POLICY BRIEF

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Systems of Use Innovation and Mission-Oriented Innovation Policy

This policy brief explores potential synergies between Mission-Oriented Innovation Policy (MOIP) and systems of use innovations. Analysed systems of use innovators develop practical, efficient, and relatively low-risk solutions for early markets. A pertinent issue for policy practitioners, is determining the most effective methods to enhance support for these systems of use innovations leading the green transition in high emission industries.

Systems of use innovation refer here production and business process renewal by the lead innovator firm

The urgency of addressing the climate emergency is clear. On top of the ecological and human costs, uncontrolled climate change may cost the global economy USD 178 trillion over the next 50 years time (Deloitte, 2022). This is coupled with increasing socio-economic disparities and escalating geopolitical tensions. Additionally, external factors such as rapid technological change and COVID-19 type crisis can change the preconditions frequently. These factors have underscored the critical importance of sustainability, resilience, and inclusiveness. Effective collaboration is essential in transforming these policy orientations into actionable strategies, as underscored by the OECD in 2024.

MISS: Practicing mission-oriented innovation policy: inclusive and systems of use approach

The brief focuses on governmental support for innovation and how to organize the support schemes for the green transition and other large societal challenges. More specifically it centers on how concepts like systems of use innovation, mission-oriented innovation policy, and behavioral innovation may play a role in advancing policy objectives. This discussion aims to articulate strategic recommendations that can support and amplify the impacts of innovations in the steel and aluminum sectors - industries that are crucial not only to the industrial base but also to environmental sustainability.

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MISS - Practicing mission-oriented innovation policy is a two-year research project funded by Business Finland at the University of Vaasa, Finland. The project employs two analytical lenses, inclusive policy approach and systems of use approach as way to analyze and advance mission-driven innovation policies. Linking of mission-oriented policy and systems of use activities can facilitate not only the systemic change, but also the societal acceptance of the speed and scale of changes. The project studies the users capability to be key actors in systemic innovation rather than merely targets of the policy. The main research questions of the project are: How to successfully make large systemic changes and/or transformations happen? What would be the right scale of choices and actions especially in a small open economy such as Finland? How mission-oriented policy can create added value for businesses and for the wider society?

BUSINESS FINLAND

The aim of Innovation and Growth Research funded by Business Finland is to find solutions to the global challenges of the Finnish economy and society.

The insights of the brief are intended to guide policy formulation. They also serve as a foundation for future research and dialogue on integrating innovative practices with mission-oriented policy goals to address global challenges effectively.

Green Steel and the case of HYBRIT Joint Venture

Fossil free steel production will be a significant step in green transition and great policy learning opportunity

'Steel production has a significant global CO2 footprint, with nearly 2 billion tons of steel produced annually, accounting for about 7 percent of human greenhouse gas emissions—more than the emissions of Russia or the entire European Union' (Science, 2024). The transition to CO2-free operation in steel making requires a comprehensive change extending beyond the core production process within the steel mill. It reaches through the entire value network from iron ore mine to steel mill and its customers. To address this transition, the HYBRIT joint venture was established, bringing together a green steel value network organized by SSAB with energy supplier Vattenfall and iron ore supplier LKAB. HYBRIT was initiated based on a shared strategic vision among these businesses for developing sustainable business practices and specifically CO2-free steel. Adopted approach is based on reducing CO2 emissions to zero rather than capturing and storing the emissions from steel making. Cooperation is crucial in implementing the transition to CO2-free steel production.

In 2016, SSAB, LKAB (Europe's largest iron ore producer) and Vattenfall (one of Europe's largest energy companies) joined forces to create HYBRIT – an initiative that endeavours to revolutionize steelmaking. Using HYBRIT® technology, SSAB aims to replace coking coal, traditionally needed for ore-based steelmaking, with fossil-free electricity and hydrogen. The result will be the world's first fossil-free steelmaking technology, with virtually no carbon footprint. The goal is to reduce Sweden's CO2 emissions by 10% and Finland's by 7%.
https://www.ssab.com/en/fossil-free-steel/

In April 2024 SSAB made a decision to build new Fossil free minimill in Luleå.
https://www.ssab.com/en/news/

In March 2024 US Department of Energy awarded up to 500 Million USD to SSAB. The aim is to set up Zero Emissions steel making plant in Mississippi and Montpellier in Iowa. Other steel and iron project were awarded 507.5 Million USD at the same time as part of the Industrial Demonstration Programme.
https://www.energy.gov

Green transition in industrial processes is often based on electrification. This requires major developments in the infrastructure and regulatory framework

New electric arc furnace technology requires collaboration with the iron ore supplier. The transition also demands a massive supply of fossil-free

electricity and hydrogen, to be provided by Vattenfall. This innovation project introduces a new production process to the world while maintaining the quality of the product, positioning green steel as a premium category product. Vattenfall is set to become a green hydrogen supplier, and LKAB will transition to furnace operation. Alltogether, these innovations will enhance each firm's position within the value network and builds a solid business case for each entity in the green transition.

Innovating and supporting zero emission production systems

Systems of use innovation is an effective tool to analyze innovations on production and business process levels.

Innovating users, be they businesses or individuals, benefit from direct control, enhanced design freedom, and an intimate knowledge of their systems when they innovate. This confers significant advantages in modifying and improving their systems (Hippel, 1994; Reiman et al., 1998). The systems of use innovation concept extends the idea of user innovation to a systemic dimension that encompasses personal, business, value chain, and ecosystem levels (von Hippel, 2021).

The system of use innovation is a relevant unit of analysis for reducing CO2 emissions in energy intensive industries.

The analytical perspective is particularly relevant for examining production system-level innovations, such as those in steel mill and in aluminum processing. These systems address specific challenges and pioneer early solutions for emerging zero emission markets, balancing limited resources against risks. The steel and aluminum sectors are noteworthy, contributing approximately 6 to 9 percent of global CO2 emissions, in Finland the steelmill is largest single source of carbon emissions making 7 % of the countrys overall emissions (Pandit et al, 2020; SSAB, 2024).

Mission-Oriented Innovation Policy represents a top-down state intervention, in contrast to the bottom-up approach of systems of use innovations. Key features of Mission-Oriented Innovation Policy include: societal challenges focus, directionality, cross-sectoral collaboration, market shaping and creation, transformative impact, and dynamic capabilities. MOIP is designed to address grand societal challenges or "missions" that require systemic transformations and cannot be solved by individual actors alone. These missions are ambitious, clearly defined, and targeted at addressing urgent societal, environmental, or technological needs (Mazzucato, 2018). MOIP can benefit from cross-sectoral collaboration, encompassing efforts from government, the private sector, academia, and civil society (Hekkert et al., 2020). The government's role as an enabler involves providing funding, incentives, favorable regulations, and creating markets for new solutions. It necessitates that public sector organizations cultivate dynamic capabilities to adapt to

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changing conditions, manage uncertainties, and engage in co-creating and shaping innovation ecosystems (Schot & Steinmueller, 2018).

Mission oriented innovation policy, systems of use innovation and behavioral innovation are key elements of societal transition.

Technological revolutions and societal transitions are contingent upon significant behavioral changes. In the context of the green transition, changing behavior catalyzes market demand for sustainable products, which in turn drives business investment towards zero-emission production, fostering innovation in production sytems. Direct impacts of behavioral change are estimated to contribute 8-10 percent towards the zero-emission target (IEA, 2021). Moreover, behavioral innovation and change are essential on the governmental side as well. MOIP transcends governmental boundaries, underscoring the importance of integrating systems of use innovations into the policy agenda.

Data Sources

The analysis is supported by research papers, interviews with policy and business practitioners, and policy and programme documents published by ministries, agencies, the OECD, the International Energy Agency (IEA), and the United Nations.

Zero emission steel production is a system of use consisting of elements like tools, behaviours, modules, strategies, and methodologies.

Nature of systems of use innovation

New near CO2 emission-free production processes and value networks emerge from systems of use innovation. The steel production process and aluminium processing exemplify systems of use where the manufacturer oversees a complex process aimed at competitively producing steel or aluminium structures in terms of price, quality, service, and sustainability. The strength and innovativeness of such complex systems rely on numerous suppliers capable of providing innovative components and process improvements. System of use companies coordinate suppliers' contributions to a multi-component innovation, which is crucial for the success of the innovation. Iansiti and Levien, 2004 refer these as Keystone companies that are chieving long-term success by fostering the health of their business ecosystems.

A system of use encompasses all elements employed by a user within a system to achieve their goals, including tools, behaviors, modules, strategies, and methodologies. Each module, whether a physical product or behavior, plays a role in the overall system by accepting inputs, processing them, and delivering outputs within and beyond that system of use (von Hippel, 2021). The ability to directly control and intimately understand the entire system allows user innovators to tailor the system effectively to their needs. In the industrial context, this means that a steel

mill and aluminium processing companies themselves are best positioned to innovate and optimize their production process.

Policy recommendations

Innovation is needed in mission-oriented innovation support tools, methods and practices

The following recommendations aim to create a supportive, adaptive, and inclusive policy environment that fosters innovation and accelerates the transition towards sustainable systems and technologies.

Recognice and support innovations on systems of use (production process) level. Systems of use innovations can make a significant contribution to green transition. Innovation support should be able to address systems of use innovations that are transforming production processes in line with the MOIP. This is especially important in highly energy-intensive industries where the positive impact can be maximised.

Expand Innovation Support to Supplier Networks. To enhance the impact of mission-oriented innovations, extend support mechanisms beyond individual keystone firms to their entire supplier networks. These suppliers are integral in providing components and inputs essential for innovation. Supporting them directly can create a ripple effect, boosting the overall innovation capacity and efficiency of the ecosystem. This approach ensures that critical enablers of innovation across international borders are included, promoting a more integrated and effective progression towards MOIP's transition targets.

Innovation funding is important but regulation and infrastructure largely define the speed of green transition

Accelerate Infrastructure Development. Recognize the strategic importance of infrastructure development in supporting societal transitions towards sustainable systems, such as those required for a fossil-free electricity supply. Considering the long lead times of 7-14 years for such developments, introduce expedited planning and approval processes. Additionally, allocate resources for upgrading existing infrastructures to cope with new demands, ensuring that infrastructure does not become a bottleneck in the transition process.

Implement Stable and Predictable Regulations. Establish regulatory environments that are stable and predictable to encourage investments in sustainable technologies. This stability is crucial for businesses to have confidence in long-term planning and investment. Utilize regulatory tools like innovation sandboxes to allow businesses to experiment with new models and technologies under temporary, flexible regulatory conditions. This can foster innovation while maintaining oversight and ensuring public safety and interest.

Adopt Problem-Oriented Innovation Policies. Shift policy focus from prescribing specific technologies to setting broad innovation goals, such as reducing CO2 emissions. This approach allows for a wider range of potential solutions to be explored and developed, catering to diverse technological advancements and creative solutions. It encourages innovators to explore various pathways, full range of technologies such as biogas, solar energy, wave energy, fuel cells, carbon capture storage and utilisation, energy storage, wind- and hydro powers, geothermal energy, to achieve zero-emission targets effectively.

Incorporate a Life-Cycle Perspective in Policy Development. Design MOIP policies with a dynamic, life-cycle approach that evolves in response to changing environmental conditions and technological advancements. Over time the tasks and priorities of MOIP implementation change reflecting the evolving environment and progress on policy goals achievement. As the policy matures, its focus should naturally shift from setting initial goals to more solutions through trial and learning. Development is hardly linear due to policy learning and related adjustments. This adaptive policy approach helps to align with the evolving needs of innovators and the markets they serve.

Foster Behavioral Innovation in Policymaking. Enhance the impact of MOIP policies by involving systems of use innovators and policymakers in a collaborative manner throughout the policy design and implementation process. Behavioural insights form markets and systems of use actors help to adjust policy design and set mission ambitions and target accordingly. Keystone businesses, which are central to system-level innovations, should be actively involved in setting goals and shaping policies. This inclusive approach ensures that policies are not only designed to meet current needs but are also adaptable to future changes and innovations within the industry.

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