

TRANSFORMATIVE INNOVATION POLICY IN PRACTICE IN AUSTRIA, FINLAND AND SWEDEN

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RESILIENCE PLANS TELL US ABOUT
LINKING TRANSFORMATION AND
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Transformative innovation policy in practice in Austria, Finland and Sweden: What do the Recovery and Resilience Plans tell us about linking transformation and innovation policy?

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Governments are increasingly utilising research and innovation (R&I) policy to foster economic and societal change. Yet, the empirical correlation between these policies and socio-technical transformations remains under-explored. The report investigates this relationship by comparing the Recovery and Resilience Plans (RRPs) of Austria, Finland and Sweden, initiated under the NextGenerationEU framework post Covid-19. The report finds significant disparities in the content, process and transformative value of the RRP among these countries. The differences in the content of the national RRP, and the ability and willingness to seize the opportunity presented by the RRP to drive transformation, are explained by existing national policy contexts and frameworks. Surprisingly, the role of R&I policy in the RRP is less important than expected, despite its emphasised importance in literature and political rhetoric. The report further identifies implications for a transformative innovation policy as well as areas for further research.

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Executive summary

Policymakers and researchers increasingly frame innovation policy as a domain that can and should contribute to addressing societal challenges, driving transformative change and combining social, economic and environmental sustainability. However, there is little empirical work on the relationship between research and innovation (R&I) policies on the one hand and transformations, or socio-technical transitions, on the other. This paper seeks to shed light on the relationship by examining and comparing the Recovery and Resilience Plans (RRPs), part of an investment package with high transformative ambitions launched in the wake of the Covid-19 pandemic, in the national innovation policy contexts of Austria, Finland and Sweden.

We find considerable differences between the three countries regarding the content, process but also ‘transformative value-added’ of the national RRP. The differences in their content, and in the ability and willingness to seize this opportunity to drive transformation, are largely explained by existing national policy contexts. Furthermore, the role of R&I policy in the RRP, and in transformative policy practice in general, is less pronounced than one might expect, in spite of the strong emphasis placed on this role in the literature and political rhetoric.

Several factors explain the significant differences between the national RRP:

- The first relates the respective countries’ points of departure, regarding the level of development – e.g., the degree of digitalisation or green transformation in industry – but also national priorities;
- Second, RRP do not exist in isolation, but complement existing policies, as well as the existing COVID-19-related measures. This means that the RRP need to be understood in the wider strategic policy context, with regard to which they fulfil specific roles, such as patching certain gaps in the current portfolio of measures aiming to achieve specific transformations;
- Third, domestic political and governance contexts play a role in the ability and willingness of countries to seize the opportunities presented by the RRP;
- Fourth, specific factors appear to have created more of a sense of urgency or inclination to seize the opportunity presented by the RRP in Finland than in the other two countries;
- Fifth, countries’ views of the RRF specifically, but also of the EU more generally, provide a fifth explanation for the differences in approaches to the RRP.

Overall, preconditions in terms of national context and path dependencies impact how transformative opportunities presented by crises can be harnessed. Furthermore, the relationship between driving transformative change and R&I policy is complex and deserves further attention both in research and policymaking. Based on our findings from the analysis, we present suggestions of how R&I policy might be designed, implemented and communicated to better comply with the societal transformation imperatives in a number of areas:

- R&I policies have so far played an isolated role in the concert of policy fields. As societal challenges increasingly guide concerns of public policy, this isolated/autonomous role can no longer be sustained. To become more effective in supporting societal transformations, R&I policy needs to better connect with other

policy fields, by giving new impulses, and better aligning with stronger sectoral policy and overarching political ambitions.

- R&I policy could play an important role in linking transitions which need to interact in a mutually beneficial way, but tend to be separated by policy silos, such as the green and digital transitions, and fulfil important coordination functions for transformation processes though mainly in the early phases of exploring novel systemic solutions.
- As shown by the RRP, R&I policy can play a vital role in carving out experimental spaces for institutional change, which are needed to prepare farther reaching policy changes in sectoral and cross-cutting policy fields and across policy levels.
- There is no single best-practice model of how R&I policy can foster transformative change, but much depends on specific national institutional settings. However, if well embedded in a sound transformative policy framework, R&I policy can open up spaces for institutional and policy learning to redirect and properly utilise investments to support transformative change.
- Major horizontal policy programs, such as RRP, are learning devices for transformation governance, but the learning and engagement should not be restricted to the policy space, but include also society, reaching out well beyond the range of stakeholders usually concerned with R&I policy matters.
- R&I policy as part of wider transformative policy packages should not restrict itself to a national and regional focus, but needs to explore complementarities in the European Research Area, as well as global opportunities for innovative and sustainable products and services.
- Existing technologies and solutions may provide quicker fixes for transformative ambitions (e.g. for reducing CO₂-emissions by 2030), but novel R&I options (and policies) are crucial to prepare for the later phases of a transformative pathway, and to trigger the necessary (infra-)structural and institutional changes.
- The broader scope of transformative policies and their need for coordination requires a similar level and quality of cooperation at the operational levels of implementation by agencies and programs as it does at the conceptual level.
- While R&I policy plays an important role in enabling transformation and in creating spaces for experimentation with novel solutions, the extent to which it actually contributes to transformation depends critically on conditions and policies, which are often beyond the remit of traditional R&I policy.

R&I policy often finds itself in, or actively seeks to assume, a driving role in transformation processes. This is partially due to the fact that its significant budgetary resources can be allocated to projects and programs. A more contentious suggestion is that rather than leading transformations, R&I policy should rather facilitate or support transformation processes run by relevant problem owners (such as ministries of environment, mobility or health, regions, cities or industries). It could do this through funding research and innovation, through providing a suitable theory of change and intervention logic as well as expertise on how to manage transformation processes. Through the linking of transformation processes in different policy areas and through strengthening the international and regional or local dimensions of transformation as well as by providing spaces for complex and multi-dimensional experimentation, it enables learning about potential synergies and complementarities.

1. Introduction

1.1. Transformative innovation policy in times of crisis

In the past decade, we have witnessed a significant shift in the focus of, and discourse on, innovation policy. Practitioners and researchers increasingly see and frame innovation policy as a domain that can and should contribute to addressing societal challenges, driving transformative change and contributing to combining social, economic and environmental sustainability. Schot and Steinmueller (2018^[1]) describe this as the third frame of innovation policy. In the first frame, *the primary purpose of innovation policy has been to promote economic growth* by strengthening the generation and utilisation of research and knowledge. The second frame refers to *innovation policy seeking to bolster national innovation systems*, and particularly to optimising interactions and linkages between different actors within a country. The third frame differs significantly from the first two in terms of “an aspiration for purposive and directional innovation” (Diercks, Larsen and Steward, 2019, p. 880^[2]). Weber and Rohracher (2012^[3]) provide a framework for “legitimizing” *the reorientation of innovation policy towards directionality, and specifically towards societal challenges*. In addition to well-established market failures, Weber and Rohracher (2012^[3]) identify structural and transformational system failures, which they argue provide a rationale for “underpinning a broader approach to innovation policy that is geared towards inducing and realising long-term processes of transformative change towards sustainability” (p. 1045^[3]).

These three framings or ‘generations’ of innovation policy are not completely separate from each other but overlap in terms of content and time. However, they differ in terms of drivers or rationales for policy design and intervention. Rather than smoothly succeeding, complementing or co-existing with each other, there are potential frictions, incompatibilities and tradeoffs between them. These could consist of conflicts in policy objectives – for example, the objective of maximising environmental sustainability versus maximising economic growth. Furthermore, designing, implementing and evaluating policies for transformation requires quite different instruments, remits or mandates (from government), reach (regarding relevant stakeholders) and competencies than most actors in charge of innovation policy dispose of (Schwaag Serger and Palmberg, 2022^[4]).

These frictions have several consequences. Firstly, they may lead to a discrepancy between the transformative intent or rhetoric and the outcome of policies (Borrás and Schwaag Serger, 2022^[5]). Examining recent innovation policies in Finland and Sweden, Schwaag Serger and Palmberg (2022^[4]) find that “in many cases, new policies, and programs introduced under the banner of ‘transformative innovation policy’ are transformative more in their rhetoric than in their design, implementation or evaluation” (p. 144^[4]). Secondly, transformative innovation policy runs the risk of raising or creating expectations that it might not be able to meet. This is because some determinants of transformative change—such as behaviors, institutions, laws, regulations, market creation—are beyond the remit or reach of the actors running innovation programs, such as research and innovation (R&I) or enterprise development agencies.

Moreover, innovation policies are not sufficiently coordinated with or nested on other relevant policy areas, such as sectoral policies (Borrás and Schwaag Serger, 2022^[5]). This brings up a question, which deserves much more attention than it has received so far, on how innovation policies should relate to or interact with other relevant policies that affect system transformation and the ability to tackle societal challenges. Rogge and Reichardt

(2016^[6]) identify consistency, coherence and comprehensiveness of policy processes and mixes as important in determining their ability to achieve sustainability transitions (see also Howlett and Rayner (2007^[7])). Kivimaa and Kern (2016^[8]) show that successful sustainability transitions require a mix of different instruments or policies which combine policies supporting the creation and diffusion of new knowledge and innovations with policies that promote the destabilisation or decline of existing regime practices and technologies. Such mixes combine innovation policy instruments with instruments from, for example, climate, energy and transport policies. Kivimaa and Kern (2016^[8]) find that relatively rarely innovation policies targeting the generation of knowledge and niche innovations are accompanied by policies with regime destabilisation (ibid.). More recent research shows that policy experimentation can be used to better align innovation policies with other policy areas, while transformative innovation policy also requires institutional change (e.g., legislative and administrative reforms) for coordinating across domains (Kivimaa and Rogge, 2022^[9]).

We can generalise that research and innovation (R&I)—and by extension, R&I policies—play an important role in developing new knowledge and solutions for addressing transition challenges and fundamentally changing our consumption and production systems. However, this does not automatically imply that R&I agencies should be leading, managing or driving transformation. Nor does it imply that innovation policy is the key mechanism for achieving transformative change. This point is illustrated by Larrue (2022^[10]) who finds that net zero missions – an example of policies with transformative ambitions – “remain for the most part focused on support to research and innovation, and are led and funded by STI authorities”, which he calls the “STI only trap” (p.2). Rather, the widespread consensus over the need for systemic change merits a more systematic focus on the role of innovation policies, e.g., in terms of directionality, degree and form of intervention and proactive/reactive nature.

Summing up, the relationship between driving transformative change and innovation policy is complex and deserves further attention both in research and in policymaking. Particularly, first and second- generation innovation policies have been institutionalised in policy contexts with little concrete reference to the more directional orientation of the third generation (Arnold et al 2022). Furthermore, policymakers rarely acknowledge or discuss potential frictions between the first and second generation versus the third generation of innovation policy (ibid). These frictions generally relate to promoting incremental or bottom-up innovation with a primary focus on economic growth, on the one hand, and driving system transformation and seeking to address societal challenges, on the other hand. In addition, the inclusion of regime destabilising policies in transformative innovation policy mixes broadens the scope of innovation policy beyond its traditional boundaries, further exacerbating policy coordination challenges (Diercks, Larsen and Steward, 2019^[2]; Haddad et al., 2022^[11]). Finally, differences in instruments, priority-setting, and time perspective, and between regional, national and international dimensions receive too little attention or consideration (Arnold et al., 2022^[12]).

1.1.1. EU COVID-19 recovery policies as an example of transformative innovation policy?

To reflect on shifts in innovation policy more closely, we turn towards European Union (EU) and national innovation policy strategies established in the aftermath of the global COVID-19 pandemic in 2021-2022. In response to the COVID-19 pandemic and the ensuing widespread economic and social disruption, together with the increasingly urgent need to tackle climate change, the EU launched one of the largest investment packages in its history, NextGenerationEU, with a clear transformative ambition or intent:

“This is more than a recovery plan. It is a once in a lifetime chance to emerge stronger from the pandemic, transform our economies, create opportunities and jobs for the Europe where we want to live. We have everything to make this happen.” (European Commission, 2022^[13]).

The Recovery and Resilience Facility (RRF) is by far the largest component, or, as described by the European Commission, “the centerpiece” of NextGenerationEU. The European Commission’s homepage states that “the aim of the Recovery and Resilience Facility is to mitigate the economic and social impact of the coronavirus pandemic and make European economies and societies more sustainable, resilient and better prepared for the challenges and opportunities of the green and digital transitions” (European Commission, 2022^[13]). The RRF entered into force on 19 February 2021 and its total size is EUR 723.8 billion (EUR 385.8 billion in loans and EUR 338 billion in grants). Countries can access the funds of the RRF by presenting national Recovery and Resilience Plans (RRPs) in which they propose how they intend to achieve the goals of the RRF.

The RRP is a one-time and temporary policy measure in which Member States were required to propose measures that shall contribute to six pillars: green transition; digital transformation; economic cohesion, productivity and competitiveness; social and territorial cohesion; health, economic, social and institutional resilience; and policies for the next generation. Green transition and digital transformation were set to account for at least 37 and 20 percent of total spending, respectively. The RRP was to contain both investments and reforms; the latter referring to new institutions, laws, programs or organisations intended to ensure that measures are both lasting and transformative, rather than just temporary financial injections (European Union, 2021^[14]). Payments from the fund are tied to the achievement of the reform milestones. Furthermore, to avoid adverse effects on the environment from the actions, the European Commission established the “Do-No-Significant-Harm” (DNSH) principle as a guiding feature of the RRP implementation; this is connected to the Taxonomy Regulation (European Union, 2020^[15]).

The COVID-19 disruption can be understood as a landscape shock – a sudden impact with long-term effects on shaping sustainability transitions – that opened opportunities for reconfiguring practices and activities across the societal sectors (Kanda and Kivimaa, 2020^[16]; Geels, Pereira and Pinkse, 2022^[17]). The RRP provides a unique case for studying how countries attempt to drive and govern transformation in terms of policies and processes. Furthermore, examining the RRP within national innovation policy contexts allows valuable insights into how efforts to drive transformation and innovation policy relate to, or interact with, one another. Thus, in this paper, we examine the RRP against the backdrop of the national R&I policies and transformation contexts and processes to shed more light on whether and how the complicated (and not friction-less) relationship between transformation and innovation policy has been turned into a more synergetic one.

1.1.2. A comparative perspective on three small and advanced European economies

This paper focuses on the interaction and integration between R&I policies on the one hand and transition policies on the other (Geels, Pereira and Pinkse, 2022^[17]), by examining and comparing the RRP in their respective three national contexts and on how framework-setting EU policies influence the formation and (early) implementation of national policy strategies. The RRP provides a good opportunity to study these relationships since they are developed by national governments, but all follow a common framework monitored by the European Commission and the European Council. To understand the process, content, intent and context of the RRP, we have conducted a comparative study of the RRP design in Austria, Finland and Sweden. We have studied official policy documents, secondary

sources (e.g., assessments and commentaries by experts and stakeholder organisations), and national implementation processes, and interviewed representatives from relevant ministries and agencies in the three countries. Further detail on the materials, data collection and analysis processes can be found in the appendix.

During our analysis (conducted during May 2021 – June 2022)¹, the context for the EU’s Recovery and Resilience Facility abruptly changed with the landscape shock of the Russian Federation’s invasion of the Ukraine and resulting reactions by the EU member states and the European Commission (European Commission, 2022_[18]). On the one hand, the geopolitical role of fossil resource dependency in the EU has accelerated many green transition actions. Yet on the other hand, the need to secure energy supply has led to policy decisions favoring fossil energy, such as reactivating coal-fired power stations, e.g., in Germany, and investing in liquefied natural gas resources and infrastructure. Further complicating the situation, the 2021–2022 inflation surge—attributed to supply shortages coupled with strong consumer demand—has made the social justice implications more severe. However, the analysis in this report has been conducted primarily on the initial directionality of the COVID-19 recovery policies, acknowledging that potential security and geopolitical implications motivated EU fossil phase-out merits another analytical effort.

The remainder of this paper is divided in six sections. In Section 2, we examine the national contexts and trends in R&I policies of Austria, Finland and Sweden. Section 3 presents the process of developing the RRP in the three respective countries, lays out and compares their content. Section 4 analyses the countries’ RRP as a reflection of the integration between policies for transformation and innovation. In Section 5, we draw conclusions on issues and challenges of pursuing a transformative innovation policy based on our analysis. Finally, Section 6 presents reflections for policymaking.

2. National Context

*“{T}he green recovery plans are powerfully shaped by pre-existing contexts, plans and developments, which constrain the use of the crisis-induced opportunities”
(Geels, Pereira and Pinkse, 2022^[17])*

2.1. Political and governance context of Austria, Finland and Sweden

Austria, Finland and Sweden are comparatively small countries (in terms of population size) that are among the net payers in the EU budget. All three have been evaluated at the top end, in the EU and globally, regarding overall sustainability (environmental, social and economic) as defined in Agenda 2030 (Sustainable Development Report, 2022^[19]). Regarding digitalisation, Finland and Sweden rank at the top in the EU while Austria is above average (DESI Index, (European Commission, 2021^[20])). All three countries invest comparatively high shares of GDP in R&D and rank above European average in GDP per capita, environmental sustainability (e.g., renewable energy as a share of total energy consumption), or income equality.

There are some interesting differences between the three countries regarding citizens' views of climate change, digitalisation and GDP volume. According to a 2021 EU survey, 43 percent of respondents in Sweden regarded climate change as the single most serious problem facing the world as a whole (the highest figure of all member states), whereas in Finland and Austria, the corresponding numbers were 25 percent and 15 percent, respectively (Eurobarometer, 2021^[21]). The timing of the survey amid the COVID-19 pandemic and differences in national experiences might explain why 21 percent of Austrian respondents listed the spread of infectious diseases as the most serious problem compared to only eight percent in Finland and four percent in Sweden.

The overarching policy, governance and political backdrops in the three countries appear to be important contextual factors for the RRP. This is because the RRP is situated as part of the countries' broader governance and policy mixes pertaining to innovation, climate change and the sectoral policies addressed in the RRP. They do not affect innovation or transformation in isolation of other policies in force. Below, we describe the political situation for the governments in each country at the time of the RRP preparation.

Austria's governance system is characterised by a division of labour between ministries that establish programmes and strategies and agencies that take care of the day-to-day administration and funding. At the ministerial level, the Federal Ministry of Climate Action is a central player due to its competences for environmental agendas, but also regarding transport and innovation. The Federal Ministry of Labour and Economy² is another important player in the fields related to the RRP, mainly because it oversees start-up policies and other business-related agendas. Digitalisation and investments in digital infrastructure have recently moved into the competence of the Ministry of Finance, which also plays an increasing role in science and technology via R&D tax credits ('Forschungsprämie') introduced in 2002. The Federal Ministry of Science and Education, responsible for universities, is also important actor in the innovation policy context.

At the agency level, the Austria Wirtschaftsservice (AWS), in charge of various programmes to support entrepreneurs and SMEs, and the Forschungsförderungsgesellschaft (FFG), responsible authority for the promotion of

business R&D, are notable players. Both agencies organise various programmes for the Ministry of Climate Action, the Ministry of Labour and Economy² and the Ministry of Finance. There is a rather clear division of labour, with ministries designing policies and programs and agencies mainly operating as implementing actors.

The government has undertaken efforts to strengthen horizontal R&I policy coordination, for example, through the establishment of an RTI Task Force chaired by the Federal Chancellery (Bundeskanzleramt). While this has strengthened information exchange among ministries, the OECD (2018) argued that there is still a “need to make coordination more effective and better adapted to new challenges” and concluded that “[s]tronger structures and incentives for policy making [than the RTI Task Force] may be required” (OECD, 2018, p. 45^[22]). In 2018 Innovation Review, the OECD recommended Austria to strengthen the overall R&I governance by establishing a Council for Science, Research and Innovation, and to enhance the “operational and financial autonomy” of R&I funding agencies (FFG and AWS) “while reinforcing the strategic steering capacity” in the Ministries in charge (OECD, 2018, p. 46^[22]).

The Austrian government took important steps towards a more integrated approach in climate policy in recent years. First, a dedicated agency, the Klima- und Energiefonds (KLIEN) was established in 2007 to fund projects towards a sustainable energy generation and consumption. The KLIEN funds research, as well as investments in transport, enterprises, households, as well as public measures towards awareness. The budget of the KLIEN will be between EUR 282 and 303 million in 2022 (Klien - Klima- und Energiefonds, 2022^[23]).

A second step towards more integration was the creation of the Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology (BMK) in January 2020 which integrates the most important competences for climate policy with the competences for innovation policy. This created a powerful instrument for climate policy. The BMK kicked off or contributed to some ambitious projects described below which both set important parts of the legal framework for transition of the energy system.

However, despite the concentration of competences in one ministry, it seems that Austrian climate policy still suffers from some contradictions which can only be solved over time. One of these contradictions is the fact that there are still subsidies with a negative effect on the environment) in the areas of energy generation, energy use and transport at a federal level which are in the competence of BMK (Laufer, 2022^[24]) (see also Kletzan-Slamanig and Köppl (2016^[25])). Another field where integration is progressing is bottom-up R&D funding by the Forschungsförderungsgesellschaft (FFG) which increasingly integrates sustainability criteria in their funding decisions (FFG, 2022^[26]).

Following the September 2019 elections, a two-party government led by the Austrian People's Party (ÖVP) was formed in January 2020 together with the Green Party. The coalition had a clear majority in the parliament. A comprehensive political program for the new government was published at its start and remained intact through two changes of Prime Minister. Several highly prioritised initiatives laid down in this program went also into the Austrian RRP. Examples are the “Ecological and social tax reform” and the “Climate ticket”, but also strategies such as the “Mobility master plan 2030” or the “Research, technology and innovation strategy 2030”. The Green party entered the government for the first time and took charge of the Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology (BMK), which has an unusually broad portfolio covering large parts of climate related policies as well as innovation policy, the latter area shared with the Ministry for Digital and Economic Affairs. The government inherited a budget more or less in balance. The main goal is climate neutrality in 2040 and reaching the EU climate targets for 2030.

In line with this ambition, the Austrian Parliament enacted various laws that constitute the framework to reach these goals. A new Climate Act (Klimaschutzgesetz) has been discussed since the measures foreseen by the previous version (adopted 2011 and last changed in 2017) ran out by end of 2020 – the governmental programme for 2020-2024, however, has foreseen reaching climate neutrality by 2040. The Renewable Energy Development Act (Erneuerbaren-Ausbau-Gesetz) sets the goal to satisfy the demand for electricity completely by renewable energy sources by 2030 and provides a framework for higher investments in renewable energy, including public support for investments and minimum prices for renewable energy. The Austrian government also started a tax reform (ökosoziale Steuerreform) which includes taxes on CO₂ emissions, a “climate bonus” that should promote climate-friendly behavior, and support for the substitution of oil and gas heating. The Austrian 2030 Mobility Master Plan (Mobilitätsmasterplan 2030) sets the transformation path until 2030 to reach the national climate target of climate neutrality by 2040. It is complemented by the R&I Mobility Strategy 2040 (FTI Strategie Mobilität 2040), which focuses on the longer-term research and innovation opportunities to help improve mobility systems. Mobility can be regarded as the policy field where the integration of sectoral and innovation policies is most pronounced. A stronger integration between sectoral and innovation policies is also envisaged for energy.

Finland’s governance system is based on strong ministries, regional implementation agencies and comparatively few national agencies with well-defined responsibilities. In addition to a vertical implementation structure, there is also an orientation towards horizontal coordination between the ministries, as many issues are advanced in cross-ministry working groups, including climate and energy strategies that have been prepared since 2001. This partially reflects the old committee system in Finland that has transformed features of corporatist planning (Holli and Turkka, 2021^[27]). However, Deschryvere, Husso and Suominen (2021) find that since 2011/2012 policy coordination, particularly regarding S&T policy, deteriorated. This, combined with the absence of a shared long-term vision contributed to a significant weakening of Finland’s innovation system. In the case of COVID-19 recovery, Finland has shown renewed readiness for broad-based coordination and commitment to R&D spending, while also acknowledging need of balancing between the different sectoral demands.

A government program prepared each government term and coordinated by the Prime Minister’s Office sets the main policy context for the forthcoming four-year period. The government programs have become increasingly detailed over the years and, thus, they already set the key priorities for different policy domains, including R&I and climate policy of Finland. The Ministry of Employment and Economy (MEE) is a key ministry for both innovation policy and for climate policy, while these domains are located in different departments. MEE and its energy department coordinate national climate and energy strategy preparation, while MEE’s innovation department supervises Business Finland. The Ministry of Education, and the Academy of Finland are also important contributors to R&I policy. In turn, the Ministry of the Environment is in charge of medium-to-long-term climate policy. The Ministry of Transport and Communications and its agency Traficom are coordinating digitalisation efforts.

Finland was one of the first countries to establish a Research and Innovation Council. The Council chaired by the Prime Minister, played a critical role in coordinating and setting whole-of-government priorities for research and innovation policy in the 1980s and 1990s. However, in recent years the council’s influence and importance have declined (Schwaag-Serger, Wise and Arnold, 2015^[28]; Arnold et al., 2022^[12]; Deschryvere, Husso and Suominen, 2021^[29]; OECD, 2022^[30]). In Finland, a five-party coalition government led by the Social Democrats was elected in June 2019. The Social Democrats had been out of government since 2014 and were eager to develop new initiatives but had to find support

for such initiatives among the other coalition partners, which together controlled most ministry posts. The political program that formed the basis for the coalition government specified a fairly conservative fiscal policy aiming at turning a budget deficit into a balanced budget by 2023. The main ambitions of the government program included a carbon neutrality target on the national scale by 2035 and advancing social and health care system reform by establishing a new regional administration level.

The reform of the Climate Change Act entered into force on July 1, 2022, and is an important landmark in coordinating Finland's climate policy ambition, as it sets monitoring principles and imposes obligations on the authorities (Ministry of the Environment of Finland, 2022^[31]). The act will also strengthen and further institutionalise the role of the scientific Climate Change Panel, which was formed in 2016, following the introduction of the Climate Act in 2015. Furthermore, the roles of and relations between the four main climate strategies are defined in the act. First, the Energy and Climate Strategy responsible of emission trade sector policies is coordinated by MEE and is currently under preparation (Ministry of Economic Affairs and Employment of Finland, 2022^[32]). Second, the Medium-term Climate Change Policy Plan responsible of effort sharing sector policies is coordinated by ME and was approved by government on 2 June 2022 (Ministry of the Environment of Finland, 2022^[33]). Third, the Climate Plan for the Land Use Sector responsible of policies on land-use sector emissions is coordinated by MAF and was approved by government on 8 July 2022 (Ministry of Agriculture and Forestry of Finland, 2022^[34]). Finally, the update of National Climate Change Adaptation Plan is currently under preparation and is coordinated by MAF (Ministry of Agriculture and Forestry of Finland, 2022^[35]). Despite clarified responsibilities under the revised Climate Change Act, the strategies remain fragmented across three ministries and their integration partial.

In 2021, the government conducted an extensive process of requesting sector roadmaps towards decarbonised society to be prepared as a collaborative effort with the main stakeholders. These economic sectors included transport, energy, technology industry, chemicals industry, forest industry, construction, food, commerce, agriculture, textiles and tourism. The intent has been to include economic sectors more closely to the national climate governance framework and steer also their RDI investments towards shared targets. This is also well reflected in the more industry oriented actions of the Finnish RRP.

In April 2020, the government published a “National Roadmap for Research, Development and Innovation” in which an ambitious goal was set to increase Finland's R&D expenditure as a share of GDP from the then 2.7 percent to 4 percent by 2030, as Finland's R&D expenditure had been lower than in other Nordic countries. The roadmap entitled “Solutions for a sustainable and developing society” formulated its central ambition as “a new beginning for RDI cooperation between companies and research organisations”. During the latter half of 2021, a working group in the parliament reached a preliminary cross-party agreement on a strategy for reaching the four percent R&D-intensity target.

In the wider governance setting, the interaction between industry and the ministries is strong. Private sector members are typically a part of stakeholder committees used in policymaking, and there is a tradition of public-private networks for innovation and industrial development. For example, recently public-private collaborations have resulted in the preparation of sectoral low-carbon roadmaps for energy, transport, and the circular economy and different industrial sectors. The government has drafted climate and industry policy decisions based on the roadmap processes, but the lack of cross-sectoral coordination has raised also critical public discussion.

Sweden's governance system is characterised by relatively small ministries and independent agencies. Ministries annually provide agencies with instructions

(‘Regleringsbrev’) on their overall objectives but are prohibited from interfering directly in agencies’ operations (‘Ministerstyre’). The division of labor between ministries and agencies in the Swedish public administration system, sometimes referred to as a dualistic system, is rather unique (Wennergren 1998). In 1997 the Swedish ministries were merged into one administrative organisation (‘Förvaltningsmyndighet’) with the objective of strengthening horizontal policy coordination and whole-of-government policies.

In recent years, several efforts have been made to improve further horizontal policy coordination. Relevant examples with regard to innovation policy are the National Innovation Council (established in 2015), the creation of four governmental innovation partnership programs (Climate neutral industry; Skills supply and lifelong learning; Digital transformation of industry; and Health and life sciences), and the establishment of the “Committee for Technological Innovation and Ethics (Komet)” (Kommittén för teknologisk innovation & etik, 2022^[36]) in 2018 (with the task to ensure favorable framework conditions for technological innovation and competitiveness).

The result of the national elections in September 2018 made it difficult to form a stable government. The minority government consisting of the Social Democrats and Green party that took office in January 2019 was politically much more constrained in what it could do than the governments in Austria and Finland. It was bound by a political program agreed with two other parties in the so-called January agreement which specified 73 items political initiatives to be implemented and for which the government could count on the support from the two other parties. The government program basically defined and constrained the actions that the government could undertake until the agreement fell apart in July 2021. After a period of political instability, the Social Democratic formed a minority government under a new Prime minister in December 2021, the 2022 budget for which was the one put forward by four center-right opposition parties. Sweden has one of the strongest budget conditions within the EU so the limitations on new political initiatives have been political rather than availability of fiscal means.

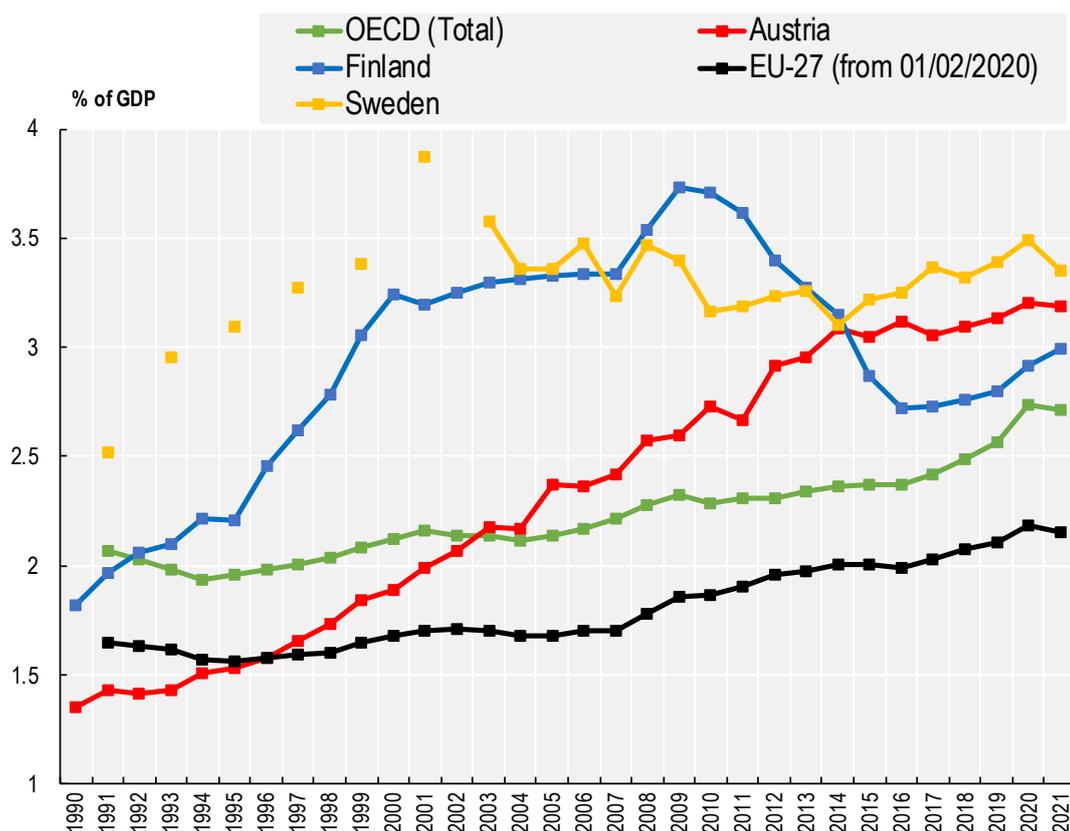
R&I policy followed a long-established four-year cycle and the R&I bill for 2021-2024 was presented in December 2020. An ambitious climate policy had a strong cross-party political support and also followed a four-year cycle of defining climate goals for Sweden and setting a climate action plan for the government. The first climate action plan of its kind in Sweden was presented by the expeditionary government in December 2019 and its key actions included in the January agreement.

In 2017, the ruling Social Democratic Party declared its goal of Sweden becoming the first fossil fuel free welfare state by 2045 (Socialdemokraterna, 2017^[37]). In line with this ambition, in 2017, Sweden adopted a new climate policy framework. The framework consists of a climate act, climate targets and a climate policy council. Sweden's long-term target is to have zero net greenhouse gas emissions by 2045 at the latest. The framework was adopted by the Parliament with a broad majority of the political parties and is set up to withstand political shifts. The Act states that the Government shall: present a climate report in its Budget Bill each year; draw up a climate policy action plan every fourth year to describe how the climate targets are to be achieved; make sure that climate policy goals and budget policy goals work together (Naturvårdsverket, 2017^[38]). The government also established a Climate Policy Council, an “independent, interdisciplinary expert body tasked with evaluating how well the Government’s overall policy is aligned with the climate goal of no net greenhouse gas emissions by 2045” (Swedish Climate Policy Council, 2022^[39]). The government also launched an initiative in 2015, called “fossil fuel free Sweden”, with the aim of accelerating industry’s transitions to sustainability while maintaining (strengthening) competitiveness (Fossilfritt Sverige, 2022^[40]). Under the umbrella of this

initiative, 22 roadmaps towards “fossil-free competitiveness” have been developed in various industrial sectors together with the respective industry stakeholders.

2.2. Science, Technology and Innovation policy context

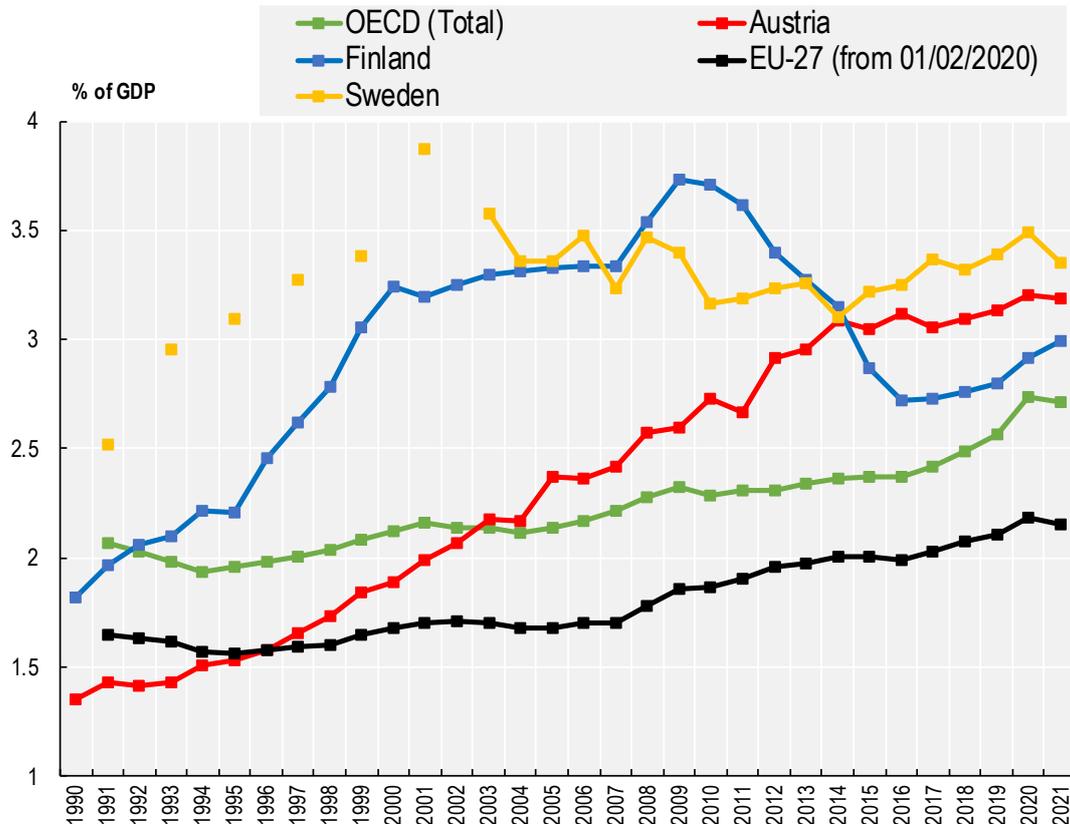
The context of R&I policy differs considerably between the three countries. In terms of aggregate R&D expenditure (Figure 1 below), Austria has seen a rapid, uninterrupted increase since the early 2000s, turning it from a laggard to one of the leading countries in Europe. Between 1998 and 2016, its growth in R&D spending as a share of GDP was the second highest among all OECD countries after Korea (OECD, 2018^[22]). R&D spending as a share of GDP increased from 1.4 percent in 1990 to 3.1 percent in 2019. In contrast, Finland’s R&D spending as a share of GDP increased from 1.8 percent in 1990 to a peak of 3.7 percent in 2009, but then dropped again to 2.7 percent in 2016. In recent years, it has started to increase slightly again, indicating that the downward tendency may have been halted. Compared to Austria’s significant and continuous increase and Finland’s dramatic drop, Sweden’s R&D spending as a share of GDP has been rather stable since the mid-1990s, with a peak of 3.9 percent in 2001 (right before the burst of the IT bubble) and a low of 3.1 percent in 2014 (see Figure 1). Gross expenditure on R&D (GERD), as percentage of GDP, 1990-2021



Source: OECD, Main Science and Technology Indicators Database, <http://oe.cd/msti>, last updated: 31 March 2023

). All three countries, however, are still well above OECD average.

Figure 1. Gross expenditure on R&D (GERD), as percentage of GDP, 1990-2021



Source: OECD, Main Science and Technology Indicators Database, <http://oe.cd/msti>, last updated: 31 March 2023

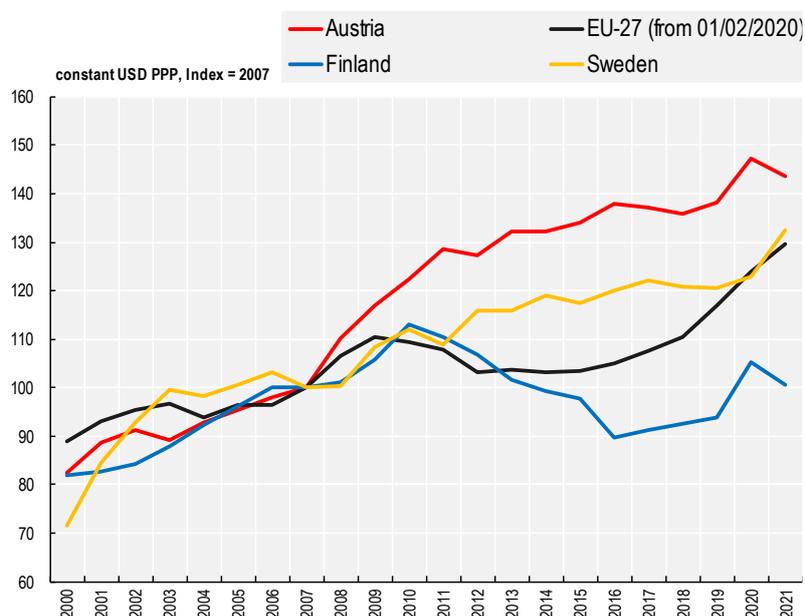
Increases in public R&D funding in Austria were matched with higher funding by the enterprises themselves and from MNE headquarters abroad for their Austrian subsidiaries. The main instruments of Austria's R&I policy are the R&D tax credit (Forschungsprämie) which provides funding for R&D active enterprises regardless of size and/or technological focus, bottom-up funding in the form of the Basis program by the Austrian Research Promotion Agency FFG, and topical funding for co-operation, special technologies, sectors, etc. The expansion of Austria's innovation system in terms of funding also revealed some weaknesses, for example a low attention to the impacts, the efficiency and effectiveness of its investments in R&D and towards excellence (OECD, 2018_[22]). The pooling of competences for innovation, energy, transport and climate into one ministry may help to develop more output focus in R&D policy over time. The rise in Austrian R&D expenditure is driven by an increase in government funded R&D expenditure (as a share of GDP), particularly up until 2014, which was eventually complemented by an increased in business-funded R&D expenditure, including considerable higher R&D efforts by foreign-owned firms (OECD data). The rise in Austrian R&D expenditure is driven by an increase in government funded R&D expenditure (as a share of GDP), particularly up until 2014, which was eventually complemented by rising business-funded R&D expenditures, including considerable higher R&D efforts by foreign-owned firms (OECD data).

In contrast, Finland's drop in R&D spending (as a share of GDP) since 2009 was mainly the result of the dramatic reduction in business sector R&D (particularly by Nokia), following the financial crisis. Finland's development, from a country that has been an

international leader in R&D expenditure, to a rather stark and persistent drop, is noteworthy. Finland has a long-standing tradition of setting and reaching national R&D targets, starting in the early 1970s (see Figure 2) (Deschryvere, Husso and Suominen, 2021^[29]). According to Deschryvere, Husso and Suominen (2021^[29]) the 2008 global economic crisis and the ensuing recession, both of which struck Finland particularly hard, have weakened the government's long-standing resolve and commitment to maintain high R&D spending. More generally, the decade after the global economic crisis was marked by an erosion of a previously solid consensus on the importance of R&I for the Finnish economic prosperity and competitiveness (Deschryvere, Husso and Suominen, 2021^[29]; OECD, 2017^[41]). Cuts in public R&D spending between 2010 and 2016, particularly for applied research, research institutes and innovation programs, the significant weakening of both Tekes (Finland's technology and innovation agency) and the Research and Innovation Council (RIC) as tool for innovation policymaking illustrate this erosion, leading the OECD to conclude in its Innovation Review Finland from 2017 that "STI [science, technology and innovation] policy seems to have lacked coherence and orientation in recent years" (OECD, 2017, p. 11^[41]). However, in December 2021, a parliamentary working group on research, development and innovation agreed on a proposal to introduce legislation that would commit Finnish governments (regardless of political party) to work to reach the target of R&D spending of four percent of GDP by 2030 (Zubaşcu, 2022^[42]). Thus, after a decade-long dip, Finland now seems to be returning to its traditionally strong commitment to R&D spending, though it remains to be seen how this will translate into innovation policy and transformation.

Finally, Swedish S&T policy over the past 15 years can be described as one of relative stability and incrementalism. Thus, public R&D funding has seen a modest but stable increase and there have been no major changes in the higher education or R&I funding landscape.³ Sweden's research priorities are set out every four years in a research bill. In the latest research bill, presented in 2020, the government identified five societal challenges: climate and environment, health and welfare, digitalisation, skills supply and working life, and a democratic and strong society (Regeringskansliet, 2020^[43]). The recent research bill includes the budget framework for most of civilian government R&D expenditure, including R&D funding agencies and institutional funds for research in the higher education sector and the RISE institute, for the period 2021-2024. While smaller adjustments may be made in the annual budgets, based on past experiences the expectation is that budget figures in the research bill will be kept unchanged. Importantly, sector agencies, of which the Swedish Energy agency is the largest in terms of R&D, are not covered by the research bill.

Figure 2. Government budget allocations for R&D at constant prices and PPP\$ (Index = 2007)



Source: OECD Main Science and Technology Indicators, https://stats.oecd.org/Index.aspx?DataSetCode=MSTI_PUB#, extracted 4 June 2023.

COVID-19 led to increase in R&D government spending in all three countries. However, the R&D funding by firms decreased in Austria and Finland.

2.3. Innovation policy and transformation

Compared to other OECD countries, Austria directs relatively little government R&D towards specific socio-economic objectives (OECD, 2018^[22]). The first comprehensive Research, Technology and Innovation (RTI) Strategy, published by the Austrian government in 2011 and covering the period 2011 to 2020, recognised the importance of R&I contributing to addressing grand challenges. However, the top priority was on turning Austria from an ‘innovation follower’ to an ‘innovation leader’, as illustrated in the title “Realising Potentials, Increasing Dynamic, Creating the Future: The Path to Innovation Leader” (*Potenziale ausschöpfen, Dynamik steigern, Zukunft schaffen: Der Weg zum Innovation Leader*). The second strategy presented in 2020 and covering the period up to 2030, continues to focus strongly on improving Austria’s ranking in the European Innovation Scoreboard. It mentions societal challenges only in the context of Horizon Europe and the five EU Missions, stating that Austrian RTI actors are well positioned to participate in funding tenders. In its Innovation Review of Austria, the OECD pointed to a “lack of effective priority setting” (p. 40^[22]) in R&D funding and concluded that “[a]n opportunity exists to better articulate Austria’s many public R&I policies with societal challenges” (p. 20^[22]). Since the change in government in 2020, more attention has been placed in Austria on the role of innovation for addressing societal challenges, in particular in the context of climate-related agendas.

Similar to Austria, but for different reasons, Finland has not been an early adopter or frontrunner of the shift towards a more challenge- or transformation-oriented R&I policy (Schwaag Serger and Palmberg, 2022^[4]; OECD, 2017^[41]). In the Finnish case, this can be partly explained by economic, employment and budgetary challenges crowding out other

considerations. Thus, in comparison to Sweden, where societal challenges became a focus of innovation policy as early as 2010, Finnish innovation policy continued to be more strongly oriented on economic growth and competitiveness (Schwaag Serger and Palmberg, 2022^[4]; OECD, 2017^[41]). The government has undertaken several initiatives in recent years to strengthen the focus of R&I on societal impact and on addressing societal challenges. These include the creation of the Strategic Research Council in 2014, with the purpose of funding “long-term and programme-based research aimed at finding solutions to the major challenges facing Finnish society” (Academy of Finland, 2022^[44]), the Flagship programs launched in 2018 which “supports high-quality research and increases the economic and societal impact emerging from the research” (Academy of Finland, 2022^[45]) and more generally an increasing focus on societal relevance in some of the Academy of Finland’s funding instruments (Arnold et al., 2022, p. 61^[12]). Overall, however, Arnold et al (2022^[12]) observe that “Finland has not evidently reprogrammed significant amounts of R&I effort towards the societal challenges or made organisational responses to these challenges” (ibid). The remarkable disintegration of a traditionally strong and holistic R&I policy also partially explains why Finland was rather late in linking transformation and innovation policy:

Up to about ten years ago, Finland was admired internationally for the boldness and effectiveness of its research and higher education policy, which was credited with supporting Finland’s growth and the completion of its transition from being a resource-based economy to become a leading industrial country.... Following the 2008 financial crisis and the Nokia crisis, political consensus and commitment to research and higher education broke down. The holistic perspective was lost, gaps started to appear, notably in technology policy, and Finland began to lag behind international thinking about refocusing parts of research and innovation policy towards the societal challenges and the UN Sustainable Development Goals. (Arnold et al., 2022, p. 6^[12]).

Sweden was one of the first countries to link explicitly innovation programs and societal challenges, (see Schwaag Serger and Palmberg (2022^[4]) and Borrás and Schwaag Serger (2022^[5])). The homepage of the Swedish government agency, Vinnova, proclaims that it develops system innovation for a sustainable future (Vinnova, 2022^[46]). However, Vinnova’s attempts and initiatives to drive transformation have hitherto not been sufficiently nested in or linked with a larger context for driving transformation (Schwaag Serger and Palmberg, 2022^[4]; Borrás and Schwaag Serger, 2022^[5]). The link between innovation policy on the one hand, and energy, climate, healthcare or social policies, on the other hand has been rather weak. Furthermore, the Finance Ministry – which plays a key role in overall policy direction due to its authority over budgetary processes – has hitherto not bought into or embraced the transformative rationale of innovation policy. Thus, at the Finance Ministry, innovation policy is still strongly associated with more traditional objectives of promoting commercialisation and contributing to competitiveness, growth and job creation.

Overall, the analysis points to a complicated relationship between innovation policy and transformation. Sweden and Austria show that a strong long-term commitment to R&D is no guarantee for innovation policy being highly transformative. Austria’s R&I policy has been strongly oriented towards catch-up. The link between sectoral policies and innovation policy has been strengthened particularly in the area of mobility, while the role of innovation policy in transforming other sectors (e.g. healthcare, education, public sector) is not clear. Sweden’s hitherto rather passive EU policy is an example of how Sweden’s transformative ambitions (Agenda 2030, first fossil-fuel free welfare state) clash with a reluctance or unwillingness to engage and seek to influence EU policies and frameworks for transformation. In Finland, economic growth and export continue to dominate the

innovation policy agenda, despite strong governmental climate policy efforts. Thus, all three countries show a need to better connect transformative challenges to the practice of innovation policy. RRP's have created an experimental setting to connect societal challenges and sectoral policies for transformation with R&I policies, by providing a horizontal platform for the creation of new kind of policy mixes that potentially advance transformative innovation policy.

3. The Recovery and Resilience Plans in Austria, Finland and Sweden

The purpose of this section is to compare the content of the recovery and resilience plans (RRPs) of Austria, Finland and Sweden. The analysis is based on the policy documents (Austrian Federal Ministry for Finance, 2021^[47]; Austrian Federal Ministry for Finance, 2021^[48]; Finnish Government, 2020^[49]). While the total portfolio of the plans is considered, the focus is on measures aimed at climate and digital transformations. To varying extent, policy measures in the RRP will be placed in their broader national context. The section begins with a description of the processes of RRP preparation, moves to main elements of the RRP and concludes with a comparison of the division of responsibilities between ministries in the RRP implementation of the three countries. As shown above (Section 2.1), the countries' political and governance contexts differ, which has also significantly affected implementation of the RRP.

It is important to point out that the RRF volume accounts for a small share of these countries' GDP compared to most other EU countries: 0.87 percent for Austria and Finland, and 0.69 percent for Sweden (European Commission, 2022^[50]). By comparison, it accounts for 16.63 percent for Greece, 10.67 percent in Italy, 5.59 percent in Spain, 1.62 percent in Germany and 1.24 percent in Belgium (ibid). The share of investments related to digitalisation and climate is high in the RRP of the three countries compared to other EU member states – thus indicating stronger transformative intent and innovation orientation. It also reflects policy priorities in these countries towards climate change and digitalisation. It is interesting to note that in the negotiations on the EU recovery fund in 2020, Austria and Sweden formed a coalition with Denmark and the Netherlands (referred to as "the Frugal Four") opposing what they considered an overly generous budget.

3.1. Preparation of the RRP

The preparation of the RRP followed very different processes in the three countries in terms of the actors involved, the openness of the process and the extent to which the process sought to develop new measures. These differences reflect the room for political initiatives at the time but also deeper aspects of political culture and the structure of the government in terms of ministries and agencies, as well as existing policy frameworks and orientations.

However, there are also common boundary conditions in all three countries that have shaped the final form of the RRP. One of these boundary conditions is the tight time frame. The European Commission finalised the proposal for the RRF in late July 2020, it was adopted by the European Council in December 2020, and entered into force on 19 February 2021. Time for preparing the proposals for the national RRP was short, as can be seen from Table 1. Austria submitted its proposal one month ahead of Finland and Sweden.

Table 1. Submission and endorsement of the RRP⁴

	Austria	Finland	Sweden
Submission of plan	30 April 2021	26 May 2021	28 May 2021
Endorsement of plan by EU Commission	21 June 2021	4 October 2021	29 March 2022

Source: European Commission

Another boundary condition was that 37 percent of the national RRP had to be spent on climate action, and another 20 percent on digital transformation. These goals have been reached: according to the European Commission, the 22 Member States where the RRP has been approved so far have allocated a total of 40 percent of their RRF budgets to climate measures and more than 26 percent on the digital transition (European Commission, 2022^[51]). In all three countries, the development of the RRP was coordinated by the Ministry of Finance. The motivation to utilise the RRP to develop new policy measures appears to have been the strongest in Finland and weakest in Sweden with Austria probably closer to the Swedish situation. Here we summarise the basic approach to RRP in each country.

Austria: The Austrian RRP stresses that two thirds of the measures are new investment projects which had not been considered in Austria's federal budget so far (Austrian Federal Ministry for Finance, 2021^[47]). However, the final RRP was firmly rooted in the previously ongoing policies of the Austrian government and was dominated by already planned initiatives. Evidence from interviews (Dachs and Weber, 2022^[52]) indicates that Austria's RRP was mainly the result of the inputs of the public administration, less by external experts. There was a public consultation organised by the Federal Chancellery, but it seems it yielded only a few new inputs.

Finland: The Finnish government saw the formulation of the RRP as an opportunity for developing a growth plan that, at least partly, went beyond already decided plans and policy measures. For this purpose, an inter-ministerial coordination group was established and started its work already in the autumn of 2020. The preparation process involved wide-ranging external communication, including a minister-led regional tour during which views from various sectors were heard on the purposes for which the EU recovery funds should be used. The interviews indicated a thorough preparation process, given the short time available, involving many ministries, different regions and stakeholders (Kivimaa, Lukkarinen and Lazarevic, 2022^[53]).

Sweden: Early on in the planning process, the Swedish government decided to build the RRP from already planned policy measures. These were considered sufficient in content as well as scale of budget to meet the criteria of the RRF. External communication during the preparation process was not visible to the public. Consultation of ministries or agencies outside the Ministry of Finance seems to have been limited too (this is at least partially explained by the fact that the RRP consisted of policy measures that had previously agreed up on or were already being implemented).

3.2. Content of RRP

The main structure of the three countries' RRP is shown in Table 2. It shows the size of the grants to be provided as well as number of reforms under the main "pillars". While Finland and Austria have introduced four pillars in their respective RRP, Sweden has five pillars. For each pillar, the share of expenditure classified by the EU-Commission as contributing to climate and digital transition respectively is also indicated. The pillar structures in Table 2 are from the RRP of the respective country.

Each plan has one pillar focusing on climate and another on digitalisation. A third common theme is education and training with a link to labor market issues. In Austria and Finland this latter theme is combined with investments in R&I. In Sweden two pillars are devoted to education and training, one with a special focus on education of staff in elderly care. In Austria, health related measures are part of the Just Recovery pillar, while in Finland health and social services form a large separate pillar. In Sweden health related measures are

limited to education and training. Sweden stands out with a separate pillar for investments in housing.

While most themes mentioned in the previous paragraph are present in all three plans, there are considerable differences in their relative weight. Austria stands out with 41 percent of its investments having a digital content compared with 27 and 21 percent for Finland and Sweden, respectively. The differences are smaller for climate content, with the share of investments largest in Finland with 50 percent and around 45 percent in Austria and Sweden (European Commission, 2021^[54]; European Commission, 2021^[55]; European Commission, 2022^[56]). Not all reforms are matched by investments. In Sweden, for example, measures to “secure the integrity of the financial system” only include changes in bank regulation.

Table 2. Main structure of Austria's, Finland's and Sweden's RRPs

AUSTRIA	Investments				Reforms
	Million EUR	Percent	Climate	Digital	Number of
1. Sustainable recovery	1,507	33.5	86%		5
2. Digital recovery	1,828	40.6	27%	73%	3
3. Knowledge-based recovery	868	19.3	20%	56%	3
4. Just recovery	296	6.6	19%	9%	16
Sum Total	4,500	100.0	45%	41%	27

FINLAND	Investments				Reforms
	Million EUR	Percent	Climate	Digital	Number of
1. The green transition will support structural adjustment of the economy and underpin a carbon-neutral welfare society	825	39.2	99%	7%	10
2. Digitalisation and the data economy will strengthen productivity and make services available to all	234	11.1	14%	97%	7
3. Raising the employment rate and upskilling to accelerate sustainable growth [incl. "RDI, research infrastructure and piloting"]	638	30.4	31%	22%	8
4. Access to health and social services will be improved and their cost-effectiveness enhanced	405	19.3		36%	1
Sum Total	2,102	100.0	50%	27%	26

SWEDEN	Investments				Reforms
	Million EUR	Percent	Climate	Digital	Number of
1. Green recovery	1,552	47.2	86%	1%	4
2. Education and transformation	504	15.3		32%	2

3. Improving conditions for meeting demographic challenges and secure the integrity of the financial system	452	13.7			4
4. Expansion of broadband infrastructure and digitalisation of public administration	485	14.7		100%	0
5. Investments for growth and housing construction	296	9.0	40%		7
Sum Total	3,289	100.0	44%	21%	17

Note: As far as the share for greening and digitisation is concerned, the values for Austria are not those from the Commission's assessment. The Commission confirms a share of 59% for greening and of 53% for digitisation. The values given here come from Austria's calculation. The misunderstanding or the difference comes from the fact that Austria has submitted more investments (namely 4.5 billion euros) than it was originally allocated by the EU Commission (namely 3.5 billion euros).

Source: European Commission (2021^[54]; 2021^[55]; 2022^[56]), own calculations

The three RRP have different structures, and similar policy measures appear under different headings and with very different levels of specification. In our analysis, we attempted to regroup investments to allow for more meaningful comparisons (Table 3). This table is the main reference in the following analysis of the main content of the RRP on climate and environment (section 3.2.1), digital transformation (section 3.2.2), labor market services, education and training (section 3.2.3) and health and social services (section 3.2.4).

3.2.1. Climate and environment

Climate and environment related content create the starting point in each plan, as the European Commission introduced the baseline of 37 percent of funding directed to climate action. Investments related to climate and environment include sector-specific and more general programs. Among the latter are the Austrian "Investment Premium", the Swedish "Climate Leap" and the Finnish "RDI funding package supporting the green transition".

In **Austria**, the Investment Premium was introduced to help the recovery from the COVID-19 pandemic by incentivising companies to invest. The basic subsidy was set at 7 percent of the investment but for investments towards sustainability, digitalisation and life sciences the subsidy was doubled to 14 percent. The demand for the subsidy far exceeded expectations with the result that the allocated budget was increased twice from the initial EUR 1.9 billion to the final EUR 7.8 billion. Only a smaller part of this budget, EUR 605m, is included in the RRP with the use limited to "digitisation and greening of companies" of which by far the largest portion goes to "greening" (EUR 504m).

Sweden's Climate Leap program, launched in 2015, accounts for a fourth of the total RRP expenditure, providing subsidies for investments expected to reduce green-house gas emissions and is administrated by the Swedish Environmental Protection Agency in co-operation with county administrative boards. The subsidy rate has so far been around 40 percent on average. The grants are prioritised according to the green-house gas emission reduction achieved in relation to the size of the grants. Until the end of 2021, around 60 percent of the subsidies were directly or indirectly aimed at reducing emissions from transport. Of this, at least two thirds were for investments in production and distribution of biogas and purchase of gas-powered trucks. Production and distribution of other biofuels, charging infrastructure for electric vehicles and rail-truck intermodal terminals are other targets for the transport-related investment subsidies. Another almost 30 percent of the Climate Leap grants extended so far are aimed at reducing emissions in industry mostly

through investments in conversion from fossil to non-fossil fuels but also investments to increase energy efficiency. Most of the remaining 10 percent of the Climate Leap grants have been for investments in recycling plants for lithium batteries, plastic, phosphorus, textiles and other materials.

Table 3. Investments in Austria's, Finland's and Sweden's RRP in a common structure

Main focus	Subfocus	Component measures	Austria	Finland	Sweden	
			Percent of total RRP-investments			
Climate & Environment	Broad programs	"Investment premium" for greening of companies	11,2%	-	-	
		RDI funding package supporting the green transition	-	9,1%	-	
		"Climate leap"	-	-	24,7%	
	Energy	Energy infrastructure investments	-	7,4%	*	
		Investments in emerging energy technology	-	7,7%	-	
	Industry	"Industry Leap"	-	-	8,7%	
		Transformation of industry towards climate neutrality	2,2%	-	-	
		Direct electrification and low carbonisation of industrial processes	-	2,9%	-	
	Circular economy	Circular economy	Hydrogen (IPCEI) & CCUS	2,8%	7,4%	-
				6,7%	5,2%	*
Transport	Railway network (expansion & digitalization)	Emission-free buses, commercial vehicles & related infrastructure	12,1%	4,0%	4,5%	
		Recharging and non-fossil refuelling infrastructure	6,8%	-	*	
			-	1,9%	*	
Building stock & construction ind.	Reducing climate impact of buildings & construction industry	Investment support for rental housing and student housing	5,8%	5,2%	1,8%	
			-	-	9,0%	
Nature	Nature conservation	1,1%	1,4%	7,5%		
Focal area share of RRP			48,6%	52,3%	56,2%	
Digital transformation	Infrastructure	Broadband	19,8%	2,4%	14,1%	
	Technology	RDI on advanced digital technologies	5,2%	1,2%	-	
	Digitalization in and across organizations	"Investment premium" for digitization of companies	Digitalization of SMEs	1,5%	-	-
			Digitalization of business sector	0,7%	-	-
			Digitalization Public administration	-	1,3%	-
	Cross-sectoral digitalization projects, incl. cybersecurity	3,6%	-	0,6%		
		-	2,2%	-		
Focal area share of RRP			30,8%	7,1%	14,7%	
Labor market services, education and training	Labor market	Reforming labor market services	-	8,1%	-	
	Education and	Vocational and continuous education	University education	6,2%	2,1%	6,0%
			Addressing inequalities in education	-	0,7%	9,4%
			Digitalization in education system	2,9%	-	-
		3,8%	2,2%	-		
Focal area share of RRP			12,8%	13,1%	15,3%	
Health & social services	Research	Austrian Institute of Precision Medicine	1,7%	-	-	
	Education	Paid education for staff in elderly care	-	-	13,7%	
	Health and social services	Access to health and social services and their cost-effectiveness	Promotion of primary care unit and other health projects	-	19,0%	-
			4,0%	-	-	
Focal area share of RRP			5,7%	19,0%	13,7%	
Other	RDI infrastructure	RDI infrastructure	0,7%	3,6%	-	
	Revitalization	Revitalisation aid for the cultural, creative and tourism industries	Other support for growth and exports of primarily SMEs	1,5%	2,9%	-
				-	1,6%	-
Autonomous Åland	Åland: Renewable energy, education and digital health services	-	0,5%	-		
Focal area share of RRP			2,1%	8,5%	0,0%	
Total contribution to RRP from RRF			100,0%	100,0%	100,0%	

* The "Climate Leap" program includes investments related to "Energy" (production of biogas, biogas stations, energy efficiency, energy conversion), "Circular economy" (recycling of batteries, plastic, etc.) and "Transport" (charging stations, transport infrastructure, purchase of non-fossil vehicles)

Source: European Commission, own calculations

There are no requirements for a certain level of technological novelty in investment projects supported under the Climate Leap. Some of the projects may nevertheless constitute first-of-their-kind-novelty in Sweden as exemplified by large plants for sorting of plastic waste in Motala and recycling of lithium batteries in Skellefteå respectively.

In **Finland**, the “RDI funding package supporting the green transition differs from the broad programs in Austria and Sweden as it is more directly dependent on the RRP funding, and it is primarily aimed at R&I projects administered by Business Finland (EUR 147m) and the Academy of Finland (EUR 45m). Details of this funding were presented at an information event organised by the two funding organisations on 17 June 2021 (Business Finland, 2021^[57]). Of the Business Finland RRP funding, EUR 100m is devoted to the “leading company funding” scheme launched in 2020. Prior to the RRP, six projects had already been selected and each provided with EUR 20m in funding. Six new projects were announced in late 2021 and early 2022. Four of the R&D themes are climate-related: zero emission marine technology (Wärtsilä); sustainable plastics (Borealis Polymer); climate-neutral cruise ships and shipyards (Meyer Turku); process technologies, automation and services for circular economy (Valmet) (Business Finland, 2022^[58]). An additional EUR 27m of RRP funds will be allocated to companies and research organisations for projects contributing to the ecosystems of the leading companies. The remaining EUR 20m of Business Finland’s funding will go to R&I projects in SMEs seeking growth through exports.

Academy of Finland is directing its research funding for green transition under the RRP towards “twin transition” projects that simultaneously advance climate and digital transformation. The result of a first call for nationally significant proposals with a budget of EUR 25m with a list of 17 funded projects was announced in December 2021 (Academy of Finland, 2021^[59]). All projects are carried out by multidisciplinary consortia of at least two research groups bringing in both “green” and “digital” expertise and involving collaboration with partners utilising the knowledge generated in the research. A second call with regionally significant proposals was carried out in April 2022. In addition, the Academy of Finland is funding research infrastructures and Business Finland innovation infrastructures at the level of EUR 50m and EUR 25m, respectively. Although the contribution towards digital and green transitions in these infrastructure investments is prioritised, the connection is less direct.

In addition to the above-described initiatives targeting climate and environment more generally, several programs in the three countries deal with more specific challenges, namely energy, industry, circular economy, transport, buildings and construction, and nature conservation. The relative emphasis on these areas or challenges varies considerably between the countries. Transport is a special focus in Austria, where 12 percent of all investments are in railway infrastructure and another six percent for subsidies to purchase of fossil-free heavy buses, commercial vehicles and related infrastructure. The share of investments in railways in Finland and Sweden are about a third of those in Austria. As mentioned earlier, other transport-related investments make up for a large portion of the Swedish Climate Leap mainly for production and distribution of biogas.

In Finland, large investments in energy infrastructure and emerging energy technologies stand out and have little counterpart in Austria and Sweden except for hydrogen and CCUS technologies which are categorised under “industry” in Table 3. Energy infrastructure investments in Finland include the electricity network for connecting wind power to the national grid, recovery of surplus heat for district heating and transmission of low-carbon gas such as hydrogen, biogas and biomethane. With regard to energy technologies, the RRP particularly mentions offshore wind power, renewable transport fuels (electrofuels,

biofuels), and non-combustion heat production (heat recycling, sea water heat exchange pumps, energy storage, geothermal energy, surplus heat).

With the exception of biofuels for vehicles, the Swedish RRP pays very limited attention to energy. This can be explained by electricity generation and heating in Sweden using almost no fossil fuels and instead are based on hydropower production, nuclear power and incineration of waste and biomass. The RRP focuses instead on reducing carbon emissions in industry and transport, identifying electrification in both cases as the major means, although there are expectations that biofuels will play an important role for decarbonisation of transports in the short and medium term.⁵ The Industry Leap program operated by the Energy Agency seeks to promote the decarbonisation of industry and stands out in the Swedish RRP as the one and only policy measure explicitly supporting R&I. The program which started in 2018 represents nine percent of total expenditure in the Swedish RRP. Within the program, grants can be given to “feasibility studies, research, pilot and demonstration projects and to investments”. Initially the support focused on reduction of process-related green-house gas emissions. Later the scope was expanded to include bio-CCS and most recently to include “strategically important initiatives within industry that in a significant way can contribute to reducing green-house gas emissions in the rest of society”. As examples of the latter, the program lists “new technologies and innovative solutions or systems and value chains in areas such as batteries, biofuels and recycling”. The scope is thus very broad.⁶ As of February 2022, Industry Leap had extended grants amounting to SEK 1.6 billion (EUR 154m) to 76 projects. Two companies in the steel industry, two in the mining industry and one company each in the chemical, forest and cement industries account for 85 percent of the total amount of grants, in some cases together with collaborating partners. The subsidy rate for funded projects varies from 14 to 100 percent depending on where on the scale from commercial to research projects fall.

There are programs similar to the Industry Leap in Austria and Finland but smaller in size. Both Austria and Finland have included the participation in the Hydrogen IPCEI (Important Projects of Common European Interest) in their RRP. While this is not the case for Sweden, the country is nevertheless likely to join the Hydrogen IPCEI, as the Energy Agency has been commissioned to identify potential projects through which Sweden can contribute to the program.

Heating of buildings is a major source of carbon emissions in the EU. Conversion to non-fossil energy sources for heating is the objective of RRP investments in Austria and Finland. In Austria, part of investments in the so called “renovation wave” are included in the RRP. A major purpose of the renovations is to change the heating systems of buildings from oil and gas to renewable energy sources, such as low emission district heating, biomass heating and heat pumps. Other parts of the budget are used for protecting low-income households from rent increases caused by the renovations. Investments in building renovation also appear in the RRP under the item “resilient communities”, in which case the focus is on the special conditions for renovating buildings in city centers to reduce their climate footprints.

Around 10 percent of the “climate content” of the Finnish RRP aims to reduce the environmental impact of the building stock. The largest part is devoted to accelerating the conversion from oil heating in low-rise housing to non-fossil heating systems under a scheme introduced in the autumn of 2020. Another part targets low-carbon and circular economy solutions in the construction industry and real estate industry mainly through an RDI aid program of Business Finland under the guidance of the Ministry of the Environment. The international competitiveness of the construction industry appears to be a central objective along reducing the climate footprint.⁷

In Sweden, carbon emissions tied to heating come mainly from burning of waste plastic and biomass. These have so far been regarded more favorably than fossil-fuel based emissions and as a result energy efficiency in buildings has not been a top priority in the Swedish climate policy. In the Swedish RRP, 40 percent of investment support for rental housing and student housing is counted as contributing to climate transition due to improved energy efficiency in buildings.⁸ The RRP also includes as many as seven reforms affecting the housing market, including changes in the processes for granting building permits and in the rules for setting housing rents.⁹

Both Austria and Finland include significant resources in their RRP for promoting the circular economy. The Austrian EUR 300m initiative targets the bottle recycling, waste sorting plants and a bonus for electrical and electronic equipment repair. Finland devotes EUR 110m to “reuse and recycling of “battery materials, plastics, textiles, packaging, electrical and electronic devices, construction waste, demolition waste”. Funding is to go to “first commercial institutional applications, pilot projects and demonstration facilities, to introducing new technology to existing processes, and to digital platforms and service investments promoting reuse and recycling.” Thus, circular economy measures in the Finnish plan link strongly to innovation policy. By comparison, the Austrian program seems primarily aimed at subsidising the diffusion of established technologies and solutions. As already mentioned, a few large pioneering facilities for sorting of plastic waste and recycling of batteries have already been funded by the Swedish Climate Leap. Moreover, Kivimaa and Kern (2016^[8]) suggest that the destabilisation of incumbent technological regimes that may block the emergence of new technologies should have an important role in policy mixes towards transition. This element is hardly present in the RRP of all three countries.

Finally, measures to protect and promote biodiversity are present in all three countries. Sweden allocates by far the largest resources to this objective, 7.5 percent versus 1.1 and 1.7 percent in Austria and Finland. Sweden pursues this goal by assigning certain forest grounds and water areas as nature reserves and compensating the landowner for restrictions imposed on managing the property. In some cases, the government buys the land. In Finland, on the one hand, the promotion of nature-based solutions aims at enhancing biodiversity protection, while, on the other hand, the investment in gypsum treatment of fields is merely oriented towards maintaining existing agriculture practices. The share of funding for biodiversity in the Finnish RRP is small.

The climate content is more prevalent than other environmental actions in the recovery plans. Overall, the main differences between countries lie in the mix of RRP actions. Austria’s specific emphasis is on railway investments and general investment subsidies, supporting already existing technologies. Finland develops a mix of actions ranging across several sectors, infrastructures and stakeholder groups, with quite a lot of orientation to promoting the development and especially upscaling of innovative solutions with potential for transformation (Kivimaa, Lukkarinen and Lazarevic, 2022^[53]). Sweden has a special focus on non-fossil fuels and infrastructure for road transport, as well as on innovation for decarbonisation of industry and nature-based solutions.

3.2.2. Digital transformation

The second core area for RRP supported by the EC is digital transformation; which is considered to be key in improving economic renewal and enhancing climate action. A variety of policy measures support digitalisation. The digital transformation heading in Table 3 includes digital infrastructure, R&D on digital technologies, and digitalisation of public administration and the business sector. Measures for education, skill development,

and the development of digital platforms in labor market, medical and social services have been placed under other headings in the same table. These are particularly large in Finland.

Investments in broadband infrastructure are major parts of both the Austrian and Swedish RRP at 20 and 14 percent of the respective country's total expenditure. In Finland, wireless broadband infrastructure covers already 99 percent of the population so less investment is needed (Ministry of Transport and Communications 2019). The Austrian investment is part of the Broadband Initiative Austria 2030 which also includes national funding, the guidelines of which were decided in 2021. Both the Austrian and Swedish investments as well as the much smaller investment in Finland, are for improving broadband infrastructure in geographical areas poorly served through the regular market. The Austrian government channels the subsidies through the Austrian Research Promotion Agency (FFG), better known for being the principal R&I funder. In Sweden and Finland, the Swedish Post and Telecom Authority (PTS) and in Finland by the Transport and Communications Agency, respectively, administer the subsidies. In Finland, two thirds of the investments in digital infrastructure are for railroads and listed in Table 2 under the transport heading of climate and environment.

The Austrian RRP puts much more emphasis on R&D in digital technologies than Finland while in Sweden such measures are non-existent.¹⁰ The Austrian initiatives include EUR 125m to the IPCEI Microelectronics and Connectivity and EUR 107m to The Quantum Austria program.

Under the title “Accelerator programme for spearhead technologies”, Business Finland provides relatively modest support for the “microelectronics value chain” (EUR 15m) and for testing and experimentation facilities for AI, 5G/6G and quantum technologies (EUR 10m). Projects in the former area form the basis for Finland's participation in the IPCEI Microelectronics and Connectivity while projects in the second area aim at building national test environments to serve as a Finnish node in a European-wide system of test and experimentation facilities.

Austria invests EUR 160m in a Digitisation Fund for public administration. The corresponding investment in Sweden amounts to only EUR 20m. In Austria and Finland there are also measures for promoting digitalisation in the business sector. In the Austrian case, there is the general Investment premium already described earlier under climate and environment. In addition, two programs KMU.DIGITAL and KMU.E-Commerce focus on the needs of SMEs. The former program was started already in 2017 and the latter in 2020. Both programs provide small scale funding to a large number of companies for their purchasing of external help in their digitalisation efforts.

In Finland there are several examples of ambitious projects to build cross-sectoral digital platforms that involve both the public sector and the business sector which don't seem to have any direct counterparts in the other two countries. “Data economy projects” in three areas, all aim at creating “interoperable information entities at the national level for promoting the availability, quality and reuse of information”. Corporate financial data and residential and commercial property data are two of the areas. The third concerns building an integrated service platform, Virtual Finland, for foreign nationals and foreign enterprises in order to facilitate their dealings with authorities in Finland in connection with an individual relocating to Finland or a foreign enterprise setting up operations in Finland. Projects in all three areas will involve collaboration between selected authorities and private-sector operators. An additional area is digital security.

In the RRP context, we can discern noticeable differences in the three countries' digitalisation orientations. Austria shows the strongest ambition in innovation actions, while also directing large investments to infrastructure development. Finland has more of

a governance orientation with the public sector capabilities and platforms at the core. For Sweden, digitalisation seems to be more an afterthought with infrastructure projects designed to match the EC requirement of digital content.

The differences between the three countries regarding the digitalisation components of the RRP in terms of content, scope and scale can to a significant degree be explained by differences in the countries' point of departure when it comes to digitalisation. Finland is one of the most advanced countries in Europe and the world, as reflected in its number one ranking in the 2022 DESI index (European Commission, 2021^[20]). Sweden also ranks highly in the DESI index (4th in the 2022 index), whereas Austria is closer to the average (8th). Interestingly, connectivity seems to be a relative weakness shared by all three countries, with Austria below the EU average whereas Finland and Sweden hover at or slightly above. Thus, the analysis of the digitalisation components of the RRP illustrates the importance of examining them within their larger national policy context in order to be able to understand and assess both their transformative thrust and their link to R&I policy.

3.2.3. *Labor market services, education and training*

Labor market, skills and education policies constitute another large area common to each RRP. The pandemic has created pressures on several sectors and their workforce, while the digital and green transitions require profound transformation of the systems for education and skills development.

Investments in education and training form a major pillar in the Swedish RRP. The explicit goal is to facilitate structural changes in society with a particular focus on digital transformation. A key reform is a “modernised labor law” which is allowing for a more flexible labor market while at the same time offering new economic support to persons already in the labor force, employed as well as unemployed, for their education and training at an expected annual cost of SEK 11 billion when fully implemented in 2026. This economic support is not part of the RRP. Changes in the labor law have been a long-standing politically sensitive issue which was resolved after a breakthrough in negotiations between some of the major labor market organisations. The new labor law and scheme for study grants are still under preparation and draft legislation was presented in January 2022¹¹.

The investments under the RRP expand the capacity of study programs for secondary adult education, post-secondary vocational education and higher education, with higher education accounting for the largest share of the funding. It should be noted that the RRP-investments, while fairly large, still only make up a small part of the significant increase in the annual government expenditure for the three respective types of education for 2020-2024 compared with 2019.

Austria invests an amount similar to Sweden in vocational and continuous education in its RRP but nothing in higher education (except for support for the digitalisation of universities). Other education-related investments in Austria concern providing pupils in schools with digital end-user devices and special support for disadvantaged pupils to reduce inequalities in education.

Raising the employment rate has been identified as critical factor for improving the growth performance of the Finnish economy. For this purpose, a reform of labor market services is planned. A key element in the overall reform is overhauling the jobseeker service process to make it more individualised. This will require a significant increase in the number of staff at offices providing the labor market services, the costs of which are a large part of the funds to be used from the RRP. Special measures are devised to meet the needs of young people and persons with partial work ability as well as to address issues related to

mental health. Of the EUR 170m allocated to the reform EUR 40m are for the development of digital systems and solutions, half of which for a “world-class digital infrastructure to support the immigration of skilled labor”.

Developing digital solutions also play a central in among the measures for education and training. Of the EUR 107m spent on “upskilling and continuous learning”, EUR 46m goes to development of two nation-wide digital systems, one for all types of continuing education and the other for the higher education system. The two systems will be connected.

The different situations in labor markets explain the diverging orientations between the countries. However, the emphasis on continuous education and re-education, particularly in the Swedish RRP – signal the need for more far-reaching transformation in education systems – an area where we will return to in the section 4.2.

3.2.4. Health and social services

In several countries, the shock of COVID-19 revealed shortcomings and structural deficits of their health care systems. Therefore, the RRP also provide means for mobilising investments and reforms for responding to these issues and for improving societal resilience. Furthermore, aging societies have longer-term needs for improving the social and health sector – something which is especially visible in Finland.

In Finland, major reform in the delivery of health and social services is being implemented after having been on the political agenda for more than a decade. At the heart of this reform is a change in the responsibility for health and social services from the municipal level to 22 new “autonomous wellbeing services counties” which will assume statutory responsibility for regional health and social services as of 1 January 2023. This structural reform is expected to improve the access, quality and cost-effectiveness of health and social services. As a consequence of the COVID-19 pandemic, a large treatment, rehabilitation and service deficit has developed in the health and social services system. A new key task for the reform is to overcome this deficit. The largest portion of the RRP-funding will go to regional projects aimed at developing more effective service systems and processes, including preventive measures and early identification of problems. As much as 36 percent of the EUR 405m in investments will be devoted to the development and introduction of digital solutions.

The COVID-19 pandemic revealed serious weaknesses in the Swedish system for elderly care. High turn-over and insufficient competences among nursing care staff, although known before, became an overriding concern. To deal with this problem, the RRP includes a measure to provide funding to municipalities for offering staff in elderly care the opportunity to study while receiving full pay. The measure represents 14 percent of the total expenditures under the RRP, which means that altogether almost 30 percent of the expenditures in the Swedish RRP are devoted to education and training. An associated reform is to introduce “assistant nurse” as a protected professional title to secure the necessary competence level among assistant nurses and increase the attractiveness of their profession.

Health related measures represent a much smaller part of the RRP in Austria than in Finland and Sweden. The main investment objective is to drastically increase the number of primary health care centres. Previous plans to this effect were derailed by the COVID-19 pandemic. A different initiative is the establishment of the Austrian Institute of Precision Medicine.

The Finnish focus on transforming health and social care to follow principles of predictive care illustrates the potential of a broader societal understanding of “transformativeness”. However, the different orientations to health and social services between the countries also

indicate that the RRP preparation was strongly tied to policy continuities and proposals already on national policy agendas. This is especially apparent in areas not emphasised by the EC.

3.2.5. Other measures

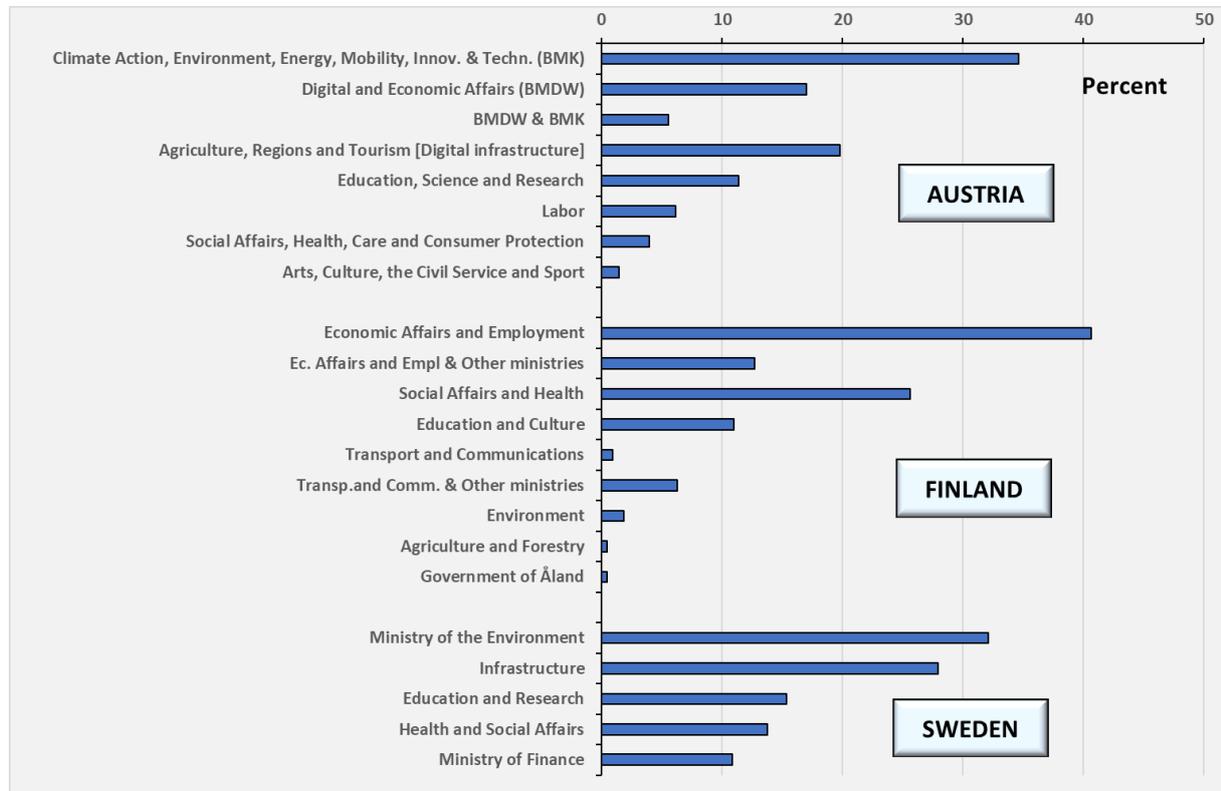
Several of the initiatives in the Finnish RRP do not naturally fall under any of the above main categories. Some concern investments in RDI infrastructure. Others support the recovery of certain sectors hit particularly hard by the COVID-19 pandemic, such as cultural, creative and tourism industries. Special support measures target growth and exports in SMEs. In Austria the culture sector receives special attention.

3.3. Comparing the division of responsibilities among ministries

As already discussed, the processes for developing the RRP differed greatly between the three countries. Here we will briefly compare the division of responsibilities between ministries in implementing the RRP. Figure 3 provides an overview for the three countries.

The dominating role for the Ministry of Economic Affairs and Employment in Finland is maybe the most striking observation. Including programs for which the implementation responsibilities are shared, the ministry is directly involved in more than half of the investments. In comparison, the Swedish Ministry of Enterprise and Innovation has no role in implementing the RRP. A principal reason for the difference is that investments in the fields of energy and environment are currently handled by the ministries for Infrastructure and Environment respectively. In Austria the Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology (BMK) has, as the name indicates, an extremely broad portfolio which covers most of the areas related to climate change. It is therefore not surprising that it is the single largest ministry in terms of responsibility for RRP investments. In contrast to climate change, the portfolio of policies for digital transformation is more fragmented in Austria.

Figure 3. The distribution of investments by the responsible ministries for the RRP in Austria, Finland and Sweden²



Source: Authors' elaboration based on National Recovery and Resilience Plans

4. Examining the policy integration between transformation and innovation through the RRFs

The purpose of the RRF is to facilitate and accelerate high priority societal transformations in the EU in conjunction with other public and private initiatives, with a special focus on the twin transition – climate transition and digital transformation. R&I activities are generally regarded as crucial for realising the twin transition and are among the six pillars targeted by the RRF (European Union, 2021_[14]). Section 3 shows that the three countries differ considerably in how and to what extent R&I-related measures are included in the national implementation plans. In this section we will probe possible reasons for these differences and explore whether the differences may reflect how policies for transformation and innovation intersect and support each other more generally. First, we summarise the R&I-content of the RRFs, including a comparison of the role played by innovation agencies in implementing the RRFs. Second, we place the R&I-content of the RRFs in the broader context of recent developments of government R&I-funding, in general, as well as climate-related R&I more specifically. Finally, we conclude with a discussion of how innovation policy can contribute more effectively to the national and global climate transitions.

4.1. How much R&I-related measures in the RRFs?

To determine the amount of R&I related measures in the RRFs we need to clarify what we mean by R&D-related measures, which is not straightforward. Without arriving at a conclusive definition, we compare the R&I-content in the RRFs, first, by looking at the nature of the investments and, second, by examining the extent to which the investments are channeled through R&I-funding agencies. Separately we compare measures in the area of skills and education and argue that these should be included in a broad concept of innovation policy.

4.1.1. How to delineate Research and Innovation related investments?

While there are at least in principle firm criteria (the Frascati manual, (OECD, 2015_[60])) for what constitutes R&D, there is no clear definition of the “I” component in R&I-related investments. Testing, demonstration and upscaling of new technologies or solutions are probably today counted as innovation-related investments but there may be good reasons for extending the term even further in the context of transitions. Regarding technology diffusion from the perspective of transformative innovation policy, for example, the novelty of the technology is less important than its ability to achieve environmental and/or social improvements. For instance, the diffusion of public transport is likely to be more important for transformation than of autonomous vehicles. Yet, the general advancement of public transport is not typically regarded as R&I policy, while social innovations advancing it might be.

Further, the extent to which a particular technology or solution is universally applicable to different uses and locations varies greatly. In many cases, a well-functioning practical “solution” will require the integration of different technologies, software and organisational designs into a complex system adjusted to the specific conditions for which the solution is being developed. Much of what is today referred to as “innovation” constitutes such system integration rather than the development of “elemental technologies”. Whether such software and systems development are categorised as R&D or not probably varies a lot.

More generally, one can argue that there is a need for more differentiated characterisation of investments other than those which can be strictly defined as R&D in terms of “innovativeness” and the risks involved. This is particularly relevant in light of the increasing focus on risk- and cost-sharing between public and private financing in efforts to address climate change but maybe also for when addressing other societal challenges. EU-regulations for state aid does distinguish between different types of investments but the conceptual and empirical basis for this differentiation may benefit from further work.

4.1.2. Finland stands out as having a much larger component of R&I

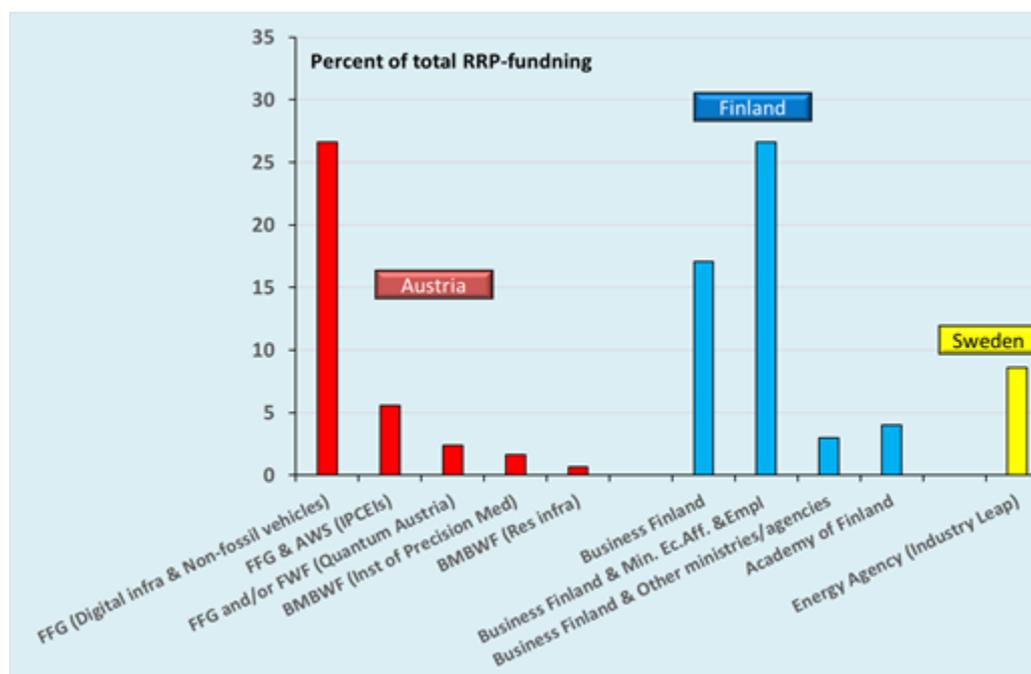
First, funding allocation reveals national differences in RRP focuses. Broadly speaking, Austria and Sweden have much smaller R&I components in their RRP than Finland. In Austria, R&I-related measures concern the country’s participation in two Important Projects of Common European Interest (IPCEI Hydrogen and IPCEI Microelectronics and Connectivity), two research initiatives (Quantum Austria and Austrian Institute of Precision Medicine) and investments in digital research infrastructure. Altogether these investments amount to EUR 265m – or 7.6 percent of all the investments in the Austrian RRP. For Sweden, the only clearly R&I-related measure is the Industrial Leap program that aims to promote decarbonisation of industry. Investments under this program to be covered by the RRP amount to EUR 282m – or 8.6 percent of total investments in the Swedish RRP. In the Finnish RRP, 70 percent of the funding in the green transition pillar alone can be seen to contain an intention to expand and mainstream potentially transformative innovations (see Kivimaa et al 2022).

Because of a more complex structure, it is more difficult to say exactly which parts of the Finnish RRP are R&I-related. The part labelled “RDI, research infrastructure and piloting” with a budget of EUR 267m – representing 12.7 percent of the total RRP – clearly falls in this category. In addition, many of the projects that appear under “Energy system transition” and “Industry renewal and investments supporting the green and digital transition” have innovation ambitions that go beyond investments in established technologies. The same can be said for at least some of the investments in new cross-sectoral information systems, which appear in several parts of the Finnish RRP, including “data economy”, “labor market reform” and “social and health care reform”. Similar projects are hard to find in the Austrian and Swedish RRP, although some of the projects funded through “Climate Leap” in Sweden and through the program for “Transformation of industry towards climate neutrality” in Austria might be considered as investments in technologies which are not yet in general use.¹² This part in the Austrian RRP is, however, small compared to the total volume. In conclusion, our analysis finds that R&I-related activities make up a significantly smaller share of the RRP in Austria and Sweden than in Finland.

4.1.3. Comparing the involvement of R&I-agencies in RRP implementation

Second, we examine the role played by innovation agencies in the implementation of the RRP. In Austria, more than a quarter of the RRP investments are channeled through the country’s principal funder of R&I projects, the Austrian Research Promotion Agency (FFG). However, almost all of the funding goes to digital infrastructure and subsidies for purchase of non-fossil vehicles. Only a small part is for other R&I-related measures and these the FFG implements together with other agencies.

Figure 4. RRP-funding through R&I-agencies and directly to research from BMBWF (for Business Finland partly shared with ministry)



Note: BMBWF - Federal Ministry of Education, Science and Research of Austria, FWF – Austrian Science Fund

Source: Authors' elaboration based on National Recovery and Resilience Plans

In Finland, Business Finland is a principal implementing agency for a wide portfolio of measures. In some cases, it shares the responsibility with the Ministry of Economic Affairs and Employment and in a few cases also with other ministries or agencies.¹³ Probably more than a quarter of the investments in the Finnish RRP are administered by Business Finland. Furthermore, four percent of Finnish RRP investments go through the research council, Academy of Finland. In summary, R&I-related investments account for well over 20 percent and possibly even more than 30 percent of the Finnish RRP.

In Sweden, all R&D-related investments in the RRP are channeled through the Energy Agency, which administers the Industrial Leap program. The program makes up around nine percent of the Swedish RRP. As mentioned in Chapter 3, the original version of the Swedish RRP included investments in research related to digitalisation but these were later deleted. These investments would have represented seven percent of the total RRP and were included in the R&I-bill presented in December 2020.

4.1.4. Education and skills a part of transformative innovation policy?

Third, education and skills can be viewed as important determinants of a country's capacity for R&I and for societal transformations. One might even argue that this is the area in which the innovation and transition policy realms most explicitly overlap, given the importance of deep learning processes in transformative change (van Mierlo and Beers, 2020^[61]) and transformative innovation policy (Ghosh et al., 2021^[62]). In the RRP, there is a close connection between education and development of skills, on the one hand, and the functioning of the labor market, on the other. Therefore, the measures aimed at strengthening education and skills development—both through financial support and reforms—play an important role besides the direct investments to R&I activities.

Of the three countries, Sweden puts the strongest emphasis on skills, education and labor market reform in its RRP, with the new labor law being arguably “transformational”. Including paid training of staff in elderly care, nearly 30 percent of in total investments in the Swedish RRP goes to education and skills. In addition, the broader governance reform includes, for example, an annual EUR 1 billion funding for a new grant system for people in the labor force to take time off to study. While this system is not limited to skills required for climate and digital transitions, the system is expected to play a key role in the development of such skills.

In Finland, the focus is on labor market reform but in a different sense than in Sweden. The primary goal is to increase the employment rate through a reform in labor market services which is associated with considerable expenditures. In Austria, labor market issues are less prominent and equality in education more central.

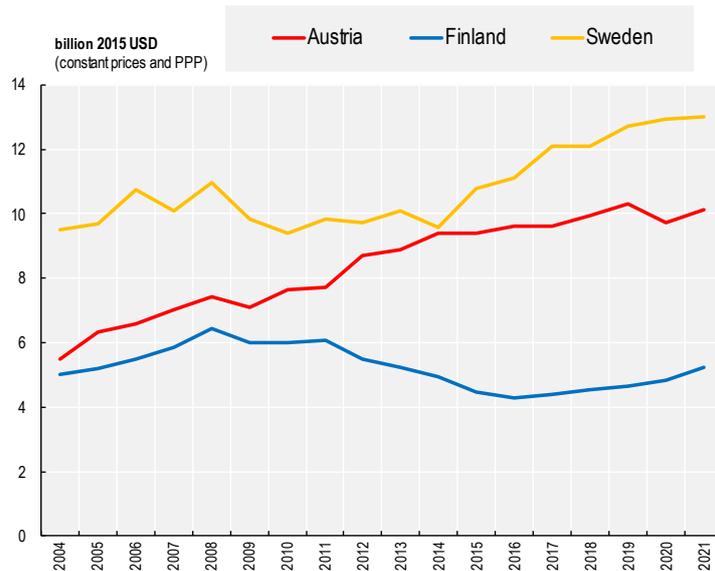
4.2. How representative are the RRP of the relation between policies for innovation and transition?

Judging from the distribution of investments of the RRP and their implementation, it would seem that innovation policy and policies for climate change mitigation and digital transitions are more integrated in Finland than in both Austria and Sweden. Is this impression a proper reflection of the actual state of affairs, if we look at the policy landscape more broadly in the three countries? A comprehensive analysis of interlinkages of R&I policy and policies for zero-carbon and digitalisation transitions in each country is beyond the scope of this paper but we present some preliminary observations focusing on the zero-carbon transition and leaving out the digital transformation. We will briefly examine the way and extent to which the contribution to zero-carbon transition is an objective of R&I policy and inversely the role of R&I-related measures in zero-carbon transition policies. As we believe that the geographical dimension needs to be made explicit in any discussion of the relation between R&I and zero-carbon transition policies, we devote a special section to this issue. As a background we present some data on the dynamics of R&D investments complementing those already shown in Chapter 2.

4.2.1. Patterns of R&D spending dynamics differ greatly

R&I policies have developed in quite different ways in the three countries. In Chapter 2, we showed that the dynamics of R&D in the business sector have followed rather different patterns in the three country contexts. It is worth looking closer at these differences. In 2004, business sector expenditure on R&D (BERD) represented 2.5 and 2.3 percent of GDP in Sweden and Finland, versus 1.5 percent in Austria. In the following decade, BERD stagnated in Sweden but grew continuously in Austria to the effect that Austria caught up with Sweden in 2014 (Figure 4). An opposite development to that in Austria occurred in Finland where BERD declined after the financial crises and until around 2016 after which there has been a modest increase. Since 2015, Sweden distinguishes itself from the other two countries with a very strong growth in BERD with the vehicle industry as the foremost driver.

Figure 5. Expenditure for R&D performed in the business sector (BERD), 2004-2021

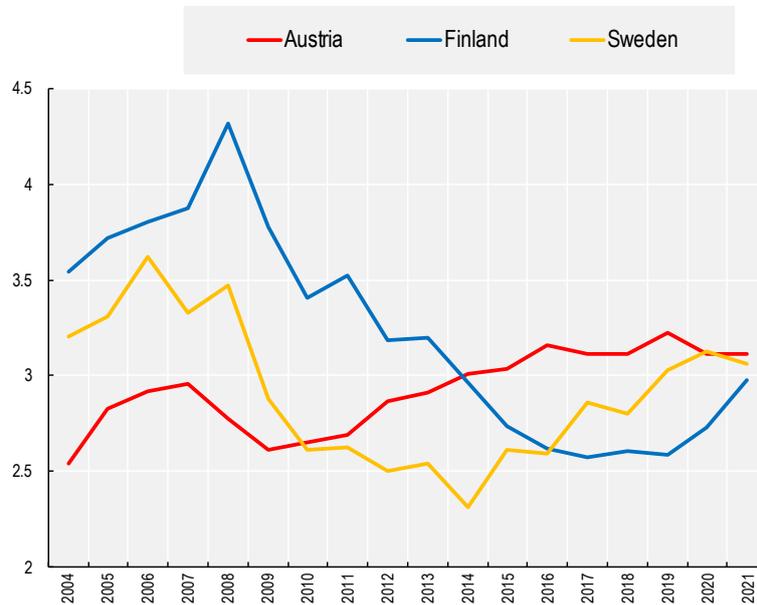


Source: OECD Main Science and Technology Indicators, https://stats.oecd.org/Index.aspx?DataSetCode=MSTI_PUB#, extracted March 2022

During the same time span, R&D in the higher education sector has grown in all three countries. In Austria, R&D-expenditure in the sector was 47 percent higher in real terms in 2020 than in 2004. The corresponding increase was 40 percent in Sweden and 25 percent in Finland. The combined effect of the developments in the business sector and the higher education sector result in large changes in the relative weight of R&D in the two sectors (Table 2). Today the ratio between R&D expenditure in the two sectors is about the same in Austria and Sweden while the balance tilts somewhat more towards the higher education sector in Finland. While in Austria and Sweden the balance today is not so different from that 15 years ago, in Finland the relative weight of the higher education sector compared to the business sector has greatly increased. This is the combined effect of reduced R&D in the business sector and a prioritisation of the higher education sector in government R&D spending.

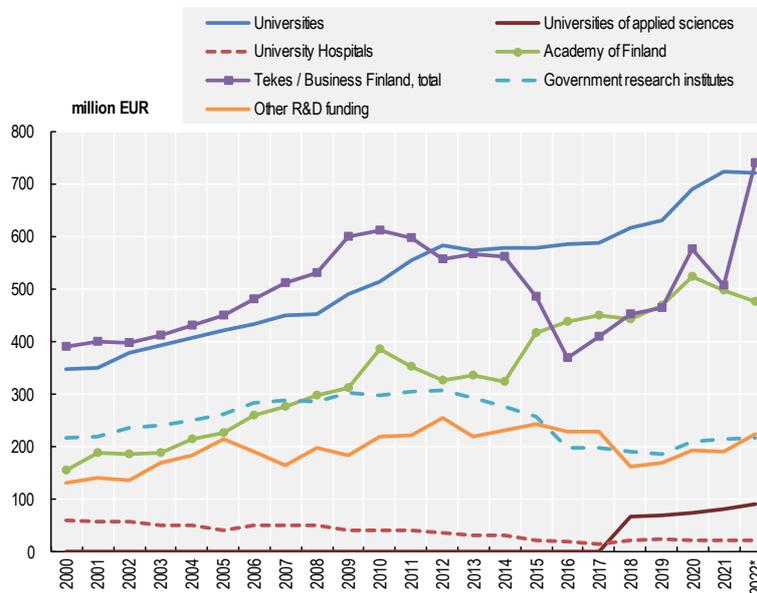
On a per capita basis R&D expenditure in the business sector is around one third higher in Sweden than in Austria or Finland. This may at least partly explain why policy focuses more on increasing R&D expenditure in the business sector in Austria and especially Finland than in Sweden.

Figure 6. Ratio between expenditure for R&D performed in Business sector and in Higher Education sector, 2004-2021



Source: OECD Main Science and Technology Indicators, https://stats.oecd.org/Index.aspx?DataSetCode=MSTI_PUB#, extracted March 2022

Figure 7. Government R&D funding in Finland by organisation 2000-2022



Note: R&D funding at current prices. Prior to 2017, funding of universities of applied sciences was included in “Other R&D funding”. Data for 2022 may become revised based on supplementary budgets.

Source: Statistics Finland: Data downloaded from website: https://pxweb2.stat.fi/PXWeb/pxweb/en/StatFin/StatFin_tkker/statfin_tkker_pxt_11ba.px, extracted March 2022

In Finland, there was a large innovation policy shift after the decline of Nokia, away from supporting large companies towards promoting renewal of industry through start-up companies and SMEs. More recently there has been some rebalancing towards support for large companies with the leading company scheme, a major instrument for incentivising large companies to increase their R&D investments in Finland. As mentioned above, some of the most recent grants to leading companies are financed by the RRP. Finland has also experienced changes in the governance of innovation policy, by merging innovation-focused TEKES with export-focused Finpro to form Business Finland at the start of 2018. This change implicated a shift towards more specific business, growth and export thinking perhaps at the expense of broader innovation policy development.

The shifts in Finnish R&I policy are reflected in the great volatility in the pattern of public financing of R&D to an extent not seen in Austria or Sweden (Figure 5). Especially Business Finland (and its predecessor Tekes) has seen roller-coaster-like changes in its budget. In 2020, the budget increased sharply due to domestically financed countermeasures to the pandemic while in 2021 and 2022 the RRP has been the source of increased funding. The injection of RRP-funding has been geared towards zero-carbon transition. A large part has been on innovation-related activities other than R&D so only part of the increase appears in Figure 5. In December 2021, all political parties in the Finnish parliament agreed to set the goal of increasing R&D expenditure in Finland from 2.7 percent in 2020 to four percent in 2030 with both the government and the business sector expected to contribute to the increase (State Treasury Republic of Finland, 2022^[63]).

In Austria, R&D tax credits have been seen as a key instrument to help increase business sector R&D and thus of the Austrian R&I policy more generally. In 2019 the R&D tax credit amounted to around EUR 841m or around 10 percent of total business R&D expenditure. In the same year, project-based government funding of business sector R&D was EUR 321m. According to the budget plans published by the Ministry of finance in Austria, funding for the period 2021-2024 governmental expenditure for R&D is planned to increase by a combined total of EUR 3.1 billion compared with the level 2020. Of this increase, only 13 percent will be under the budget headings which provide funding for industry-led projects. Of the total increase, the RRP will contribute a modest EUR 266m during the years 2022-2024 (and an additional EUR 104m in 2025). Budget projections are often highly uncertain and whether the increase in R&D expenditure in the budget plans in Austria for 2023-2024 will materialise remains to be seen.

In Sweden, the four-year budgets included in the R&I-bills are usually adhered to with only minor changes in the annual budgets. The R&D bill for 2021-2024 projects a combined total increase in government R&D expenditure of SEK 13.6 billion (EUR 1.3 billion) for the period compared with the level in 2020. The Industrial Leap is not included. This is less than half of the increase planned over the same period in Austria but still a sizeable increase. As already mentioned, no part of the initiatives in the R&D bill are included in the Swedish RRP. The Industry Leap program in the RRP amounts to around EUR 250m for the period 2021-2024, which corresponds around 19 percent of the increase in government R&I-expenditure projected in the R&D bill.

An interesting comparison can be made between the three countries' innovation or innovation-funding agencies and their development. Sweden's innovation agency, Vinnova, has gradually broadened its mandate to promote innovation to include system transformation, challenge-driven innovation and innovation in the public sector. At the same time, Formas (the Swedish Research Council for Sustainable Development) has gradually shifted from primarily funding academic research to also providing funding for innovation projects to academia, industry and the public sector. Innovation in the energy sector is somewhat separated from innovation policy with funding primarily channeled

through the Swedish Energy Agency. In Finland, public innovation support has shifted away from strategic investments in certain industrial sectors or technologies and more towards supporting firm innovation and export orientation (partially as a result of the merger of Tekes with the export and investment promotion agencies). Austria's FFG has perhaps remained the most constant in terms of its profile and mandate though its budget has increased considerably (and considerably more than for Vinnova and former Tekes) in line with the sustained increase in government R&D funding. Recently it has begun to shift from primarily funding R&D and innovation projects to addressing societal challenges (part. environmental sustainability) and system transformation. The Climate and Energy Fund (KLIEN) is an important instrument to put this strategic shift into practice.

Summing up, business sector R&D (and innovation governance?) have developed very differently in the three countries, with Sweden showing the most positive development in recent years. Consequently, increasing business sector R&D is a much more central objective or concern of government R&I policy in Austria and especially in Finland than in Sweden. While government R&D expenditure has increased fairly steadily in Austria and Sweden, both the level and structure of such expenditure have been rather volatile in Finland with the RRP playing a potentially important role for the recent recovery of funding allocated to Business Finland.

4.2.2. Increasing prioritisation of climate change mitigation in the RRP and innovation policy

The Austrian RRP contained little in terms of R&D investments for the zero-carbon transition. Hydrogen IPCEI and the program “The transformation of industry towards climate neutrality” are the main measures in this category. A look at the programs at the FFG reveals a much broader policy portfolio, much of which of recent date.

In Austria, the main instrument for the government to influence the orientation of innovation-related funding is through directives given to the FFG to fund R&I for certain themes. This is done through multi-year programs agreed between FFG and ministries. The most recent program (FFG 2021) is for 2022-2023. The combination of the pandemic and the restructuring of ministries when the new government was formed in early 2020 led to a major overhaul in the ministerial directives to FFG, especially by prioritising climate and environment, and working out the details of a new multi-year program was delayed. Extra funding for climate-relevant R&D was provided already in 2020 mainly as part of an economic package in response to the pandemic. This extra funding of climate-relevant R&D was made permanent at the level of EUR 100m per year for the whole period 2022-2025. FFG reports that in 2021 46 percent (EUR 337m) of the expenditure in all its funded projects was in “climate-relevant” projects, up from 38 percent in 2020. The 2022-23 program contains quite a comprehensive list of climate and environment related themes including topics related to the circular economy. Significant parts of the climate- and energy-related R&I funding stems from KLIEN, with FFG being in charge of their financial implementation.

In Sweden, “directed” government investments in R&I of relevance for mitigation of climate change is primarily be channeled through Sweden's Innovation Agency (Vinnova), the Energy Agency or the Research Council Formas. Of their many programs only the Industry Leap program managed by the Energy Agency is included in the Swedish RRP.¹⁴ The fact that this program was selected may be explained by it being a fairly large program with a big increase in its budget in 2021 compared to 2020 and thus simple to administrate as a component of the RRP. Many other existing and new programs managed by the three mentioned agencies wholly or partly aim to mitigate climate change but each one is much smaller than the Industry Leap.

In the Swedish government R&I-bill for 2021-24, Climate and environment is one of five prioritised societal challenges. Ear-marked climate-related new initiatives in the R&I-bill are primarily a number of new or expanded research programs administered by Formas representing around 10 percent of the total increase in funding in the R&I-bill. An important message in the R&I-bill was an instruction to Vinnova, Formas and the Energy Agency to start the development of a new generation of Strategic Innovation Programs (SIPs) as the first generation of 17 SIPs are reaching the end of their 12 year running periods. The instructions for the new generation of SIPs (and the remaining life of the current programs) states that the objective of the development shall be “that new and existing programs more clearly shall contribute to transformative change and sustainable development, as a basis for global competitiveness and societal benefits. [...] The programs shall contribute to systemic change in order to achieve societal impact, with a clearer focus on for example a fossil free society, non-toxic circular economy and digital transformation which supports climate transition as well increased knowledge and strategic initiatives for enhanced international collaboration both within the EU and globally.” The instructions also asks that the “interplay between technological development and policy and regulatory development” shall be considered with the framework of the SIPs. Development in accordance with the instructions has started. The SIPs, currently with an annual contribution from the government of around EUR 50m, is the foremost broad Swedish innovation program and jointly managed by the three agencies.

As evident from the analysis above a fairly large part of the Finnish RRP is R&I-related investments, most of which directly aimed at supporting the zero-carbon transition. Like in Sweden, there are surely many other existing R&I-programs managed by Business Finland and Academy of Finland which partly or wholly contribute to mitigation of climate change. In addition, since its set-up in 2015, the Strategic Research Council of Finland has funded research consortia linking to the zero-carbon transition. The latest theme launched is the just green transition.

Detailed analysis of the budgets of the major R&I-funding organisations and themes would be needed in order to obtain an accurate picture of the total government climate-related R&I-investments in the three countries and their development over time. In the case of the three countries studied, the RRP constitutes a tiny piece of this picture and studying it in isolation risks leading to misleading conclusions.

Overall, one of the limitations of our analysis is that we focus on the RRP and their relationship to research and innovation policies. However, a more complete understanding of the transformative contribution and thrust of the RRP in their national contexts would require a more in-depth examination how they relate to and complement other sectoral policies with transformative ambitions (for example climate and environmental policies).

5. Findings and conclusions

Since the outbreak of COVID-19, European countries as well as the European Commission have raised considerable funds to overcome the social and economic effects of the pandemic, and simultaneously speed up transformation towards a greener and more digital economy. At the European level, the Recovery and Resilience Facility (RRF) is the main instrument to achieve these goals. The sheer amount of funding distributed by the RRF – EUR 723.8 billion within a five-year period – makes it one of the largest transformational policy initiatives world-wide and in a historical perspective. While the absolute size of the RRF is impressive, the funds allocated to the three countries analysed here account for a very small share both of the total RRF and of the respective countries' GDP.

In this report, we analysed the RRFs in the national contexts of Austria, Finland and Sweden. In particular, we sought to shed light on the link between the RRF – as an example of a program with a high transformative ambition – and national R&I policies. We have focused on the “twin” – digital and zero-carbon – transition as a main goal of the RRF and investigated how steps toward this goal have been implemented in Austria, Finland, and Sweden. We find that the plans differ considerably in terms of focus, instruments and spending types despite following common guidelines by the EU. Furthermore, there have been significant differences in the processes on developing and implementing the plans. Regarding the content of the plans, for example, Austria and Sweden respectively invest 20 and 14 percent of their RRFs in broadband infrastructure while the corresponding figure for Finland is only 2.4 percent.¹⁵ On the other hand, Finland's investments in energy infrastructure and emerging energy technologies have little counterpart in the other two countries. Austria invests three times as much of its RRF in railways than either Finland or Sweden. Sweden puts an especially strong focus on education, in particular for staff in elderly care and on legislative changes to promote life-long learning. Some of these differences can be explained by country-specific challenges but also by path dependence and lock-ins of national policy.

We identified several factors that explain the significant differences between the national RRFs. The first relates to the respective countries' points of departure, regarding the level of development – e.g., the degree of digitalisation or green transformation in industry – but also national priorities. This is illustrated by the fact that the national RRFs are firmly rooted in existing strategies and policies.

Secondly, RRFs do not exist in isolation, but complement existing policies in the respective countries, as well as the existing COVID-19-related measures taken by governments. This means that the RRFs need to be understood against the much wider strategic policy context, with regard to which they fulfil specific roles, such as patching certain gaps in the current portfolio of measures aiming to achieve specific transformations. In Sweden, for instance, the transformative role that the RRF can play needs to be seen in conjunction with the long-standing policy strategy of turning Sweden into a sustainable economy with very ambitious targets, and for which already several important initiatives have been set in motion over the past years. The comparatively limited level of transformative ambition of the Swedish RRF needs to be seen against the backdrop of an already existing transformative policy portfolio and context but also other factors preventing Sweden from fully seizing the opportunity presented by the RRF. Similarly, in Finland there is a need to catch up again in terms of R&D expenditures to consolidate a transformation-oriented policy portfolio, which may explain why research- and innovation-related elements play a comparatively important role in the Finnish RRF. And the Austrian emphasis on certain infrastructure investments (e.g.

broadband) is known as – finally – addressing a major gap in the overall digitalisation policy, but which could not be financed so far. Thus, differences in existing policy directions play a critical role in explaining the differences between the RRP.

Thirdly, domestic political and governance contexts play a role in the ability and willingness of countries to seize the opportunities presented by the RRP. Finland and Austria had new governments in place in early 2020 with the strong motivation to utilise the RRF to implement new policy measures, while the ability of the Swedish government to present new initiatives was hampered by the fact that it consisted of a coalition which was forged based on a detailed joint agreement or political program between several parties, the ‘januariöverenskommelsen’ from January 2019. This central policy document defined and significantly restricted the political space for new policy initiatives. In contrast, for Austria and Finland, the political programs were more open-ended, leaving room for new initiatives. Furthermore, the traditional of horizontal policymaking across ministries can be seen in the Finnish RRP process.

Fourth, and somewhat related to the first three factors, specific factors created more of a sense of urgency or inclination to seize the opportunity presented by the RRP in Finland than perhaps in the other two countries. After more than a decade of slow economic growth, budgetary austerity and stagnating R&D expenditures, Finland welcomed the financial injection offered by the RRP. In a somewhat similar vein, the RRP aligned with a long-standing party-transcending objective, both in Finland and Austria, to raise R&D expenditure. In contrast, this sense of urgency or appreciation of the RRP seems to have been rather absent in the Swedish case.

Countries’ views of the RRF specifically, but also of the EU more generally, provide a fifth explanation for the differences in approaches to the RRP. Sweden was one of the critics of the RRF, viewing it as excessive or irresponsible fiscal spending. In general, the Swedish population also seems to have less faith in the EU and in EU policies than Austria or Finland. In a Eurobarometer survey carried out in August 2021 (Eurobarometer, 2021^[64]), Sweden was the country with the lowest share of the population that believed the Next Generation EU projects would help its country “overcome the economic and social damage brought about by the coronavirus pandemic”, nor that it would help Sweden “be better prepared for future challenges”. Sweden’s ability to engage in and influence EU decision-making is encumbered by the fact that it has relatively small ministries, while its strong government agencies tend to have clearly delineated areas of responsibility that fall squarely within the policy areas of the ministries they report to. An apparent consequence is that, compared to other countries, it seems to lack resources and mechanisms to be a powerful and consistent voice or actor in strategic decision-making processes.

Finally, timing with regard to national policy-making frameworks or processes may play a role in explaining how the RRP fit into national policy contexts. This is perhaps particularly important in the case of Sweden which, in contrast to Austria and Finland, has four-year research and innovation bills, rather than annual budgets. Even more important are governance processes, and the extent to which they facilitate or hinder coordination and harmonisation across different policy fields. This collaborative culture seems to be quite well developed in Finland, where inputs from different ministries to the definition of the RRP were brought together and integrated in a seemingly coherent manner, whereas in Austria most ministries were consulted, but the level of integration and coherence seems to be more limited, partly as a result of time pressure in preparing the RRP. In Sweden, the degree to which the Ministry of Finance consulted other ministries, not to mention agencies under other ministries, appears to have been rather limited.

An overall finding is that there is a clear link between the RRP plans and central policy documents in the three countries. This confirms the observation by (Geels, Pereira and

Pinkse, 2022^[65]) that green recovery responses to the pandemic are dependent and deeply shaped by contextual conditions and path-dependencies. These preconditions impact how the transformative opportunities presented by crises can be harnessed.

While national contexts and conditions are important, perhaps even decisive, in understanding respective countries' RRFs, it is important to note that these contexts are not static. Thus, Sweden, has recently sought to increase its engagement in and influence on EU decision-making processes (Regeringskansliet, 2022^[66]). The Finnish parliament reached a historic agreement in December 2021 to set an ambitious target for R&D spending. Austrian R&I policy is currently shifting from a dominant focus on increasing R&D expenditure to more directionality and orientation towards missions, societal challenges (particularly climate change and mobility), and transformation.

The RRF has been launched as an initiative with a strong transformative ambition, and there are specific structural characteristics in the RRF aimed at strengthening transformation. First, the European Commission carefully monitored the design of the national plans by providing reviews and consultations. Second, the investments of the national RRFs have been connected to structural 'reforms' in the national contexts aimed at securing the longer-term impact of the funding. And third, the RRF introduced a new, more binding character by tying investments and reforms to national milestones to ensure full commitment over their implementation timeline. These milestones should be seen as an opportunity because they can fulfil a self-binding function for national strategies and thus help avoid diluting them, even when national governments change. In this sense, the RRFs as financial instruments induced by the EC become a quite powerful instrument of multi-level governance to ensure the longer-term commitment to structural reform efforts.

When examining the RRFs, we see a clear common focus on physical investments in all three countries. Investments in intangible assets such as skills, new institutions or strategies are present in all countries, but are significantly smaller. This indicates that governments are good at making a case for increasing spending rather quickly but often lack the capacity for realigning policies and mindset towards transformation and for engaging in and promoting continuous and iterative 'deep learning', which is also seen as a prerequisite for sustainable transitions. From a transformative viewpoint one may criticise that systemic change requires a different intervention logic than subsidies for investments: more pro-activity, and a stronger interaction and coordination between public agencies and the recipients of funding measures, and between different policy areas. Such a level of pro-activity, inclusiveness and coordination, however, is difficult to implement in a large and centrally administered program such as the European RRF. In this perspective, the RRF faces similar challenges as Horizon 2020 or Horizon Europe. There is also a clear trade-off in the RRF between the speed of preparation and the long-term transformative intent of the program. From a transformative viewpoint, one may also criticise that there are no dedicated measures to bring new actors into climate policies or to build new networks between actors. The RRFs in all three countries were largely a result of interactions between different ministries and different departments within these ministries. For future initiatives, we recommend strengthening such pro-active components in the program even if this requires longer for preparations and a greater administrative effort. Yet, it is understandable that for Covid-19 recovery speed was essential in setting up the RRF, and despite this urgency the European Commission and the member states managed to set rather ambitious objectives that also support the green and digital transitions.

Another noteworthy feature regarding transformation is that some components of the RRFs consist of programs or initiatives that had already been launched or decided upon at national level prior to the RRFs. This phenomenon could have several implications with regard to transformativeness. One could argue that the transformative impact of the RRFs – at least

in some countries – is rather limited since, to varying degrees, it funds things that would have happened anyway. Alternatively, the RRFs might serve to free up national funds for other projects that wouldn't have happened without them, though we can't say anything about the nature of such alternative projects. However, in other cases, the RRFs provided additional funding necessary to fully roll-out transition initiatives, such as shifting from oil-based heating of homes to other sources in Finland.

An interesting finding from our analysis is that science and innovation plays a relatively small role in the RRFs of all three countries and most investments go into existing technologies. Again, this may be a result of the time constraints in preparing national plans; however, it also points to the complicated relationship between R&I policy and transformation. It may also relate to which organisations in the different member states have been allocated implementation responsibilities. For example, in Finland R&I organisations were the main distributors of funding, whereas in Sweden Vinnova was not included. While both researchers and policymakers increasingly argue that R&I policy should be and is an important component of transformation, this link is not clearly observable in many fields. Thus our analysis indicates that the role of R&I policy (and its limitations) in driving or contributing to transformation still needs to be clarified. In particular, the RRF clearly illustrates that R&I policy is not in the driving seat when it comes to transformation. An alternative conclusion might be that the RRF is not an obvious example of transformative policy. Moreover, destabilising technological regimes (Kivimaa and Kern, 2016^[8]) plays hardly a role in the RRFs.

One factor which might explain the relatively weak link between the RRFs and R&I policy might be summarised as “administrative expediency”. Large well-defined programs would tend to be more attractive than small “explorative” programs breaking new and uncertain ground. This means that much of what would be counted as programs supporting research and innovation would find it hard to compete for attention. This may partly explain why research and innovation programs managed by FFG in Austria and Vinnova in Sweden were not included.¹⁶ The R&I-programs that were included in the three countries' RRFs tended to be large and well-defined ones, although not exclusively. Especially the Finnish RRF includes several newly created R&I-related initiatives with fairly limited budgets such as the Academy of Finland's new program for research on twin transitions and several projects to develop cross-sectoral digital platforms. More aligned with administrative expediency are the IPCEIs (Finland and Austria), the Quantum Austria Program and the Business Finland “leading company funding” scheme. The Swedish Energy Agency's Industrial Leap program is a large program although the size of the projects funded under program varies over a broad range from EUR 20,000 to EUR 45m.

Fixed capital investments make up a much larger part of the RRFs than investments in R&D in all three countries. Some parts of the former are in pilot, demonstration and scaling-up equipment and facilities and might arguably be characterised as innovation-related investments. Most of the investments under the IPCEIs and Swedish Industry Leap fall in this category as well as some of the Finnish energy-related investments and the Swedish Climate Leap. It is not possible to determine what part of the investments should be regarded as transformative. Here the key question is whether these investments will reinforce existing non-sustainable pathways or whether they are geared towards making things differently and more sustainably. This is a challenging question of assessing the (non-) transformative nature of investments.

Would the investments included in the RRFs have been undertaken even without the RRF? It is impossible to answer this question with certainty, but the indications are strong that the investments in the Austrian and Swedish RRFs were not dependent on obtaining funding through the RRF. The Finnish RRF represents a kind of ‘policy patching’ (Kern,

Kivimaa and Martiskainen, 2017^[67]), as the RRP complements other government policies and the budget and some of the funding instruments create added value (Kivimaa, Lukkarinen and Lazarevic, 2022^[53]).

Should a larger portion of the RRP investments have been devoted to research and innovation? It is useful to break up this question into three. Should other ongoing or planned R&I-initiatives have been included? Should some of the ongoing or planned R&I-initiatives have been scaled up and included? Should new R&I-initiatives have been created as part of the RRP planning process? Research and innovation are highly complex and long-term activities that benefit from reasonably stable conditions for their planning and implementation. At the same time the RRP was an opportunity to demonstrate the importance of engaging research and innovation in policies for societal transformation. This opportunity was definitely more fully utilised in Finland than in Austria and Sweden. Perhaps even more importantly, they presented an opportunity to launch bold, more experimental and perhaps more high-risk initiatives – all of which are essential elements of a more transformational policy – than national contexts and budgets might otherwise allow for.

A relevant question for further research is what factors might explain why the relationship between R&I policy and systemic change or transformation is not unproblematic or obvious. One explanation might be that R&I policy focuses on supporting change or development in general or generically, without necessarily considering particular dynamics, path dependencies or timeframes which characterise different policy areas. R&I policy might also be argued to both benefit and suffer from the fact that – in contrast to sectoral policies – it has no responsibility or time commitment to achieve specific outcomes. Whereas sectoral policies often have targets against they can be measured – e.g., lower emissions, better healthcare, better education – research and innovation policies tend to embrace and promote bottom-up experimentation, technology neutrality and market dynamics (niches, serendipity, creative destruction, scaling of successful solutions). In other words, sectoral policies and the strategies of other, non-governmental actors, represent the “missing link” between R&I policy and systemic transformation. A further explanation for why R&I policy is limited in its ability to contribute to or drive transformation lies in the fact that it tends to view and frame transformation within the rather narrow framework of the instruments that are at its disposal, such as funding research and innovation projects, promoting commercialisation, and promoting networking or clustering.

Finally, the RRP has a strong focus on the national dimension of transformation, as opposed to the international or regional/local dimension. However, the transformations that they seek to promote cannot be confined to the respective countries’ national territories if they are to ensure environmental, social and economic sustainability. Rather they require cooperation, pooling of resources, sourcing of knowledge and scaling of solutions that transcend national borders. Although the RRP is triggered at EU-level, they are in the very end national action plans, with little connection or synergies between the individual national plans.

RRPs can be regarded as an example of a new kind of multi-level policy approach that connects bottom-up national plans and top-down EU funding, but tied to clear requirements regarding design, implementation and – very important – structural reforms at national level. Whether or not the funding is used in a strategic and coherent way in order to target transformative change, however, is largely left to member states’ current strategies and priorities. It will be interesting to monitor how effective and reliable the implementation will be over the coming years, or whether the initially defined rules will be diluted.

As we have pointed out earlier, our analysis has focused on the content of the RRP's and their link to national research and innovation policies. A more comprehensive approach of analysing the RRP's as embedded in a policy mix of R&I as well as sectoral policies in order to better understand their role for transformation is an issue for further research.

6. Beyond RRP: What implications do they raise for a transformational innovation policy?

RRPs are a rather special instrument, but the first experiences with them suggest that they could be a promising instrument for fostering transformative change in Europe. They show how directionality of policies across member states can be fostered through an intelligent interplay of national and EU-level policies. This does not deny that there is room for improvement, but they show how large-volume public resources can be mobilised for purposes of systemic transformation, and thereby point also to the potential as well as the limitations of R&I policy in such a context.

Based on our findings from the analysis, we present a few suggestions of how R&I policy might be designed, implemented and communicated to better comply with the transformation imperatives our societies face in a number of areas. These lessons build mainly on the analysis of the RRP but also reach beyond them to reflections on the last decade of developments in the studied countries. Rather than serving as answers to the question “what transformational innovation policy is”, these are framed as conversation points to move forward regarding possible key development areas in society. Overall, our understanding of transformational innovation policy is rooted to process of adapting to shifting societal demands rather than defined institutional structures.

- R&I policy policies have played a rather isolated role in the concert of policy fields in the past. This was because they were understood for a long time as ensuring knowledge production for society at large (but often without specific focus) and – as far as the innovation part is concerned – fostering economic growth and competitiveness. With the emergence of societal challenges as guiding concerns of public policy, this isolated/autonomous role can no longer be sustained. Rather, R&I policy needs to connect much better with other policy fields, both by giving new impulses and by aligning with sectoral policy ambitions. Some RRP have been quite successful attempts of doing this, but the extent to which this has been achieved varies across countries

To become more effective in supporting societal transformations, R&I policy needs to move out of its niche and better connect with other policy fields, both to give new impulses and align with sectoral and overarching political ambitions.

- R&I policy could play an important role in linking transitions, which need to interact in a mutually beneficial way, but which tend to be separated by the respective policy silos. The most prominent example is the linking of the digital and green transitions. Therefore, to be able to play an active and influential role in relation to transformations, R&I policy should seek to increase coordination and improve coherence with other sectoral policy domains, next to their traditional role of being a source of new ideas and impulses in society. Horizontal policy packages, such as the RRP, provide a frame to address the breadth of interconnected transformation dynamics needed, i.e. in terms of both creating the new and phasing out the old, with R&I policy playing a specific role in piloting novel solutions that are embedded in this wider frame.

R&I policy, when properly embedded in a wider policy frame, can fulfil important, coordination functions with regard to several inter-connected transformation processes, though mainly in the early phases of exploring and piloting novel systemic solutions.

- There is no simple recipe for how RRP could be used for transformative purpose. They should not be misunderstood as an all-encompassing transformation policy framework but rather as an important add-on that creates special horizontal (i.e. between policy fields), vertical (i.e. between government policy and implementing agencies) and multi-level (i.e. between EU, national and regional levels) linkages within a wider policy strategy. Within this setting, R&I policy can open up experimental spaces to explore not only new systemic solutions but in particular also new institutional linkages in this wider policy space.

As shown by the RRP, R&I policy can play a vital role in carving out experimental spaces for institutional change, which are needed to prepare farther reaching policy changes in sectoral and cross-cutting policy fields and across policy levels.

- Whether or not R&I policy can fulfil such a pioneering role in the context of much broader initiatives like the RRP depends on the existence and general orientation of national and European policy strategies for transformation, but also on a range of contingent factors in the national context, such as their starting position in relation to the envisaged transformations, the existence of a transformative policy framework, etc. These factors constrain the transformative potential of RRP and of R&I policy alike but can also have a major positive impact if coherently embedded in an existing transformative policy strategy.

There is no single best-practice model of how R&I policy can foster transformative change, but much depends on the specificities of national institutional settings. However, if well embedded in a sound transformative policy framework, R&I policy can play a crucial role in supporting transformative change.

- RRP have also confirmed the importance of deep and institutional / policy learning across policy fields in order to establish coherent visions, institutional structure and processes, and complementary instruments. If RRP are not developed in an inclusive manner across policy fields, it is rather unlikely that their potential for transformation can be fully reaped. It shows that financial investment is not enough, but that ability to set up coherent policies AND structural reforms is also required for triggering transformative change. Also in this regard, R&I policy can provide the experimental spaces for learning.

Transformative change ultimately depends on re-directing substantial investments, but to prepare R&I policy can open up the spaces for institutional and policy learning to properly utilise these investments.

- The RRP have played a valuable role in professionalising or systematising learning processes associated with transformation governance at large. This has not always worked perfectly well, but it could benefit from more systematic approaches to understanding and managing the destructive side of phasing out unsustainable regime practices and phasing in more sustainable ones. Such an approach should not be restricted to R&I policy, and it does not end with improved collaboration with sectoral policy domains, but needs to extend to the change processes in specific systems, such as energy, transport and food and bring on board the respective societal stakeholders.

Major horizontal policy programs, such as RRP, are learning devices for transformation governance, but the learning and engagement should not be restricted to the policy space, but include also the societal stakeholders concerned. This needs to reach out well beyond the range of stakeholders usually concerned with R&I policy matters.

- R&I policy and other policies driving transformations in thematic areas (such as climate change) tend to be strongly focused on and limited to the national and regional context. Such national focus significantly limits the transformative impact of policies. R&I could help broaden the focus, scope and reach of transformation beyond the national context, e.g. by actively sourcing knowledge and technology in Europe as a whole, but also globally as well as promoting the development of attractive and competitive products and solutions. In order to live up to that potential, priority-setting criteria in STI-policies should include and value the contribution to global and European challenges, the complementarity with related activities in other member states, and the need to safeguard and strengthen the international competitiveness of domestic industry, which has traditionally been a focus of innovation policy.

R&I policy as part of wider transformative policy packages should not restrict itself to a national and regional focus, but needs to explore complementarities in the European Research Area, as well as global opportunities for innovative and at the same time sustainable products and services.

- RRP's differ in terms of the emphasis they place on investing in existing technologies and solutions as compared to promoting new, innovative ones. From a transformative perspective, both elements and the balance between them matters. Transformation is not necessarily first and foremost about STI, but about achieving changes of a more structural, institutional and behavioral nature in society. R&I are certainly helpful and important in this regard, but it would be naïve to believe that the burden of transformation can be laid upon the shoulders of STI. In the very end, large-scale investments and behavioral change are crucial, and often comparatively mundane investments in energy efficiency can be more effective in the envisaged time frame than investments in research and innovation. Still, from a temporal perspective, R&I are crucial in advancing a portfolio of future options that may need to become available for wider use in the mid- to long-term only, but also to prepare for deeper structural, institutional and infrastructure changes.

Existing technologies and solutions may provide the quicker fixes for transformative ambitions (e.g. for reducing CO₂-emissions by 2030), but novel R&I options (and policies) are crucial to prepare for the later phases of a transformative pathway, and to trigger the necessary (infra-)structural and institutional changes.

- Transformation is about more than policy strategies. It requires the mobilisation of many other actors. Changes in policy also need to trickle down to the level of implementation by agencies; of course this depends also on how wide the remit and autonomy of agencies are in terms of defining strategies. In any case, as also shown by the experience of Vinnova in Sweden, more effective coordination is needed not only at the political level, but also at the more operational level. Also, implementation requires better alignment between the initiatives of different agencies. This is still occurring on a rather ad hoc basis and much remains before there is a more systematic integration of STI-policies into transition policies.

The broader scope of transformative policies and their need for coordination requires a similar level and quality of cooperation at the operational levels of implementation by agencies and programs.

- Finally, policymakers and agencies need to manage expectations about what R&I policy can contribute to transformation in a responsible way: research and innovation policy is often presented as having the ability to drive transformation.

We would caution against claims regarding the transformative capacity of R&I policy.

While it plays an important role in enabling transformation and in creating spaces for experimentation with novel solutions, the extent to which it actually contributes to transformation depends critically on conditions and policies, which are often beyond the remit of traditional R&I policy.

- Summing up, research and innovation policy often finds itself or actively seeks to assume a driving role in transformation processes. This is partially due to the fact that it disposes over significant budgetary resources that can be allocated to projects and programs. One of perhaps our more controversial suggestions is that rather than leading transformations, research and innovation policy should assume the role of facilitator of or supporter to transformation processes run by relevant problem owners (such as ministries of environment, mobility or health, regions, cities or industries). It could do this through funding of research and innovation, through providing a suitable theory of change and intervention logics as well as expertise on how to manage transformation processes. Through the linking of transformation processes in different policy areas and through strengthening the international and regional or local dimensions of transformation as well as by providing spaces for complex and multi-dimensional experimentation, it enables learning about potential synergies and complementarities.

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Annex A. Comparative figures of Austria, Finland and Sweden

Annex Table 1. Selected indicators for Austria, Finland and Sweden

	Austria	Finland	Sweden	EU	Source
Population (Million, 2020)	8.9	5.5	10.3	447.3	Eurostat
R&D expenditure (% of GDP) (2019)	3.19	2.79	3.39	2.19	Eurostat
Gini coefficient of equivalised disposable income (2019)	27.5	26.2	27.6	30.2	Eurostat
Share of renewable energy in gross final energy consumption (%) (2020)	36.5	43.8	60.1	22.1	Eurostat
Digital Economy and Society index (DESI Index) 2021, rank	10	2	3	n.a.	https://digital-strategy.ec.europa.eu/en/policies/desi
Sustainable development, SDG score (2021)	4th in Europe / 6th globally Goals achieved: No poverty (1), Affordable and clean energy (2), Industry, innovation and infrastructure (9), Reduced Inequalities (10)	1st in Europe and globally Goals achieved: No poverty (1), Affordable and clean energy (2), Quality education (4), Industry, innovation and infrastructure (9), Reduced Inequalities (10), Sustainable cities and communities (11)	2nd in Europe and globally Goals achieved: Affordable and clean energy (2), Industry, innovation and infrastructure (9), Reduced Inequalities (10)	n.a.	Sustainable Development Report 2021 - Sustainable Development Report (sdgindex.org) and Europe Sustainable Development Report 2021 - Sustainable Development Report (sdgindex.org), accessed December 21, 2021
GDP per capita PPP (constant 2017 intl \$) (2019)	55833	48641	52851	44389	World Bank
RRF investment volume (% of GDP) / (% of total RRF grants budget)	0.87 / 1.3	0.87 / 0.6	0.69 / 1.0		https://www.bruegel.org/publications/datasets/european-union-countries-recovery-and-resilience-plans/ accessed January 2022

Annex B. Summary of national contexts for RRP

Annex Table 2. Summary of national contexts for RRP

	Governance context	R&I policy context	Other significant factors
Austria	<p>Strong ministries with a tradition of detailed steering of government agencies.</p> <p>Attempts have been made to address 'silos' in policymaking between ministries and agencies</p> <p>Rather high political instability contrasts with rather stable policymaking</p>	<p>Strong focus on (and impressive progress in) increasing R&D intensity in past two decades</p> <p>Bottom-up, non-directional character of R&I policy (e.g. R&D tax credit, university funding)</p> <p>Ambitious transformation efforts in selected sectors (part. mobility)</p> <p>Transformative innovation policy is driven by and in selected sectors, rather than by R&I policy</p>	<p>New government with clear climate ambition (driven by the Green party)'Super ministry' of Climate Action, Environment, Energy, Mobility, Innovation and Technology (BMK) with a clear commitment to combating climate change => concentration may provide new opportunities for transformative policy approaches by concentrating fragmented competences in energy or mobility (regulation, innovation, funding, etc.)</p>
Finland	<p>Finnish long-term economic policy and financial policy has been dominated by a focus on controlling the budgetary deficits and aiming to reverse the trend of increasing government debt.</p> <p>increasing employment has been a concern since the 1990s (in contrast to other Nordic countries)</p> <p>Coordination across government and policy areas seems somewhat stronger than in Austria and Sweden (perhaps partially explained by crisis-induced pragmatism);</p>	<p>Economic crisis and an erosion of a previously strong consensus on the importance of R&I has led to significant drop in R&D intensity (albeit from comparatively high levels)</p> <p>R&I policy is rather strongly focused on enhancing competitiveness and growth</p> <p>Transformation (e.g. climate change) happens mainly through sectoral policies rather than R&I policy?</p>	<p>Fortuitous timing of the RRP:</p> <ul style="list-style-type: none"> - New government (blank slate) - Previously identified policy areas that needed funding (healthcare and social reform) - Recent austerity means government welcomes injection of funding - Reawakening consensus on importance of R&I - Opportunity for Business Finland to position itself in climate change and strengthen its position/influence
Sweden	<p>Highly independent government agencies</p> <p>Somewhat fragmented research and innovation support system with many government and public funders</p> <p>History of long-term industry-academic-government cooperation on research and innovation</p>	<p>One of the first countries to realign R&I policy towards societal challenges (as a complement to bottom-up, non-directional funding), but maybe mainly rhetorical, not so much in terms of funding?</p> <p>Increasing cooperation across research and innovation funding agencies (e.g. in Strategic</p>	<p>Weak coalition government locked into a coalition agreement which limits room for maneuver (eg to seize opportunity presented by RRF) during the preparation phase of the RRP; This government is followed by a minority government which has to govern according to a budget put forward by the opposition</p> <p>Sweden was strongly opposed to</p>

	<p>Efforts to strengthen whole-of-government policy (e.g. National Innovation Council, Climate Policy Council, Committee on Technical Innovation and Ethics)</p> <p>Strong broad-based support for combating climate change and consensus on supporting industry in transition to sustainable competitiveness</p>	<p>Innovation Programs)</p> <p>But: energy policy (energy agency) and climate change policy (Naturvårdsverket) are separated from research and innovation policy (e.g. energy research not included in the research and innovation bills presented every four years) with the exception of the government innovation partnership program on climate-neutral industry</p>	<p>expansionary fiscal policy proposed by the European Commission; the Swedish government was not enthusiastic about the RRP's from the outset;</p>
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ENDNOTES

¹ The “Climate and Transformation Offensive”, with a total budget of EUR 5.7 billion, supporting sustainability and climate neutrality in Austrian economy, was announced after the analysis has been finished and is thus not considered in this paper.

² In a reshuffle of responsibilities in July 2022, the business-related innovation agendas of the former Federal Ministry for Digital and Economic Affairs (BMDW) were integrated into the newly structured Federal Ministry of Labour and Economy (BMAW). Digitalisation and investments in digital infrastructure have moved into the responsibility of the Ministry of Finance (BMF).

³ A new university, Linné University, was created by merging Växjö University and Kalmar University but its emergence be argued to play a smaller role in the Swedish higher education system than the creation of Aalto University has played for the Finnish system.

⁴ Sweden submitted changes on 29 Sept and 10 Oct 2021 and on 22 Feb 2022

⁵ Electrification of industry will require a very large increase in electricity generation so in that respect energy supply will be a challenge. However, technology is not seen as the main hurdle although there is need for innovations to stabilize the electricity network as the share of renewable energy increases. Currently the biggest problem for increasing electricity generation appears to be the long time for granting building permits for new wind power farms, onshore as well as offshore.

⁶ It is not clear if the stipulation “in a significant way can contribute to reducing green-house gas emissions in the rest of society” refers to Swedish society or to the world at large. As many Swedish manufacturing firms export a very large share of their production, the evaluation of “significant” will depend on which of the tow applies.

⁷ “Development and coordination of joint ventures by Finnish enterprises aiming to export low-carbon solutions in the sector” is one of the measures in the program.

⁸ The original Swedish RRP included large investments to improve energy efficiency in existing apartment buildings. In the vote on the budget for 2022 the parliament the opposition’s budget won, and the item was deleted.

⁹ The reforms are in line with the January agreement.

¹⁰ In the original Swedish RRP seven percent of expenditure were devoted to digitalization-related R&D with the main part going to “digital research infrastructure”. In later revisions of the RRP, this item was deleted and replaced by an increase in the investments in broadband infrastructure.

¹¹ The modernization of the labor law and expanding educational programs were part of the political program agreed by four parties in January 2019 which formed the basis for parliamentary support of the coalition government between the Social Democratic and Environment parties.

¹² Some of the larger investments under the Climate Leap, especially in the area of recycling of batteries and plastic and production of hydrogen and certain types of biogas, are first of their kind in Sweden.

¹³ In a presentation at an information meeting in June 2021, Business Finland stated that more than EUR 500 million (corresponding to 24 percent of total Finnish RRP investments) would be channeled through the agency.

¹⁴ As mentioned earlier, some of the projects funded through the Climate Leap program may also qualify as innovation-related.

¹⁵ Finland invests an additional four percent in digital infrastructure for its railways.

¹⁶ In the initial proposal for the Swedish RRP, R&I-programs by the Swedish Research Council and Vinnova in IT-related areas were included but later replaced by an increase in investment in broadband infrastructure (see earlier discussion).