Concept paper on distractions from transformative innovation policy

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Introduction

In the last few years, policymakers and researchers have increasingly acknowledged the importance and urgency of directing innovation policy towards addressing societal challenges and transformation. However, recently, a number of rapid and major global developments have begun to take place which have potentially significant adverse consequences on the commitment to and direction of transformative innovation policy (TIP). In particular, increasing geopolitical tensions and conflicts, supply chain disruptions and concerns about inflation, and even stagflation, risk crowding out and drawing attention away from efforts to promote transitions (such as combating climate change), addressing other societal challenges and strengthening holistic sustainability through innovation.

Besides the COVID-19 pandemic, such developments include, for example, increasing global demand for energy, active efforts by some countries to phase down fossil fuels, price hikes for gas and electricity, increasing demand for critical materials (e.g., lithium, nickel, and cobalt), shortages of micro-chips influencing the supply of many technologies, and the tightening security situation in Europe following the attack of Russia on Ukraine and the ongoing war with substantial negative effects on human life and destruction of cities. Overall, the global developments, that may create distractions to the advancement of TIP, involve economic, (geo)political, and social spheres. This concept paper will briefly, first, outline developments in the different spheres; second, identify connections between these developments and TIP as well as broader STI policy; and third, reflect on what means and tools could be available for regional transformative and innovation activities to take these into account in, e.g., risk analysis and management practices.

Economic sphere

In the economic sphere, characterised by increasingly global trade and finance systems, we have already seen small-scale examples of supply chain disruptions (the Suez Canal), and price shocks (rapid increases in European gas and electricity prices), while there are also risks of economic recession following Covid-19 and the war in Ukraine, or deviance by some countries from international or European free market rules. The economic sphere strongly depends on global markets and supply for certain resources, some of them 'critical' for the functioning of the economy (e.g., certain fuels, food stocks, and materials used in water purification). For example, the increasing risks around globally rising energy demand are well-recognised, potentially slowing down the energy transition but also supporting the progress of renewable energy -based systems (Kivimaa & Sivonen, 2021). The global availability of critical minerals and metals, and the technological components using these has created a new security of supply concern as the energy

transition and other transitions relying on digitalisation progress (Lee et al., 2020; Overland, 2019). The International Energy Agency (IEA, 2021) has also increased focus on this topic. While some resources are described as rare earth elements, their availability varies based on the type of material, some being abundant enough that the rare earths industry is looking for new uses for them, while others are limited and in high demand (Binnemans et al., 2018). Innovations will be needed to create alternative solutions to and recycling those materials in high demand to reduce the impact of possible supply disruptions (Kivimaa, 2022).

Recent inflationary pressures have led to talks of 'green inflation' or 'greenflation',[1] blaming efforts to increase environmental sustainability and to phase out fossil fuels for rising prices, and effectively pitting efforts to advance renewable energy against short term economic interests. Discourses of this nature are likely to swell in line with inflation (and potential economic slowdown).

Geopolitical sphere

In the geopolitical sphere, which is connected to the economic sphere, we see different developments. US-China relations are decoupling (Fjäder et al., 2021), with increasingly tangible political and economic consequences for Europe, while also recent development show increasing tensions between Europe and Russia – and a significant geopolitical conflict following the Russian attack on Ukraine in February 2022. In addition, growth in hybrid influence from China and Russia have been reported (Wigell, 2021). The geopolitical risks and opportunities following the phase out of fossil fuels are likely to change the power positions of states (Goldthau & Westphal, 2019; Scholten et al., 2020), while current developments have also seen the need for a more rapid phase out of fossil fuels in Europe to reduce dependency on Russian oil and gas. The retreat of sea ice has created increased interest of states on the Artic and new opportunities for hydrocarbon and mineral exploration as well as new trade routes of importance to the EU (Koivurova et al., 2021), followed by both increased security presence and new environmental concerns (Morgunova, 2020). Europe-Africa relations may also be shifting under the influence of different systemic changes, such as the transition from fossil fuels to solar and wind power. We also see a stronger recent debate on Russia versus potential expansion of NATO.

It is uncertain how large fossil-fuel exporting countries react to the pursuits of other countries to phase out fossil fuels. Some see risks of regional or global instability as a result (Vakulchuk et al., 2020). For instance, a European transition to renewables may create social conflicts and out-migration in Algeria, a country dependent on fossil fuel trade with Europe (Desmidt, 2021). More significantly, it has been argued that Russia may increase military action when it cannot use its 'energy weapon' as a coercive instrument in international relations (Tynkkynen, 2019). In recent weeks and months, this risk has become more prominent with the Russian threat near the Ukrainian border and the following military action.

The supply chains for critical materials are largely controlled by China with 98 % of rare earth elements used in Europe provided by China (EC, 2020). China has also set conditions on how the technologies using some of the critical materials it sells must be produced on Chinese soil (Criekemans, 2018). Supply chain security has become an issue in the semiconductor industry, over

[1] Ist die Klimapolitik schuld an der Inflation? (faz.net), FPÖ – Angerer zu Brunner: Regierung befeuert Belastungen durch die hausgemachte „grüne Inflation" | Freiheitlicher Parlamentsklub - FPÖ, 13.03.2022 (ots.at)

60% of market share of the foundries being in Taiwanese ownership, with the shortage of microchips used in almost all modern devices intensifying since spring 2021 as a combined result of covid-19 pandemic, climate change and geopolitical tensions (Kamasa, 2021).

Edler et al. (2021) point out that increasing geopolitical uncertainties and risk of global trade conflicts direct focus to a principle of technology sovereignty[2] as one element of future-oriented innovation policy.

Social sphere

In the social sphere, we see growing inequality as well as a polarisation of views (further promoted by populist politics), such as the divide between the far right and environmental and social movements, such as the extinction rebellion. The ways in which fossil fuel phase-out impacts employment has been rather extensively discussed (e.g. Abraham, 2017). The unequal access of people to low-carbon technologies is another relevant source of possible societal tensions. These factors are creating risks for the advancement of TIP, and socially and environmentally beneficial transitions. In certain regions of Europe, discontent on energy transitions has been voiced by right-wing populists (Vihma et al., 2021) who tend to be more hostile towards renewable energy and carbon taxes (Lockwood, 2018). We see many efforts towards just transitions locally, nationally (e.g., Scottish Just Transition Committee), in the EU, and internationally, while this will not be an easy task. Some potential beneficiaries of just transition efforts see them in a negative light, as 'other people coming to tell them what to do' or impacting their communities' way of life (MacNeil and Beauman, 2022).

Connections to STI policy and transformative innovation policy

Based on the above-described circumstances, we identify a number of factors which risk undermining the focus on and support for transformation and TIP:

- Economic: energy prices, inflation, supply chain disruptions, trade disputes (partially political), economic coercion, recession
- Political/geopolitical: decoupling, technology sovereignty in the EU, critical/key technological expertise in the EU and regions, protectionism, nationalism, sanctions, tensions, military conflicts esp. Russian aggression.
- Social: growing polarisations and inequalities (within and between countries and regions), populism, reduced employment opportunities in some regions

Possible effects on transformation and TIP:

- Less resources for transformation (e.g., sustainable energy, mobility, or agro-food) and environmental protection; reallocation of budgets towards national security/military or just immediate economic recovery? But also, a new impetus for accelerating the energy transition.

[2] Technology sovereignty has been defined as "as the ability of a state or a federation of states to provide the technologies it deems critical for its welfare, competitiveness, and ability to act, and to be able to develop these or source them from other economic areas without one-sided structural dependency" (Edler et al., 2021, p. 2).

- Less popular support for transformation (e.g., combating climate change); increasing concerns about inflation, economic growth, economic disruption and unemployment, and national security
- Less focus on transformation and TIP
- Risk of misuse of policies/instruments: e.g., promoting local sourcing, national procurement, government support and preferential treatment of selected firms and industries ('picking winners'), market distortions and trade barriers (for political / protectionist reasons) under the cover of social / environmental sustainability, strategic autonomy or technological sovereignty
- Risk that transformation and TIP is perceived and portrayed to be something that only rich people, countries and regions can afford to focus on, considering more immediate / existentialist concerns

Covid created a significant momentum and a window of opportunity for transformative change in terms of support, resources, and impetus, while it is uncertain whether this opportunity has been used sufficiently. This phase that took place during 2020-2021 risks now, in the spring of 2022, being replaced by a period of opposition to transformation and retrenchment as other (more immediate or short term) concerns move to the forefront, such as inflation, geopolitical tensions and conflicts, and rising inequality. Moreover, the public response to Covid restrictions has shown strong opposition by some stakeholders to changes in current predominant lifestyles, which indicates that changes to reduce the climate and environmental threats we are facing may be even more difficult to achieve than previously thought.

The increasing focus on strengthening military capabilities might be more detrimental to transformative innovation policy in Europe than in other parts of the world, particularly the US, China and Russia. For historical and geopolitical reasons, several countries (e.g., Germany, Austria, Finland) have consciously avoided linking military development with commercial applications, and vice versa. Thus, for example, Germany has a so-called 'civil clause' ('Zivilklausel') where universities and research institutions voluntarily commit themselves not to carry out research for military purposes[3] (see Mölling & Schütz, 2021). The European context may be changing significantly after Russia initiated a war in Ukraine. For example, in Finland, the predominant discussion is applying a NATO membership and increasing military spending, while it remains to be seen how this impacts innovation and transformation policies.

The 'firewall' erected between civil and military research and innovation stands in stark contrast to China, which promotes cross-fertilisation (e.g., through supporting dual use technologies and applications) and the US, where research and innovation for military purposes has been an important driver of commercial innovation, particularly through DARPA (created in 1958). There are numerous examples of innovation agencies and programmes in Europe (e.g., the Agency for Disruptive Innovation in Germany, SPRIND) that are modelled on DARPA but without its link to military R&D and innovation needs. As a result, even though some countries (such as France and the UK) have sought to link defence and innovation more closely through strategies[4] or agencies[5] (overall, an increase in defence spending is likely to be less conducive to promoting innovation in

[3] Zivilklausel - Das Ende der Friedenspflicht - Bildung - SZ.de (sueddeutsche.de)
[4] https://www.gov.uk/government/publications/defence-innovation-priorities
[5] https://french-tech-central.com/en/service-public/ministry-of-the-armed-forces-defence-innovation-agency/

Europe than in other regions. Recently there have been calls for establishing a link between innovation and defence.[6]

Possible responses linking to STI and transformative innovation policies

While the above developments create challenges and negative effects on TIP, they can also be perhaps engaged at least somewhat positively in the future development of TIP, perhaps even become positive tipping points (e.g., Lenton et al., 2022). Two examples or indications of such potentially positive tipping points are the strengthened push for digitalisation catalysed by the Covid-19 pandemic (e.g., in higher education, remote working and the public sector) and an increased focus on sustainable energy sources as a means of reducing dependency on oil and gas from Russia in response to the war in Ukraine.

First, ***broad and deep networks*** are important in creating new inventions, advancing sustainability transitions (Ghosh et al., 2021) and enabling collaboration (with tension-reducing effects) in societies. Especially in the current context of increasing geopolitical tensions and conflicts, cross-European and cross-regional networks of innovation are important to collaboratively create solutions and reduce the tendencies for nationalism and protectionism. The European Commission can take the role of encouraging and requiring such networks to form in the programmes it funds. Also, regional transformation initiatives could play a role in supporting collaboration and positive learning across regions. Some of the tools could involve intermediary bodies and platforms that facilitate the formation of collaboration and information exchange, and physical events to strengthen social ties.

Second, transitions in early stages require ***multiple competing alternatives ('niches')*** to existing socio-technical regimes (Geels & Kemp, 2007), and hence, to a certain degree 'technology neutral' green innovation policies are important. Thus, the approach of not 'picking winners' too early is important to better address the risk of global material supply chain disruptions; by diversifying technological solutions, the risks around resources become more diffused. Therefore, while electrification or transport and hydrogen are now portrayed in the EU strategies as future pathways, some RDI funding needs to be allocated to alternative pathways (such as biogas) to prepare for backlashes, such as material shortages which may hinder the upscaling of these chosen pathways. Alternative pathways can be explored in transformation efforts that the different regions undertake, to benefit from regional differences in skills, capabilities and resources.

Third, ***multi-technology interaction*** (Andersen & Markard, 2020) and ***multi-regime interaction*** (Raven, 2007) mean that transitions can proceed in unexpected ways, and sector-integration is an increasingly relevant phenomenon. The latter indicates that **coupling green transitions with defence sector innovation** could be one novel approach to tackle the challenges around sector-integration, the limited availability of public funding, and increasing geopolitical uncertainty. Defence sector innovation in digitation and green technologies (e.g., in energy) could benefit from knowledge exchange with the broader societal green and digital transitions (and vice versa). Such interaction between green transitions and defence is perhaps best initiated at regional or member-state level, due to significant national differences in how defence is organised and due to

[6] See, for example: https://www.handelsblatt.com/technik/militaer-technologie-innovation-ist-die-beste-verteidigung-deutschland-drohen-bald-auseinandersetzungen-mit-ungleichen-waffen/27456570.html?utm_source=amp2 and https://www.bmvg.de/de/aktuelles/lambrecht-spricht-zu-innovation-im-bereich-verteidigung-5353896).

subsidiarity concerns. However, the need for such coupling could also be highlighted in EU level strategies, and connections explored between EU innovation policy and Common Security and Defence Policy (CSDP).

Fourth, an important issue that comes to the fore from the distractions we are currently seeing, is the question of **technology sovereignty and the supply of critical resources**. We can already see signs in European policymaking of shifting from the free market-based logic to a gradual rise of industrial policy (e.g. Johnstone et al., 2021). For the sake of Europe's future competitiveness, it is important that this development is handled in a way that strengthens the union and international competitiveness rather than increasing national protection in each member state separately or creating unhealthy monopolies. Rather than seeking to stop or drastically cut the supply of critical resources from abroad, member states and the European Union should promote diversification in the sourcing of these – i.e. avoiding over-reliance on individual countries or suppliers (e.g., in the case of rare earth elements). In addition, they could support promising initiatives for mining certain materials within the EU. Hitherto untapped deposits of rare earth materials are found for example Sweden, Finland, Greece and Spain.[7] Governments should seek to further enhance efforts and accelerate the development of methods to extract and process these sustainably, responsibly and efficiently.[8] Furthermore, we would like to underline the importance of further strengthening the Single Market (e.g., for digital services) as one of the most effective and efficient ways to safeguard Europe's technological strength and competitiveness and, thus, counteracting potentially problematic technological dependencies.

Besides the four points above, it is important to prepare responses that address these 'distractions' transversally across different issues to prevent the loss of momentum and focus on transformation towards long-term, holistic sustainability:

- **Recognising and handling concerns by citizens, regions, industries and other sectors**: The losses, destabilisation and disruptions to daily lives and economic activity caused by Covid-19 and the war in Ukraine raise understandable and legitimate concerns regarding future livelihoods, economic growth and way of life. National and regional governments should seek to acknowledge these concerns, address them through inclusive dialogue (around ways to handle them and make people feel they are genuinely listened to) and seek to mitigate them through policies. Credible handling of such concerns includes early-stage risk assessment, and possible creation of strategies and responses to identified risks.
- **Acknowledging and actively addressing frictions** between transformation and different spheres, including justice (equality), economic growth (e.g., concerns over jobs, new industrial/export opportunities), national security and strategic autonomy (e.g., technology sovereignty, strategies for key skills and materials) is vital. This requires taking a multi-level approach as these frictions may occur from local to global scales, and one level is not more important than another. Thus, policies aiming to reduce these frictions, such as just transitions policies or regional transformation efforts, should not only address the local economy perspective but consider effects beyond regional and national boundaries and

[7] See for example, Europe's rare earth deposits could shore up tech industry | Research and Innovation (europa.eu), Rare earth metals at the heart of China's rivalry with US, Europe – EURACTIV.com, The race for rare earth elements: A Swedish perspective (innovationnewsnetwork.com), Sällsynta jordartsmetaller i Sverige – mer miljövänligt att bryta här - Nyheter (Ekot) | Sveriges Radio. See also Goodenough et al 2016.
[8] EURARE and FRAME are examples of previous or ongoing initiatives (About EURARE | EuRare Project | Home and FRAME (sgu.se))

from the perspective of the global society. At the same time, governments should beware of using transformation as an excuse for protectionism, nationalism and old-fashioned industrial policy. **Improving open access to data** and communication of data in an easily understandable format is important to increase people's understanding regarding both the ongoing 'distractions' and associated long-term societal risks and challenges, if TIP does not advance. While our understanding of, for example, climate change is constantly increasing, so is the misinformation spreading across social media and even some news outlets. Thus, it is important to make sure governments make different types of reliable data accessible to the public to aim to reduce misinformation.

- **Work with local, regional, national (international?) social contracts on inclusively agreed upon priorities**: Participatory policymaking, recognising and compensating losers from transformation (particularly people and regions).
- **Consider ways to link security and innovation in responsible and mutually beneficial ways**. This could include applying innovation policy instruments in addressing security challenges (e.g., hackathons, competitions, prizes, missions) but also using security issues and challenges to drive innovation with potentially commercial applications and value (DARPA model).

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