the Nordic Council of Ministers published in 2020 sums up the state of the Nordic region [32]: Similar to Germany, the Nordic region faces significant challenges, like an ageing population and rapid automation in the labour market. However, **the Nordic paradigm is to turn these challenges into advantages** by drawing up smart strategies and focusing on resilient

systems to be able to respond to change. Together, the Nordics want to accumulate knowledge, learn from each other, and highlight best practices.

The Nordic added value [33]

“The entire framework for Nordic cooperation is rooted in the idea that together we are stronger, that we can achieve more by working together, and that what we achieve will be better for the inhabitants of the Nordic countries and the rest of the world. This is what we call Nordic added value.”

This sums up the concept of so-called **Nordic added value** [33]. Nordic added value refers mostly to research cooperation in and about the Nordics [34], but can, nevertheless, be transferred to other cross-Nordic initiatives as well. Nordic added value can therefore be described as the collaborative spirit of turning challenges into competitive advantages of fostering systemic transformation towards sustainable growth and a greener and socially sustainable region. Thereby, a designated institution under the Nordic council of Ministers called **Nordic Innovation** aims at making the Nordics the forerunners in sustainable growth, by promoting three business areas: entrepreneurship, innovation, and competitiveness [35]. Nordic Innovation’s annual budget is approximately NOK 90 million (EUR 8,804,739) for projects that fulfil certain [criteria](#), for example, adding Nordic value, being small and medium enterprises (SMEs), or receiving additional external co-funding [36].

The Nordic Circular Hotspot [37] and the Nordic Innovation House [38]

One project financed by Nordic Innovation is the **Nordic Circular Hotspot**, initiated in 2019 by circular economy enthusiasts from different Nordic institutions. In order to accelerate a strategic, systematic and efficient transition towards a circular economy in the Nordics, they are mainly engaging in collaboration, knowledge sharing, matchmaking, and capacity building, as well as intelligence and investments in circular economy solutions. The Nordics joint engagement for innovation does not stop at national or EU borders.

For instance, the **Nordic Innovation House**, also backed up by Nordic innovation, offers a collaboration hub to bridge Nordic innovation with the global innovation ecosystem. The Nordic Innovation House has offices in Silicon Valley, New York, Singapore, Hongkong and Tokyo.

Example box 2: The [Nordic Circular Hotspot](#) [37] and the [Nordic Innovation House](#) [38]

Five determinants of Finland and Sweden's preparedness for green transformation

In the most recent Global Competitiveness Report from the World Economic Forum, Finland and Sweden both scored highly in several categories, including education and investment in skills needed for future jobs and markets, as well as innovation for the benefit of people and the economy [39]. As a result, the report concludes that: “based on available statistics, the ‘Nordic model’ is the most promising in leading economic systems towards greater sustainability and shared prosperity. These countries (e.g. Finland, Denmark, Sweden) are among the best-prepared on most of the 11 priorities identified by this framework and are, consequently, among those that are most ready for an economic transformation.” [39]. Internationally, Sweden and Finland are two of the world's leading innovators [4], while also ranking among the top five most prosperous countries in the world [5]. But what other factors determine Finland and Sweden's readiness to innovate towards a greener future? The next sections will explore several Finnish and Swedish conditions for innovation towards sustainable development that we think foster the two countries' wide-ranging ambitions in the field of sustainability.

1) Sweden and Finland created strong and collaborative innovation ecosystems

The Nordic nations are widely renowned for their strong collaboration and teaming efforts between politics, industry, and academics, which is referred to as the **triple helix model**. In particular, Sweden and Finland take seriously on a national level what the United Nations demand on a global scale with SDG 17 (“partnerships for the objectives”): a high level of collaboration and joint engagement in driving the transition towards sustainable development.

According to the Global Competitiveness Report 2020, Finland and Sweden, along with Japan, the United States, and the Republic of Korea, are the best prepared for tomorrow's developing markets. This is due to a **well-developed network of public institutions** that shape the countries' science, technology, and innovation agendas while also collaborating closely with research institutions and the private sector to implement the joint agendas [39]. For example, the Swedish Ministry of Enterprise and Innovation bases the implementation of innovation policy on collaboration between diverse sectors, including business, academia, and the public, to identify societal challenges that will be addressed through four innovation partnership programs between 2019 and 2022 [40].

Skog et al. [41] found the **densely interwoven formal and informal social networks of entrepreneurs, seasoned business professionals, politicians, and university academics** to be one of the key factors for their innovation success, particularly in Stockholm, Sweden's capital, which is known as Europe's Unicorn Factory [42]. Stockholm boasts the highest concentration of unicorns² per capita in the world, second only to Silicon Valley, having produced billion-dollar firms such as Spotify and Klarna. In 2019, according to a study by Heyman et al. [43], young Swedish enterprises (aged five years or less) accounted for more than half of all firms in Sweden, growing at an annual rate of about 55%. This may also be due to the extraordinary network of experienced and professional entrepreneurs and business people associated with the technology sector.

The researchers from the Centre for Strategy and Competitiveness of the Stockholm School of Economics Institute for Research further suggest that the **flat hierarchies and robust informal networks of Swedish businesses** promote the movement of ideas and resources across novel constellations, fostering further innovation [44]. Through these intimate networks, for example, external CEOs can be found easily that can support start-ups' successes. The strong connection between the start-up scene and the government became visible in 2018, when Sweden cut taxes on stock option payments for employees of smaller start-ups of up to 50 employees, reacting to criticism by the music streaming company Spotify that claimed together with other enterprises that the high taxes were discouraging competent staff [45]. Ultimately, Spotify did not benefit from the tax decrease, as their revenues in 2015 were already EUR 1.9 billion, and it is only applicable to sales of up to SEK 80 million (around EUR 800.000).

Sweden and Finland have **designated innovation organizations** that play a central role in the respective innovation ecosystems. They take up several roles in the ecosystem, from providing a platform for collaboration, to innovation funding or foresight research, thereby setting an innovation agenda for sustainable development and pushing new start-ups towards sustainable business models. They do so by enabling start-ups, businesses and organizations to experiment and test new ideas before they become profitable. There are innovation agencies like **Vinnova**, the Swedish Innovation Agency, or the Finnish Innovation Fund **Sitra** involved, but also many other organizations and agencies that collaborate among each other but also with academia and the industry.

For example, Vinnova together with the [Swedish Energy Agency](#) and the [Swedish research council Formas](#), sets the agenda for sustainable innovation in Sweden and finances 17 strategic innovation programmes to find sustainable solutions to global social challenges and thereby increasing Sweden's international competitiveness in the global

² The term "unicorn" is used in the venture capital business to refer to a privately owned startup firm having a market capitalization of more than \$1 billion.

market [46]. Thereby, they do not only support start-ups but also stimulate the already existing industry, like for instance, the example of Oatly and HYBRIT shows.

Oatly's fiber residue innovation

Oatly, a large oat beverage company headquartered in Malmö, Sweden, and operating for over 25 years, has embraced a global shift toward plant-based food consumption, motivated in part by the high share of emissions and extensive land degradation caused by livestock [47]. In 2018, a question about the waste treatment from the production line was raised by the production consumers as approx. 8.000 tons of fiber residue were counted as surplus in that particular year [48]. With funding from Vinnova of SEK 1 727 500 [49] prototypes for a new line of oat based food made entirely from the by-product of our production processes were developed. Although the first attempts did not bring the expected results, other possibilities were explored, for instance, how to turn the by-product into biogas for their biogas energy renewal plant at their production facility in Landskrona, Sweden. The results of the prototyping are still unclear, however, with a global LTM Q1 revenue of US\$447 million [50] this nudge towards a circular material use supports an already successful company to improve their sustainability performance even more.

Example box 3: Oatly's fibre residue innovation

HYBRIT

In early 2017, the four-year research program financed by the Swedish Energy Agency was initiated, laying the groundwork for the long-term objective of fossil-free steel production by developing a pilot and demonstration site called HYBRIT in Luleå, Sweden. By 2026, the joint initiators SSAB, LKAB, and Vattenfall want to be the first in the world to provide a value chain for fossil-free steel. Therefore, the project received several fundings from the Swedish Energy Agency through an initiative to foster the industry (industriklivet), of which the biggest was around SEK 270 million (approx. EUR 26 million) [51]. They believe that collaboration is crucial to reach their goal. That is why they are working together with other actors such as the Swedish Energy Agency, Lund University, KTH, Luleå University of Technology, Sandvik, RISE, Stockholm Environment Institute, and Swerim [52]. The project will generate around 1.2 million tons of crude steel yearly, accounting for 25% of Sweden's supply. This will result in a 14.3 Mt CO₂ reduction in greenhouse gas emissions throughout the first ten years of operation [53]. In 2021, the project was chosen as one of the seven large-scale projects to decarbonize the industry funded by the European Commission [54].

Example box 4: The HYBRIT pilot and demonstration plant for fossil-free steel production

Vinnova alone receives around SEK 3 billion per year for research and innovation funding in order to support the Swedish government in achieving the United Nations' Agenda 2030 through innovation [55], while other institutions receive their own funding that they provide for fostering innovation in Sweden.

Finland, with a population of roughly 5 million people, paints a similar image. For example, the Finnish **Innovation Fund Sitra**, is a public fund that is directly accountable to the Finnish Parliament, thus, their decision-making processes are tied to parliamentary systems. The Finnish Parliament and the Bank of Finland together have provided Sitra with an endowment capital of approximately EUR 84 million, which laid the foundation of the current investment assets [56]. The return from Sitra's endowments is around EUR 30 million per year, which is seen as "an investment in the future" [57]. Hence, Sitra's activities range from offering collaboration space for different actors to publishing studies and other documents about and for future development, they are taking an important role in the national sustainability agenda setting. For example, Sitra established the world's first **Roadmap for the Circular Economy** in 2016, and in 2021, they assisted the government in developing their own **strategic plan to promote a circular economy** [58].

Collaboration for sustainable development and fostering innovation can also be observed in other areas. For instance, several Finnish researchers from various universities and institutions, such as **VTT**, **SYKE** (the Finnish Environment institute), or **Luke** (the natural resource institute), are involved in the assessment of current climate policies as part of the **Finnish Climate Change Panel**, which assesses the coherence of climate policy and the sufficiency of the measures implemented [59].

Also, the private sector shows a lot of initiative. For instance, **Hydrogen Cluster Finland** is a network of companies and industrial groups that promotes the hydrogen economy, creates economic possibilities, and supports each other in the transition to climate neutrality. They foster communication and collaboration with firms, clusters, and platforms operating in the hydrogen economy in Finland, Europe, and beyond [60]. In addition, **Both₂nia**, an international initiative that aims at building a large-scale hydrogen economy cluster around the Gulf of Bothnia and the Baltic Sea, has recently emerged. It acts as a unifying brand and platform for hydrogen-related activities. It will be utilized to facilitate communication across projects and stakeholders from academia, politics and the industry in order to promote the Bothnian and Baltic region's hydrogen-related technologies and manufacturing [61].

Adding to the triple helix model consisting of politics, academia and the industry, the civil society is at the core of actions. There are a variety of forums for discussion and exchange of ideas regarding policies about sustainable development, both in interdisciplinary expert committees as well as public websites. Sweden's government supports discussions about future issues. In 2011, a **Commission of the Future of Sweden** (*Framtidskommissionen*) was appointed that engaged in a public dialogue with the Swedish population about their own and Sweden's future [62]. Later, an interdisciplinary expert body consisting of several members with academic backgrounds in climate science and -policy, as well as economics, behavioural sciences and social sciences called the **Climate Policy Council** that provides independent assessments of the compatibility of policies with the Swedish climate targets, took up this role. Adding to its role as an advisory institution to the government, the Council's task also became to increase the discussion about climate policy in society. Therefore, together with the **Swedish Energy Agency** and the Swedish **Environmental Protection Agency**, a platform called **Panorama** was set up to enable climate professionals and decision makers to contribute to Sweden's climate transition, while also helping the general public to better understand the Swedish climate policy [63]. Panorama is a tool that visualizes climate emissions within Swedish borders, how they can be reduced, and which policy instruments already exist aiming to tackle climate-changing emissions (for example taxes and regulations). In addition, information about the current progress on the green transition is provided through the Panorama platform. Collaboration and participation are also actively encouraged, as external actors can hand in their proposals or inputs concerning, for instance, suggestions for new policy instruments.

Finland has also established several online participation platforms enabling the expression of opinions about ongoing projects for sustainable development. Platforms such as **otakantaa.fi** and **kestavakehitys.fi** grant access to current information about sustainable development efforts and provide the possibility to engage in the process. In addition to this, during the annual **SuomiAreena**, the largest societal discussion event in Finland, current ideas and topics relevant to the Finnish society are discussed in the presence of major stakeholders as well as the wider public.

Another key task of the innovation institutions is the enhancement of matchmaking between the industry or the public sector and growing startups, to enable the growth and scaling up of innovative ideas. Thus, there is a **high degree of matchmaking** between the Finnish and Swedish start-up scenes and the national and international industries. Vinnova together with the Swedish Energy Agency has funded an initiative called **Ignite Sweden**, that connects the innovation ecosystem closely with the Swedish industry, resulting in 230 commercial collaborations since its foundation in 2017 [64]. The initiative is co-coordinated by several **incubators and science parks** (SISP), funded by Vinnova, as well as private start-up accelerators, for example, **THINGS**, **Sting**, or **Lead**, that also foster

collaboration, competence and knowledge, and identify funding opportunities [65]. In Finland, matchmaking seems to mostly target the international market and is supported by **Business Finland**, the Finnish innovation funding, trade, investment, and travel promotion organization, headquartered in Helsinki. In 2020, Business Finland granted EUR 653 million of funding to 3,980 projects of which most were for companies (EUR 559 million) but also for research (EUR 94 million) [66]. Most of it was innovation funding, while only EUR 72 million were business funding.

With comparatively small domestic markets, Finland and Sweden want to use their high innovation potential for sustainable development as a competitive strength in the international market. Big companies like Ikea, H&M, and Wolt have paved the way for international success by **having a global mindset from the start**. The **Team Sweden** and the **Team Finland** network partners respectively are not only engaged in the innovation coordination on a national level, but also in the **internationalization and export of sustainable solutions**. Platforms like **Smart City Sweden** are an example of how sustainable solutions from Sweden are showcased internationally.

In sum, the success of the Nordic countries may be due, in part, to the Nordics' strong collaborative spirit visible in most projects, which foster the development of novel, innovative solutions for economic transformation while also addressing associated challenges. Both countries are building up long-term structures for the development of sustainable innovation that involves all actors, including the civil society. The strong mandate of the innovation agencies to fund sustainable innovation have certainly pushed the debate in the right direction. Today, nine out of ten small businesses in Sweden consider sustainable development to be critical or extremely important [67], while a survey conducted by the Finnish government in 2019 revealed that almost "90% of all Finnish innovations of this decade include directly, or at least partially, sustainability as their goals" [68].

2) Reforms in the 90s have laid the groundwork for a kickstarted economy

Finland and Sweden (together with Norway) witnessed a "**deregulation wave**" in the 1990s in response to an economic crisis, while Denmark, for instance, has always pursued a more market-oriented domestic monetary policy, for example by abolishing exchange controls in 1983 [69].

The cornerstone for Sweden's economic kickstart was already laid in the early 1990s onwards [70]. Marked reforms in previously state-controlled areas were introduced and many public monopolies deregulated, for example taxis, telecommunications or railways. Many public services like elderly care and primary as well as secondary education were

opened up to private firms. In 1993, the Competition Act was enacted to prohibit large mergers and anti-competitive conduct [71]. Foreign direct investment was liberalized so that the market was made more open for foreign ownership. So-called "product market reforms" facilitated the licensing of new businesses and aided in the exit of inefficient legacy corporations from the market [73]. The "tax reform of the century" in 1991 caused a reduction of corporate taxes of 52% to 30%, with the corporate tax later being even further lowered to today's around 21% [74] [70]. Besides, the Swedish government even provided inhabitants a tax break on personal computers to fund a mass rollout of technology [75]. In the 2000s, Sweden also eliminated its inheritance tax, property tax and wealth tax in the 2000s, further incentivizing individuals to reinvest large quantities of money back in the economy, which made angel investors³ appear. In addition, already since 1997, Sweden permits full-time workers who have worked for their company for more than six months to take six months off (unpaid) to establish their own business while at the same time keeping their employment contract with their employer in case their own business venture fails, following the Right to Leave to Conduct a Business Operation (Lag (1997:1293) om rätt till ledighet för att bedriva näringsverksamhet) [76]. All of this liberalization occurred concurrently with the growth of the internet, which meant that more individuals started firms while also experimenting with new technologies [73].

Finland's economy, which endured one of the most severe economic depressions in its history as an independent nation state in the 1990s following the fall of its main trade partner, the Soviet Union, likewise required substantial reforms to recover economically [77]. Nevertheless, **the crisis reduced Finnish society's aversiveness to structural change**. Being a late industrializing nation, Finland was not as ingrained in the same old techno-economic paradigm as many older industrialized countries. Thus, Finland counted on a new technology- and innovation-oriented growth strategy, with the central goal of increasing national R&D inputs [77] [78]. While this strategy has gone according to plan raising up from below 2% of the GDP to 3.7% in 2009, R&D numbers have since dropped to 2.7% of GDP (2018), although lately experiencing a new upward trend [135]. To counteract this trend, the Finnish Research and Innovation Council in 2020 defined that until 2030, 4% of the GDP should be invested in R&E [79].

Schienstock and Hämäläinen [77] concluded that Finland was the second most competitive country after the United States at the end of the 1990, mainly in terms of productive resources and technology. Furthermore, Finland's higher education and research systems, as well as its ICT infrastructure, were highly competitive as

³ An angel investor (alternatively referred to as a private investor, seed investor, or angel funder) is a high-net-worth individual who offers financial support to small businesses or entrepreneurs in return for stock in the business [72].

technological competitiveness and respective technology policy became the core of the government's growth strategy.

As a result of Finland's technology focus, Finnish society has been remarkably **adaptable to the new techno-economic environment**. For example, Helsinki is now Europe's eighth most valuable start-up location, as measured by the total number of startups formed since 2000, with Stockholm being in fourth place behind Amsterdam, Berlin and London [80]. Since 2015, Helsinki's start-up environment has even tripled in value resulting in an aggregate value of Helsinki-based companies of €25.2 billion. It has mostly risen because of the expansion of the game developer Supercell, and Wolt, a technology-focused business well recognized for its innovative food and product delivery platform. Besides, since 2008 Helsinki also hosts the student-led not-for-profit technological fair Slush, of the biggest such get-togethers worldwide [81].

Right now, the **maturity of the digital infrastructure** in Finland and Sweden is remarkable and certainly allows breeding room for further digital innovation. With Denmark in first place, Finland and Sweden lead the European Digital Economy and Society Index (DESI), including a high share of digital skills or digital public services [82] [83]. The high digital literacy among Finnish and Swedish society created several digital innovations for sustainable development. New digital innovations are constantly developed and integrated in the market. For example, **awake.ai** is an Artificial Intelligence (AI) application that aims at leading the transition to sustainable and intelligent maritime logistics and thereby reducing global emissions from shipping by 10% until 2030 [84]. Established in 2018, Awake.ai already collaborates with several big ports across Europe, for example the port of Rotterdam.

Also, **many public services can be retrieved online**, for example **Tax Card online services** (Vero.fi), **education applications** (Studyinfo.fi) or **personal health records** (Kanta.fi). Finland also has a laxer approach to data sharing in general. For example, the Digital and Population Data Services Agency provides a platform called **Avoindata.fi** with "all data from Finland", where data from sectors like health, transport or energy can be downloaded for free. An interesting example is the use of data in the health sector. In the **legislation about "Secondary use of health and social data"** it was set that "the customer and register data created during health and social service sector activities will be used for purposes other than the primary reason for which they were originally saved" [85]. That fostered that the health technology industry is now the fastest growing high-tech export sector in Finland with the value of health technology products exports exceeding EUR 2,3 billion and a trade surplus of more than EUR 1 billion in 2018 [86].

Fostering the levels of education and scientific knowledge has also been high on the Finnish and Swedish agenda from the 1970s, and both countries have ranked high in EU-wide comparisons since the beginning of the 2000s. The Finnish approach stands out for

its comprehensible linking visions for a system level transformation with practical actions. Finland's government, for example, aims to turn the country into a global leader in the circular economy by 2025. To achieve this goal, Finland needs to instigate a profound transition throughout the society [87]. As a result, a roadmap that was compiled under the auspices of a participatory process, including experts' ideas and viewpoints from different institutions across Finland underlined the fact that the transition towards a circular economy requires common action and systemic change with the state as facilitator. Thus, to reach this goal a project called **Circular economy teaching for all levels of education** was conducted from 2017 to 2019 in cooperation with institutions from all education levels to include circular economy expertise in the curricula [88]. In 2016, through the National Curriculum Framework (NCF), phenomenon-based teaching was introduced in order to touch upon topics that go beyond the borders of one single discipline, like the European Union, Climate Change or Community [89], adapting education to a systemic direction necessary to understand sustainability challenges.

During the last decades, Sweden and Finland were able to show that they are **countries of transformation** by demonstrating economic flexibility and openness to structural change. This laid the groundwork for a profound change and kickstart of their economies and an opportunity for the pending systemic transition towards sustainable development.

3) Commitment to international agendas across policy areas and sustainable development as a baseline for innovation

The governments of Finland and Sweden are committed to the international sustainability agendas and include them across different policy areas. They have set strong national agendas and goals for sustainable development that require innovative approaches that go beyond the traditional environmental policy making, but also involve systemic efforts for a future viable economy.

Sweden agreed to join the global efforts to implement the Agenda 2030 and the SDGs as well as the Paris Agreement. As a result, an Action Plan Agenda 2030 (**Handlingsplan Agenda 2030**) under the Ministry of the Environment and the Foreign Affairs Ministry and a **National Coordinator** (Nationell samordnare för Agenda 2030) was set up, to guide the implementation of the SDGs and transform Sweden as a modern and sustainable welfare state [90][91]. These ambitions are reflected in the Swedish environmental policy as well as several other policies, not traditionally connected to environmental policies.

In particular, this applies to national strategies promoting innovation. For example, the **Swedish trade and investment strategy** [92] highlights the need for society as a whole to work towards the SDGs and that "trade can be used to decrease the global

environmental impact, strengthen sustainable consumption and develop the circular economy." Sustainable business is pictured as creating a competitive advantage, while at the same time contributing to find solutions for global challenges. Adding to that, the Swedish **Government's Action Plan for 2018-2020** wants to strengthen the industry's competitiveness, focusing on digitalization, sustainability and innovation [93]. This is in line with the **Swedish Innovation Strategy** from 2012, which set the target to contribute to innovative and sustainable solutions that address global societal challenges and combine ecological, social and economic sustainability to increase competitiveness [94]. Together, all these strategies take up a key role in the implementation of the Agenda 2030 and the SDGs goals in order to transform the economy in the pursuit of increased competitiveness.

Finland's sustainable development policy landscape also reflects high commitment to the international agendas while focusing on creating national competitiveness through innovation. Finland developed its first sustainable development plan in 1993 and has been an active participant in the implementation of the SDGs and Agenda 2030 ever since [95]. The current **National Action plan** towards a climate-neutral welfare society and for the implementation of the Agenda 2030 [96] and Sanna Marin's (Social Democrats) **Government Programme for an inclusive and competent Finland** [97] provide an overview over the efforts by the Finnish government towards sustainable development in Finland. Both highlight the importance of a prosperous and competitive welfare state, while the latter bases all strategic themes on the overall goal of Finland as a sustainable economy. A **2030 Agenda roadmap** that is currently being set up by the Commission for Sustainable Development will provide a long-term vision on how to implement the SDGs during the next ten years [98]. These broad action plans and roadmaps reflect the integration of the concept of sustainable development as a baseline for systemic change in Finland.

If innovation is the "creative destruction" of a system, then this is an attempt to gradually alter the system, where sustainability not as a "side project" next to establishing prosperity or freedom, but the core of all actions resulting in a structural shift of the system towards being more sustainable. While it is critical to integrate sustainable development across all policy domains and to exchange novel ideas for change, the true innovation is the establishment of sustainable development as the baseline for all subsequent actions. Despite many countries having signed the declarations for more "sustainability", Sweden and Finland's policies show their determination of establishing sustainability as the foundation of their actions which holds a strong potential for a genuine transition towards more sustainable and resilient systems.

4) Holistic innovation policy approaches and global solutions

While both Finland and Sweden are **establishing sustainable development as the baseline of their governmental action and source of their prosperity**, innovation is a tool that is used to achieve these goals. Both emphasize innovation and research policy in their quests to achieve a systemic transformation towards sustainable development while at the same time enhancing their competitiveness.

In Sweden the Ministry of Enterprise and Innovation is charged with enhancing the national innovative capacity and general innovation climate in order to contribute to sustainable development, including the conditions necessary for job creation throughout the country [99]. Since 2015, the **National Innovation Council** (NIC) is commissioned to help find solutions to the major societal challenges and promote long-term competitiveness and sustainability in Sweden. It serves as a mechanism for collaboration on broad challenges of innovation policy [100]. Acting as chairperson of the NIC, the prime minister shows significant prioritization and dedication to innovation policy. The council is equipped with a diverse set of council members, which again includes representatives from industry, labour unions, and academia, as well as several ministers, reflecting the collaborative nature of this institution. This highlights the importance of innovation policy and the trend toward developing a holistic governance tool that encompasses all public actions affecting innovation processing [101].

The NIC is particularly concerned with innovation policy, as a separate government agency within the Ministry of Education and Research, the **Swedish Research Council**, focusses on funding research activities. It is Sweden's largest public provider of funding for research at universities and institutions of higher education, with an annual budget of 7 billion SEK [102]. Nonetheless, innovation and research are reunified in terms of finance. In total, Sweden invests around 3% of GDP in Research and Development, with most funds coming from the private sector [103]. The last **research and innovation bill** from 2020 states that research and innovation will be directed to tackle major societal challenges in order to achieve sustainable development with around SEK 3.2. billion and up to SEK 3.75 billion annually until 2024 [104]. Research by Edquist [100] suggests that the work of the NIC has substantial influence on Swedish innovation policy, as, for example, the establishment of **Saminvest** shows. As a reaction to studies about missing public venture capital investment in the early innovation stages by Svensson [105] and Riksrevisionen [106] that were discussed in the NIC, the public risk capital company **Saminvest AB** was created in 2016.

In Finland, the Ministry for Economic Affairs and Employment (MEAE) is responsible for preparing and implementing the Finnish innovation policy as well as Finland's industrial policy [107]. In contrast to the Swedish case, they are supported by an advisory body, the **Research and Innovation Council**, which coordinates both research and the

development of the innovation system [108]. More precisely, the Council is responsible for elaborating on key issues related to the development of research and innovation policy that aims at wellbeing, growth and competitiveness [109]. Like in Sweden, the council is chaired by the prime minister and consists of several ministers, but also representatives from academia and the private sector, appointed by the Government for the parliamentary term. The council takes a priority-setting and policy planning function and combines research and innovation [110].

For example, a **Strategic Research Council (SRC)** with an annual funding budget of EUR 55 million was established in collaboration with the **Academy of Finland**, an expert organization in science and research that funds high-quality scientific research, provides expertise in science and science policy, and strengthens the position of science and research under the Finnish Ministry of Education, Science, and Culture [111]. Their research aims to find practical solutions to large-scale problems that require multidisciplinary approaches. Collaboration between knowledge producers and knowledge users is a critical component of the research. The Academy of Finland has a total research budget of EUR 437 million annually [112]. In 2017, the Finnish Research and Innovation council adopted a **roadmap** that reflects the Council's vision for Finland to be an attractive and competent environment for experiment and innovation in 2030 [113]. This resulted in three different lines of action presented in figure 2.

Finland is the most attractive and competent environment for experimentation and innovation

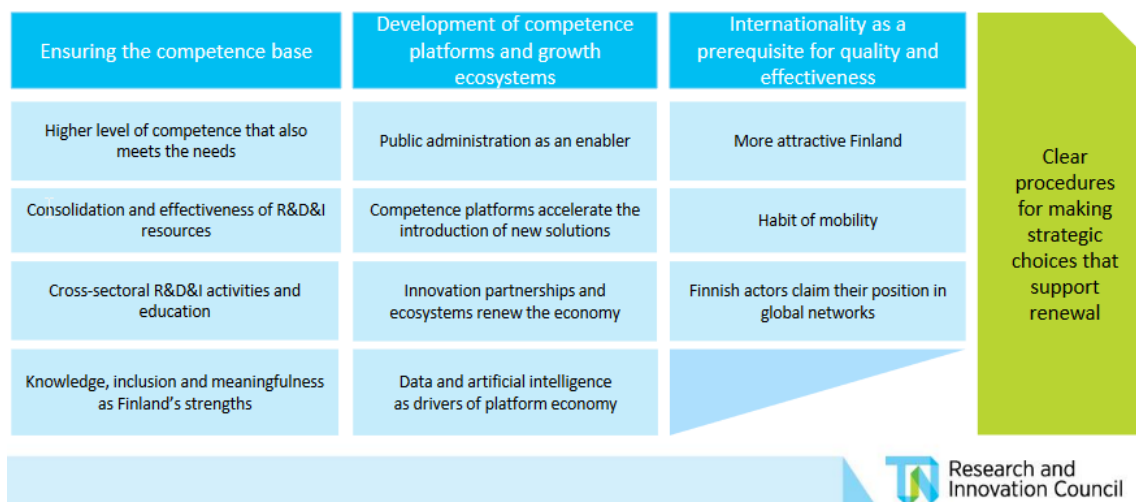


Figure 2: The Finnish research councils roadmap towards an attractive and competent environment for experimentation and innovation in 2030 [113].

The roadmap is directed towards the immediate international expansion as it captures not only the development of a stronger competence base, but also pathways for implementation and the integration in global markets. Simultaneously, the **National**

Roadmap for Research, Development, and Innovation fosters an operating environment that encourages both domestic and foreign companies to invest in Finnish solutions for a sustainable society [114].

Finland, according to the Government's agenda, is capable of playing a pioneering role in identifying solutions to global challenges, thereby expanding opportunities for research, competence, innovation, and business [115]. The Government aims at increasing the current 2.7 % expenditure-to-GDP ratio to 4 % by 2030, while at the same time enhancing competence, research and innovation in the pursuit of stronger competitiveness and improved wellbeing. The roadmap therefore focuses on three areas: (1) **Skills and competences; supply of skilled workers**; (2) **New public private partnership model, innovation ecosystems and collaboration**; and (3) **Innovative public sector** (innovative public procurement, innovation friendly regulation).

Both Sweden and Finland focus on innovation and research to provide ideas for shaping the future. With the separate governance of research and innovation, the Swedish approach supports the argument that the two are not necessarily mutually dependent, enabling the potential transformation from a linear to a holistic innovation policy [100], however, the shared financial resources question this independence in practice. The Finnish example highlights the close collaboration between producers of sustainable solutions and the global market.

5) Agile governance approaches and collaboration with industry

With the increasing speed and complexity of innovation comes the question of **adapting current legislation to ensure the rule of law and ethical behaviour**. Thus, in order to provide ground for addressing societal challenges, the Finnish and Swedish governments aim to adapt public administration to become more in line with overall current change processes so that working methods and regulations "match reality" [116]. Hence, public administration is advised to be innovative by, for example, developing innovation within their own organization by, meaning creating better services and more efficient processes. Through Vinnova's work with government agencies, the **public sector has increasingly recognized the importance of developing an ability to innovate** in order to manage its activities effectively and meet public expectations in a rapidly changing environment. Now that innovation is a priority for general management, the question has shifted from "why" to "how." For example, the agencies discovered impediments within their company culture, legal framework, and financial controls, prompting them to ask, "How can an agency focused on ensuring government safety and establishing effective processes be adept at experimenting and testing, as well as opening up for dialogue with others?". The

solution in the Nordics involves deeper collaboration and learning with partners in order to find innovations on the systems level [117].

In 2020, as part of the RDI roadmap, the Finnish Prime Minister's Office published a **study about innovation friendly regulation** resulting in six elements of innovation-friendly regulation practices, that include for example innovation-friendly implementation practices like regulatory sandboxes or Innovation-friendly agenda setting and "future committees" [118].

One such example of a future committee or an approach of discussing innovation issues across the traditional policy domains, is the establishment of interdepartmental and interagency agile project teams. In Sweden, for example, the **Committee for Technological Innovation and Ethics (Komet)** was established by the Swedish government in 2018 to identify policy challenges associated with new technologies and to contribute to reducing uncertainty regarding the applicability of existing regulations [119]. Komet promotes policy development by delivering policy proposals to the government in order to maximize the potential of emerging technologies. One example of Komet's work is the collaborative work-ways Förstå – Försöka – Förändra (understanding, testing and changing) model that was published for considering agency responsibility from a holistic approach consisting of three components: sustainability and ethics, collaboration and learning, and legal certainty and effectiveness [119].

Fossil Free Sweden is another example of how to better discuss issues across traditional silos. It was established in 2015 at the initiative of the Swedish government in advance of the international climate conference COP21 in Paris [120]. The idea is to bring together actors from businesses, municipalities, regions, and organizations that support Sweden's declaration to become one of the world's first fossil-free nations. Fossil Free Sweden plays a unique role in bridging the corporate sector and politics, via several ministries and Riksdag parties, in order to identify common ground and accelerate the transition to a fossil-free welfare state. Within the framework of Fossil Free Sweden, 22 business sectors developed roadmaps for fossil-free competitiveness. The roadmaps include both pledges and policy recommendations. Fossil Free Sweden seeks to make the roadmaps a reality and is also creating methods to accelerate the transition in several sectors. The program will run until December 31, 2024.

These examples play into the **Swedish government's aim to make the public sector contribute to developing innovative ways of meeting societal challenges**, as stated in the Swedish Innovation Strategy [94]. An interesting approach adapted from the start-up world is the establishment of a Co-Working space for public organizations in the Swedish cities or Stockholm and Östersund **SAMVERKET** (Swedish similar to samverkan/samarbete for cooperation) is a concept of authorities and public agencies to work together both physically and digitally. The project was funded by Vinnova, the

Swedish Innovation Agency and is run in collaboration with the respective county administrations [121].

In Finland, stakeholder consultations and involvement are a common aspect of the policy process. For instance, **cities have been invited to invest in test beds for new innovations**. The City of Helsinki's goal is to develop the entire city into a platform for testing and enabling innovative business solutions. Thus, a platform called **Testbed Helsinki** highlights the many options the City of Helsinki provides for testing new solutions that benefit both businesses and inhabitants [122].

Meanwhile, the Finnish government itself is **exploring ways of exploiting the potential of Artificial Intelligence (AI)** to develop digital solutions for cross-disciplines work: The **AuroraAI initiative** aims to provide individuals with personalized assistance at the correct moment in a variety of life situations and events. Therefore, public sector organizations are integrated across the AuroraAI network and can interact with services supplied by other industries, aided by AI. The AuroraAI network will assist in dismantling silos in existing service delivery and retargeting the offer to individuals or enterprises in need of a certain service. This will address the mismatch between public services and their consumers, as well as resource waste and underutilization. The AuroraAI network's objective is to establish the technological conditions necessary for information sharing and interoperability amongst diverse services and platforms. The network will be available for citizens and organisations by the end of 2022 [123]. Here, the potential of digitalization is used as an enabler for sustainable development.

A big potential to foster innovation while renewing traditional operating approaches is to exploit the potential of the demand-side: **innovative services for public procurement**. In the EU, for example, public procurement accounts for over 14 percent of GDP. However, this potential market for innovative products remains largely underutilised [124]. In fact, public procurement has immense potential to “become one of the most important mission-oriented policy instruments in the context of the Sustainable Development Goals” [125]. Edquist and Zabala-Iturriagagoitia [125] argue that to achieve greater innovation in public procurement, it is necessary to define the problems to be solved or “functions” to be completed (functional procurement) rather than the products to be purchased (product procurement). This is because, if products are already detailed in procurement documents, they already exist, and hence cannot be considered innovative.

The annual value of procurements by the Finnish public sector is approximately EUR 35 billion, or approximately 16% of the country's GDP. In order to make use of this potential, **purchasing more innovative services through public procurement** is part of Finland's innovation policy. It is further defined in an **action plan** and a **background document**, and involves the goal to increase the share of innovative procurement to 10% of total

public procurement until the end of the current parliamentary term [126]. In order to support this process, a **network-based competence centre for sustainable and innovative public procurement** called **KEINO** was established [127]. It is a platform that informs about news, events or best practices around innovative procurement. Sweden, with an annual public procurement potential of approx. EUR 60.8 billion (SEK 625 billion) under the Minister for responsible public procurement resolved a wide-ranging reform of the national public procurement [128]. Among others, they have **adopted a functional procurement approach** by setting criteria by function rather than specific criteria for goods or services, as proposed by Edquist and Zabala-Iturriagagoitia [125].

Discussion and conclusions

The Nordic countries recognized the critical nature of transitioning to sustainable development and defining their respective strengths in order to benefit from the process. For them, it is not a matter of whether they should pursue sustainable development, but rather how they will do so. By combining their defined strengths, they hope to make the best possible use of the upcoming challenges and become the world's most sustainable and integrated region until 2030. Nordic innovation can thus be defined as the collaborative spirit that transforms challenges into competitive advantages through the promotion of systemic transformation toward green growth and a more environmentally and socially sustainable region.

In conclusion, transitioning to sustainable development is portrayed in Finland and Sweden as an opportunity, rather than a threatening change. Both countries strive for green economic growth, taking advantage of challenges ahead and turning them into opportunities. Nevertheless, in order to achieve economic growth that is decoupled from resource use, like it necessary to achieve the EU Green Deal, the Nordics need to be aware of potential rebound effects⁴ [e.g., 129] and other possible limitations of their strategy. Research by Hickel and Kallis [130] concludes that “there is no empirical evidence that absolute decoupling from resource use can be achieved on a global scale against a background of continued economic growth, and (2) absolute decoupling from carbon emissions is highly unlikely to be achieved at a rate rapid enough to prevent global warming over 1.5°C or 2°C, even under optimistic policy conditions.” A shift in taxation away from labour towards carbon- and resource-intensive industry might be a possible counteract to confront rebound effects [131].

⁴ Often, efficiency improvements result in a reduction in the cost of products or services. This may result in a change in the behavior of users and users: they consume more - their initial savings are partially restored. This effect is referred to as Rebound [134].

Given the Nordic countries' declining biocapacity [132] and the particular challenges in the areas of environmental sustainability, such as responsible consumption and production, climate change, and biodiversity [95], the question then becomes whether the Nordic countries will be able to reconcile their agenda with regards to the planetary boundaries (and therewith to environmental sustainability). According to Espen Stoknes and Rockström (2018), "among the Nordic countries, Sweden, Finland, and Denmark have achieved genuine green growth, while Norway has not" by delivering absolute reductions in environmental impacts like science-based targets derived from the planetary boundaries. Nevertheless, the Nordics need to further consider their spill over effects⁵ in order to not only respect their national sustainability and export sustainable solutions, but also make sure they do not outsource their challenges [95].

This subject was addressed in a recent report commissioned by the Nordic Council of Ministers [131], where the question was asked: "is economic growth compatible with a sustainable Nordic future?". The authors conclude that Nordic nations should take a proactive role in measuring the safe operating spaces for the planetary boundaries in order to determine the Nordic fair share of remaining global budgets. Further this will support defining how green growth policy objectives may need to be adjusted and what kinds of sustainable lifestyles should be promoted to create a win-win situation for everyone.

While the ultimate success of the Nordic countries' strategy will only be evident in a few years' time, it is clear that critical questions are regularly addressed and developed. This again underlines the agile nature of sustainable development and how it is understood in the Nordics: It will never be a static state; rather, it is a continuous process guided by a systemic mentality that is constantly focused on the bigger picture.

⁵ The spillover effect is a term that refers to the influence that seemingly unconnected events in one country might have on the economy of surrounding countries.

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