



# Study on Mapping and Scoping of Frugal and Reverse Innovation in Europe





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## Abstract

The Council Conclusions on the New European Innovation Agenda<sup>1,2</sup> emphasised that innovation, in its broader sense, including societal, social, cultural and public sector innovation, is an essential enabler for achieving the Union's policy objectives, in particular the green transition and digital transformation, as well as the Sustainable Development Goals. The key findings of the study suggest that frugal and reverse innovation can support these objectives, particularly as they relate to green, sustainable, and socially driven transformation. This study, under the European Innovation Ecosystems part of Horizon Europe, provides an overview of frugal and reverse innovation in the European Union and Horizon Europe Associated Countries concerning their challenges and opportunities and proposes definitions of these concepts. The findings of the study suggest that tackling social challenges within the EU presents an ideal opportunity for frugal and reverse innovations, as these approaches can effectively overcome the obstacles encountered in traditional profit-driven markets. Frugal and reverse innovations present opportunities to meet the growing demand for affordable and accessible solutions in the EU and Horizon Europe Associated Countries. They can promote a bottom-up innovation ecosystem which strengthens sustainable supply chains and community-driven solutions, contributing to the EU's sustainability agenda and its autonomy and resilience in the face of growing emerging market competition, particularly in key sectors such as green and health technologies.

This study provides specific policy recommendations for policy makers to raise awareness of frugal concepts in policy, ensure inclusive policy instruments, explore international best practices and monitor the frugal and reverse innovation landscape to identify future opportunities.

*Keywords: frugal innovation, reverse innovation, social innovation, resource-constraints, low-cost solutions, sustainability, social issues, global challenges, emerging markets, community-driven solutions.*

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<sup>1</sup> Council of the European Union. *Preparation of the Council (Competitiveness (Internal Market, Industry, Research and Space)) on 1-2 December 2022: Conclusions on the New European Innovation Agenda – Approval*. Brussels, 17 November 2022. <https://data.consilium.europa.eu/doc/document/ST-14705-2022-INIT/en/pdf>.

<sup>2</sup> European Commission. "The New European Innovation Agenda." Accessed January 2, 2025. [https://research-and-innovation.ec.europa.eu/strategy/support-policy-making/shaping-eu-research-and-innovation-policy/new-european-innovation-agenda\\_en](https://research-and-innovation.ec.europa.eu/strategy/support-policy-making/shaping-eu-research-and-innovation-policy/new-european-innovation-agenda_en).

## Résumé

Les conclusions du Conseil sur le nouvel agenda européen pour l'innovation<sup>3,4</sup> ont souligné que l'innovation, dans son sens plus large, y compris l'innovation sociétale, sociale, culturelle et du secteur public, est un catalyseur essentiel pour atteindre les objectifs politiques de l'Union, en particulier la transition verte et la transformation numérique, ainsi que les objectifs de développement durable. Les principales conclusions de l'étude suggèrent que l'innovation frugale et inversée peut soutenir ces objectifs, en particulier en ce qui concerne une transformation verte, durable et socialement motivée. Cette étude, rédigée dans le cadre du programme Écosystèmes d'innovation européens d'Horizon Europe, fournit une vue d'ensemble de l'innovation frugale et inversée dans l'Union européenne et les pays associés au programme Horizon Europe concernant leurs défis et opportunités et propose des définitions de ces concepts. Les résultats de l'étude suggèrent que relever les défis sociaux au sein de l'UE constitue une opportunité idéale pour des innovations frugales et inversées, dans la mesure où ces approches peuvent surmonter efficacement les obstacles rencontrés sur les marchés traditionnels axés sur le profit. Les innovations frugales et inversées offrent des possibilités de répondre à la demande croissante de solutions abordables et accessibles dans l'UE et les pays associés à Horizon Europe. Elles peuvent promouvoir un écosystème d'innovation ascendant qui renforce les chaînes d'approvisionnement durables et les solutions communautaires, contribuant ainsi à l'agenda de durabilité de l'UE, à son autonomie et sa résilience face à la concurrence croissante des marchés émergents, en particulier dans des secteurs clés tels que les technologies vertes et les technologies de la santé.

Cette étude fournit des recommandations spécifiques aux décideurs politiques afin de les sensibiliser aux concepts concernant la frugalité en matière de politique publique, de garantir des instruments politiques inclusifs, d'explorer les meilleures pratiques internationales et de surveiller le paysage de l'innovation frugale et inversée afin d'identifier les opportunités futures.

Mots-clés : *innovation frugale, innovation inversée, innovation sociale, contraintes de ressources, solutions à faible coût, durabilité, questions sociales, défis mondiaux, marchés émergents, solutions communautaires.*

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<sup>3</sup> Council of the European Union. *Preparation of the Council (Competitiveness (Internal Market, Industry, Research and Space)) on 1-2 December 2022: Conclusions on the New European Innovation Agenda – Approval*. Brussels, 17 November 2022. <https://data.consilium.europa.eu/doc/document/ST-14705-2022-INIT/en/pdf>.

<sup>4</sup> European Commission. "The New European Innovation Agenda." Accessed January 2, 2025. [https://research-and-innovation.ec.europa.eu/strategy/support-policy-making/shaping-eu-research-and-innovation-policy/new-european-innovation-agenda\\_en](https://research-and-innovation.ec.europa.eu/strategy/support-policy-making/shaping-eu-research-and-innovation-policy/new-european-innovation-agenda_en).

## Zusammenfassung

Die Schlussfolgerungen des Europäischen Rates zur neuen Europäischen Innovationsagenda<sup>5,6</sup> betonen, dass Innovation im weiteren Sinne, einschließlich gesellschaftlicher, sozialer, kultureller und öffentlicher Innovationsansätze, ein wesentlicher Faktor für das Erreichen politischer Ziele der Union ist, insbesondere im Hinblick auf den grünen Wandel, die digitale Transformation und die nachhaltigen Entwicklungsziele (SDGs). Die zentralen Ergebnisse der Studie zeigen, dass frugale und Reverse-Innovationen diese Ziele unterstützen können, insbesondere in Bezug auf grüne, nachhaltige und sozial orientierte Transformationen. Diese Studie, die im Rahmen des Europäischen Innovationsökosystems von Horizont Europa durchgeführt wurde, bietet einen umfassenden Überblick über frugale und Reverse-Innovation in der Europäischen Union und den mit Horizont Europa assoziierten Ländern (HEAC). Sie analysiert deren Herausforderungen und Potenziale und schlägt präzise Definitionen für diese Konzepte vor. Die Ergebnisse der Studie deuten darauf hin, dass die Bewältigung sozialer Herausforderungen in der EU ein geeignetes Anwendungsgebiet für frugale und Reverse-Innovationen darstellt. Diese Ansätze können Hindernisse überwinden, die in traditionellen gewinnorientierten Märkten auftreten. Frugale und Reverse-Innovationen eröffnen Möglichkeiten, um die wachsende Nachfrage nach kosteneffektiven und leicht zugänglichen Lösungen in der EU und in den mit Horizont Europa assoziierten Ländern (HEAC) zu erfüllen. Ein Bottom-up-Innovationsökosystem könnte dazu beitragen, nachhaltige Lieferketten und gemeinschaftsorientierte Lösungen zu stärken. Dies würde nicht nur die Nachhaltigkeitsagenda der EU fördern, sondern auch ihre Autonomie und Widerstandsfähigkeit gegenüber dem wachsenden Wettbewerb mit Schwellenländern, insbesondere in Schlüsselbereichen wie z.B. Umwelt- und Gesundheitstechnologien, stärken.

Diese Studie enthält spezifische Empfehlungen für politische Entscheidungsträger, um das Bewusstsein für frugale Konzepte in der Politik zu schärfen, integrative politische Instrumente sicherzustellen, international erfolgreiche Ansätze zu analysieren und die Entwicklungen frugaler und Reverse-Innovationen zu verfolgen und um potenzielle Chancen besser zu identifizieren.

*Schlüsselwörter: Frugale Innovation, Reverse-Innovation, soziale Innovation, Ressourcenknappheit, kostengünstige Lösungen, Nachhaltigkeit, soziale Fragen, globale Herausforderungen, aufstrebende Märkte, gemeinschaftsorientierte Lösungen.*

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<sup>5</sup> Council of the European Union. *Preparation of the Council (Competitiveness (Internal Market, Industry, Research and Space)) on 1-2 December 2022: Conclusions on the New European Innovation Agenda – Approval*. Brussels, 17 November 2022. <https://data.consilium.europa.eu/doc/document/ST-14705-2022-INIT/en/pdf>.

<sup>6</sup> European Commission. "The New European Innovation Agenda." Accessed January 2, 2025. [https://research-and-innovation.ec.europa.eu/strategy/support-policy-making/shaping-eu-research-and-innovation-policy/new-european-innovation-agenda\\_en](https://research-and-innovation.ec.europa.eu/strategy/support-policy-making/shaping-eu-research-and-innovation-policy/new-european-innovation-agenda_en).

## Executive summary

The Council Conclusions on the New European Innovation Agenda<sup>7,8</sup> emphasised that innovation, in its broader sense, including societal, social, cultural and public sector innovation, is an essential enabler for achieving the Union's policy objectives, in particular the green transition and digital transformation, as well as the Sustainable Development Goals (SDGs). Frugal and reverse innovation hold significant relevance for the European Union (EU) and Horizon Europe Associated Countries (HEAC), presenting opportunities for tackling rising challenges and harnessing the innovation potential of less innovative regions.<sup>9,10</sup> By promoting these concepts, the EU can leverage cost-effective, locally driven solutions and gain competitive advantages against the growing influence of emerging economies, promoting more accessible and sustainable socio-economic outcomes.<sup>11,12</sup>

### Study aims and methodological approach

This study aims to provide an overview of frugal and reverse innovation within the Horizon Europe ecosystem from 2013 onwards,<sup>13</sup> to map relevant policies supporting frugal and reverse innovation, support the development of common definitions of the concepts, and provide policy recommendations for future development.

The study included desk research and a literature review; mapping of frugal and reverse innovations and supporting policies in the EU and HEAC; ten case studies on selected frugal and reverse innovations in the EU and HEAC, conducted through desk research and interviews; a cross-case analysis to systematically analyse the case study findings; additional interviews with relevant innovators, experts, policy makers, social partners and investors; a focus group with key experts in the field of frugal and reverse innovation to refine and validate key concepts; and a policy validation workshop with policy makers and experts.

<sup>7</sup> Council of the European Union. *Preparation of the Council (Competitiveness (Internal Market, Industry, Research and Space)) on 1-2 December 2022: Conclusions on the New European Innovation Agenda – Approval*. Brussels, 17 November 2022. <https://data.consilium.europa.eu/doc/document/ST-14705-2022-INIT/en/pdf>.

<sup>8</sup> European Commission. "The New European Innovation Agenda." Accessed January 2, 2025. [https://research-and-innovation.ec.europa.eu/strategy/support-policy-making/shaping-eu-research-and-innovation-policy/new-european-innovation-agenda\\_en](https://research-and-innovation.ec.europa.eu/strategy/support-policy-making/shaping-eu-research-and-innovation-policy/new-european-innovation-agenda_en).

<sup>9</sup> Malodia, S., Gupta, S., & Jaiswal, A. (2019). Reverse innovation: a conceptual framework. *Journal of the Academy of Marketing Science*, 48(5), 1009–1029. <https://doi.org/10.1007/s11747-019-00703-4>

<sup>10</sup> As promoted in the New European Innovation Agenda and Draghi report to bridge the innovation gap. See: Draghi, Mario. *The future of European Competitiveness*. Brussels: European Commission, September 2024. Accessed November 7, 2024.

[https://commission.europa.eu/topics/strengthening-european-competitiveness/eu-competitiveness-looking-ahead\\_en#paragraph\\_47059](https://commission.europa.eu/topics/strengthening-european-competitiveness/eu-competitiveness-looking-ahead_en#paragraph_47059); European Commission. *Flagship 3: Accelerating and Strengthening Innovation in European Innovation Ecosystems Across the EU and Addressing the Innovation Divide*. New European Innovation Agenda Roadmap. Accessed October 17, 2024. [https://research-and-innovation.ec.europa.eu/strategy/support-policy-making/shaping-eu-research-and-innovation-policy/new-european-innovation-agenda/new-european-innovation-agenda-roadmap/flagship-3-accelerating-and-strengthening-innovation-european-innovation-ecosystems-across-eu-and\\_en](https://research-and-innovation.ec.europa.eu/strategy/support-policy-making/shaping-eu-research-and-innovation-policy/new-european-innovation-agenda/new-european-innovation-agenda-roadmap/flagship-3-accelerating-and-strengthening-innovation-european-innovation-ecosystems-across-eu-and_en).

<sup>11</sup> Fraunhofer ISI & Nesta. (2017). *Study on frugal innovation and reengineering of traditional techniques* (H. Kroll, M. Gabriel, A. Braun, & F. Engasser, Eds.). Directorate-General for Research and Innovation. [https://www.isi.fraunhofer.de/content/dam/isi/dokumente/ccp/2017/Frugal\\_key\\_findings.pdf](https://www.isi.fraunhofer.de/content/dam/isi/dokumente/ccp/2017/Frugal_key_findings.pdf)

<sup>12</sup> Maspons, C. (2021, July 5). *Frugal innovation: challenging the orthodox European philanthropic model of funding innovation*. Philanthropy Europe Association. <https://philea.eu/frugal-innovation-challenging-the-orthodox-european-philanthropic-model-of-funding-innovation/>

<sup>13</sup> The study excludes innovations originating outside of the EU and HEAC.

## Conclusions

### Common definitions of frugal and reverse innovation

Frugal and reverse innovations can share similar interpretations, with reverse innovations sharing the resource-constrained traits of frugal innovations. This study adopts definitions suited to their applicability in the EU and HEAC, tailored for this study, and resource-constrained context:

**Frugal innovations** are products in the wider sense that appeal through their simplicity compared to more complex solutions but with sufficiently similar context-specific utility and robustness. Frugal innovations are further characterised by significant gains in affordability, reduced use of resources in manufacturing and application, lowered cost of ownership and use, and greater ecological compatibility.

**Reverse innovation** is a frugal innovation that is either developed by a low-innovator country in Europe or targeted at low-innovator countries in Europe, and that has demonstrated marketability and scalability in other high-innovator markets in Europe.

The study findings suggest that there is limited awareness at the policy and investment level of these specific innovation concepts.

### Landscape of frugal and reverse innovation in the EU and HEAC

The mapping and scoping of frugal and reverse innovation in the EU and HEAC, identified more frugal innovations in high innovator regions<sup>14</sup> with fewer examples of reverse innovations, highlighting opportunities to strengthen this ecosystem in lower innovator regions to support wider cohesion. Smaller entities drive frugal innovation due to their smaller teams with a dedicated focus on singular, socially orientated innovations. For large companies, frugal innovation is less viable due to lower profitability and internal competition against other non-frugal innovations within the company, which are more likely to be prioritised. Their prevalence in health, automotive, construction and green technology sectors demonstrates the potential to address EU social challenges, an appropriate niche outside of profit-driven markets, and to strengthen EU resilience and autonomy through localised, sustainable supply chains. The policy mapping found that frugal and reverse innovations are not policy priorities at the EU or national level, with few targeted policies or initiatives supporting them. Some examples of policies and related programmes were found which can indirectly support frugal and reverse innovation, most often through sustainability or circular principles. The findings suggest that there is room to improve the promotion of frugal and reverse innovation. Social and sustainability policy frameworks could be an appropriate area where frugal innovation, in particular, could be best supported.

### Opportunities and challenges of frugal and reverse innovation

Within the right context, frugal and reverse innovations can leverage a competitive advantage to meet specific needs, such as affordability and accessibility, or via simplified production. Advances in accessible technology, digital infrastructure and open-source innovation could support the frugal innovation ecosystem, promoting inclusiveness across the Union. Key barriers faced by frugal and reverse innovation include bias favouring established markets in regulation and funding designed for conventional or 'high-tech' innovation, investment opportunities, balancing cost-efficiency ratios including high up-front R&D costs, and cultural perceptions. Frugal innovations align with EU sustainability goals, addressing challenges such as reducing fossil fuel reliance, improving accessible healthcare, and enhancing EU autonomy by promoting local solutions, presenting an

<sup>14</sup> Classifications for 'low' and 'high' innovator countries in this study are based on the European Innovation Scoreboard (EIS) and the Global Innovation Index (GII). Further details on country classification can be found in Section 2.2.

opportunity for the EU to increase its competitiveness against growing emerging external markets.

## Recommendations

Recommendations aimed at EU, national and regional level policy makers to enable European companies to take advantage of frugal and reverse innovation in Europe include:

**Awareness raising** targeted at EU, national, and regional level policy makers:

- Consider establishing a dedicated European frugal innovation group, centre, or office to oversee related initiatives, highlight best practices, offer resources, showcase available policy or financial instruments, and support coordination between organisations working in frugal and reverse innovation fields. A European network of frugal innovators could be considered to connect stakeholders.
- Consider launching targeted and sector-specific educational campaigns about frugal and reverse innovation promoting social innovation at a community (and municipal) level, highlighting key benefits such as cost-effective innovation solutions, and the competitive and cohesive advantages of frugal and reverse innovation.
- Explore the possibility of offering prizes or awards for outstanding frugal or reverse innovations to boost the visibility and credibility of ventures and showcase their value to increase investor and consumer confidence.
- Explore the possibility of developing a model and guidelines for integrating frugal innovation into educational programmes (e.g. for engineering and business trainings) to ensure awareness of frugal innovation principles among new generations of innovators, ventures, and investors.

**Ensure frugal and reverse innovations are recognised and incentivised within policy frameworks.**

- Put efforts into ensuring inclusive policies and regulations which are technology/material neutral to support diverse innovation types and better allow frugal innovators to participate.
- Consider incorporating a 'frugal principle' into existing policy frameworks (especially social and sustainability policy frameworks). Similar to the 'innovation principle', the adoption of frugal criteria could be promoted when there is potential to achieve objectives through cost-effective, resource-efficient methods.
- Consider incentivising frugal innovation by rewarding frugality criteria (simple, economic, cheap, sustainable) with additional points in the current innovation support funding instruments targeting social issues or responses to crises.
- Public procurement should prioritise social and environmentally-orientated solutions. Public-sector adoption could support market access, R&D and scaling for cost-effective solutions.

**Explore international best practices and monitor the frugal and reverse innovation landscape** to enhance frugal and reverse innovation within the EU.

- Extract best practices, relevant and enabling factors in countries successful in frugal and reverse innovation, such as India, China, Japan, Brazil, and Mexico, which could be transposed to the EU.

## Résumé analytique

Les conclusions du Conseil sur le nouvel agenda européen pour l'innovation<sup>15, 16</sup> ont souligné que l'innovation, dans son sens plus large, y compris l'innovation sociétale, sociale, culturelle et du secteur public, est un catalyseur essentiel pour atteindre les objectifs politiques de l'Union, en particulier la transition verte et la transformation numérique, ainsi que les objectifs de développement durable. L'innovation frugale et l'innovation inversée revêtent une grande importance pour l'Union européenne (UE) et les pays associés à Horizon Europe (HEAC), car elles offrent des possibilités de relever des défis de plus en plus importants et d'exploiter le potentiel d'innovation des régions moins novatrices.<sup>17, 18</sup> En promouvant ces concepts, l'UE peut exploiter des solutions rentables locales et obtenir des avantages concurrentiels face à l'influence croissante des économies émergentes, en encourageant des performances socio-économiques plus accessibles et plus durables.<sup>19, 20</sup>

### Objectifs de l'étude et approche méthodologique

Cette étude, vise à fournir une vue d'ensemble de l'innovation frugale et inversée au sein de l'écosystème Horizon Europe depuis 2013,<sup>21</sup> à cartographier les politiques pertinentes soutenant l'innovation frugale et inversée, à soutenir le développement de définitions communes des concepts, et à fournir des recommandations politiques pour le développement futur.

L'étude a comporté une recherche documentaire et une revue de la littérature ; une cartographie des innovations frugales et inversées et des politiques de soutien dans l'UE ainsi que les pays HEAC ; dix études de cas sur des innovations frugales et inversées sélectionnées dans l'UE et les pays HEAC, réalisées au moyen d'une recherche documentaire et d'entretiens ; une analyse transversale pour évaluer systématiquement les résultats des études de cas ; des entretiens supplémentaires avec des innovateurs, des experts, des décideurs politiques, des partenaires sociaux et des investisseurs ; un groupe de discussion avec des experts clés dans le domaine de l'innovation frugale et inversée pour affiner et valider les concepts clés ; et un atelier de validation de la politique avec des décideurs politiques et des experts.

<sup>15</sup> Council of the European Union. *Preparation of the Council (Competitiveness (Internal Market, Industry, Research and Space)) on 1-2 December 2022: Conclusions on the New European Innovation Agenda – Approval*. Brussels, 17 November 2022. <https://data.consilium.europa.eu/doc/document/ST-14705-2022-INIT/en/pdf>.

<sup>16</sup> European Commission. "The New European Innovation Agenda." Accessed January 2, 2025. [https://research-and-innovation.ec.europa.eu/strategy/support-policy-making/shaping-eu-research-and-innovation-policy/new-european-innovation-agenda\\_en](https://research-and-innovation.ec.europa.eu/strategy/support-policy-making/shaping-eu-research-and-innovation-policy/new-european-innovation-agenda_en).

<sup>17</sup> Malodia, S., Gupta, S., & Jaiswal, A. (2019). Reverse innovation: a conceptual framework. *Journal of the Academy of Marketing Science*, 48(5), 1009–1029. <https://doi.org/10.1007/s11747-019-00703-4>

<sup>18</sup> Comme le préconise le nouvel agenda européen de l'innovation et le rapport Draghi pour combler le fossé de l'innovation. Voir : Draghi, Mario. *The future of European Competitiveness*. Brussels: European Commission, September 2024. Accessed November 7, 2024. [https://commission.europa.eu/topics/strengthening-european-competitiveness/eu-competitiveness-looking-ahead\\_en#paragraph\\_47059](https://commission.europa.eu/topics/strengthening-european-competitiveness/eu-competitiveness-looking-ahead_en#paragraph_47059); European Commission. *Flagship 3: Accelerating and Strengthening Innovation in European Innovation Ecosystems Across the EU and Addressing the Innovation Divide*. New European Innovation Agenda Roadmap. Accessed October 17, 2024. [https://research-and-innovation.ec.europa.eu/strategy/support-policy-making/shaping-eu-research-and-innovation-policy/new-european-innovation-agenda/new-european-innovation-agenda-roadmap/flagship-3-accelerating-and-strengthening-innovation-european-innovation-ecosystems-across-eu-and\\_en](https://research-and-innovation.ec.europa.eu/strategy/support-policy-making/shaping-eu-research-and-innovation-policy/new-european-innovation-agenda/new-european-innovation-agenda-roadmap/flagship-3-accelerating-and-strengthening-innovation-european-innovation-ecosystems-across-eu-and_en).

<sup>19</sup> Fraunhofer ISI & Nesta. (2017). *Study on frugal innovation and reengineering of traditional techniques* (H. Kroll, M. Gabriel, A. Braun, & F. Engasser, Eds.). Directorate-General for Research and Innovation. [https://www.isi.fraunhofer.de/content/dam/isi/dokumente/ccp/2017/Frugal\\_key\\_findings.pdf](https://www.isi.fraunhofer.de/content/dam/isi/dokumente/ccp/2017/Frugal_key_findings.pdf).

<sup>20</sup> Maspons, C. (2021, July 5). Frugal innovation: challenging the orthodox European philanthropic model of funding innovation. *Philanthropy Europe Association*. <https://philea.eu/frugal-innovation-challenging-the-orthodox-european-philanthropic-model-of-funding-innovation/>.

<sup>21</sup> L'étude exclut les innovations provenant de l'extérieur de l'UE et de l'HEAC.

## Conclusions

### Définition commun de l'innovation frugale et de l'innovation inversée

Les innovations frugales et inversées peuvent partager des interprétations similaires, les innovations inversées présentant les caractéristiques de contrainte de ressources propres aux innovations frugales. Cette étude adopte des définitions adaptées à leur applicabilité dans l'UE et les pays HEAC, spécifiquement conçues pour cette étude, ainsi qu'aux contextes de contrainte de ressources :

**Les innovations frugales** sont des produits au sens large qui séduisent par leur simplicité par rapport à des solutions plus complexes, mais dont l'utilité et la robustesse spécifiques au contexte sont suffisamment similaires. Les innovations frugales se caractérisent en outre par des gains significatifs en termes d'accessibilité financière, de réduction de l'utilisation des ressources dans la fabrication et l'application, de réduction des coûts de propriété et d'utilisation, et de plus grande compatibilité écologique.

**L'innovation inversée** est une innovation frugale développée par un pays européen à faible capacité d'innovation ou destinée à des pays européens à faible capacité d'innovation, et qui a démontré qu'elle pouvait être commercialisée et mise à l'échelle sur d'autres marchés européens à forte capacité d'innovation.

Les résultats de l'étude suggèrent que ces concepts d'innovation spécifiques sont peu connus au niveau de la politique et de l'investissement.

### Paysage de l'innovation frugale et inversée dans l'UE et la HEAC

Une cartographie et une analyse de l'innovation frugale et inversée dans l'UE et la HEAC ont permis de constater que les innovations frugales étaient plus nombreuses dans les régions à forte capacité d'innovation<sup>22</sup> et qu'il y avait moins d'exemples d'innovations inversées, ce qui met en évidence les possibilités de renforcer cet écosystème dans les régions à faible capacité d'innovation afin de favoriser une plus grande cohésion. Les petites entités favorisent l'innovation frugale grâce à leurs équipes plus petites qui se concentrent exclusivement sur des innovations singulières et à vocation sociale. Pour les grandes entreprises, l'innovation frugale est moins viable en raison d'une rentabilité moindre et de la concurrence interne avec d'autres innovations non frugales au sein de l'entreprise, qui sont plus susceptibles d'être prioritaires. Leur prévalence dans les secteurs de la santé, de l'automobile, de la construction et des technologies vertes démontre le potentiel de relever les défis sociaux de l'UE, une niche appropriée en dehors des marchés axés sur le profit, et de renforcer la résilience et l'autonomie de l'UE grâce à des chaînes d'approvisionnement localisées et durables. L'analyse des politiques a révélé que les innovations frugales et inversées ne sont pas des priorités politiques au niveau européen ou national, et que peu de politiques ou d'initiatives ciblées les soutiennent.

Quelques exemples de politiques et de programmes connexes pouvant soutenir indirectement l'innovation frugale et inversée ont été identifiés, le plus souvent par le biais de la durabilité ou des principes de l'économie circulaire.

### Opportunités et défis de l'innovation frugale et inversée

Dans un contexte approprié, les innovations frugales et inversées peuvent tirer parti d'un avantage compétitif pour répondre à des besoins spécifiques, tels que l'accessibilité économique et matérielle, ou grâce à une production simplifiée. Les progrès en matière de

<sup>22</sup> Les classifications des pays à forte et à faible capacité d'innovation dans cette étude sont basées sur le Tableau de bord européen de l'innovation (TBEI) et l'Indice mondial de l'innovation (IME). Pour plus de détails sur la classification des pays, voir la section 2.2.

technologie accessible, d'infrastructure numérique et d'innovation à logiciel libre pourraient soutenir l'écosystème de l'innovation frugale, en favorisant l'inclusion dans l'ensemble de l'Union. Les principaux obstacles auxquels se heurtent l'innovation frugale et l'innovation inversée sont notamment les préjugés favorisant les marchés établis dans la réglementation et le financement conçus pour l'innovation conventionnelle ou de « haute technologie », opportunités d'investissement, équilibre entre les ratios coût-efficacité y compris les coûts initiaux élevés de la recherche et du développement (R&D) et les perceptions culturelles. Les innovations frugales s'alignent sur les objectifs de durabilité de l'UE, en relevant des défis tels que la réduction de la dépendance aux combustibles fossiles, l'amélioration de l'accessibilité aux soins de santé et le renforcement de l'autonomie de l'UE par la promotion de solutions locales, offrant ainsi à l'UE la possibilité d'accroître sa compétitivité face à des marchés extérieurs émergents en pleine croissance.

## Recommandations

Les recommandations destinées aux décideurs politiques européens, nationaux et régionaux afin de permettre aux entreprises européennes de tirer parti de l'innovation frugale et inversée en Europe. Incluant :

**Sensibilisation** des décideurs politiques aux niveaux européen, national et régional :

- Envisager de créer un groupe, un centre ou un bureau dédié à l'innovation frugale pour superviser les initiatives connexes, mettre en évidence les meilleures pratiques, offrir des ressources, présenter les instruments politiques ou financiers disponibles et soutenir la coordination entre les organisations travaillant dans le domaine de l'innovation frugale et de l'innovation inversée. Un réseau européen d'innovateurs frugale pourrait être envisagé pour relier les parties prenantes.
- Envisager de lancer des campagnes éducatives sectorielles et ciblées sur l'innovation frugale et l'innovation inversée promouvoir l'innovation sociale au niveau de la communauté (et de la municipalité), souligner les avantages clés tels que les solutions d'innovation rentables et les avantages compétitifs et cohésifs de l'innovation frugale et de l'innovation inversée.
- Explorer la possibilité d'offrir des prix ou des récompenses pour les innovations frugales ou inversées les plus remarquables afin de renforcer la visibilité et la crédibilité des entreprises et de mettre en évidence leur valeur pour renforcer la confiance des investisseurs et des consommateurs.
- Explorer la possibilité d'élaborer un modèle et des lignes directrices pour intégrer l'innovation frugale dans les programmes de formation, par exemple, en ingénierie et en commerce, afin de sensibiliser les nouvelles générations d'innovateurs, d'entreprises et d'investisseurs.

**Veiller à ce que les innovations frugales et inversées soient reconnues et encouragées dans les cadres politiques.**

- Déployer des efforts pour garantir des politiques et des réglementations inclusives, neutres sur le plan technologique et matériel, afin de soutenir divers types d'innovation et de mieux permettre aux innovateurs frugaux de participer.
- Envisager d'intégrer le « principe de frugalité » dans les cadres politiques existants (notamment dans les cadres de politiques sociales et de durabilité). À l'instar du 'principe d'innovation', l'adoption de critères frugaux pourrait être encouragée lorsqu'il existe un potentiel pour atteindre les objectifs par des méthodes rentables et économes en ressources.

- Envisager de stimuler l'innovation frugale en récompensant les critères de frugalité (simple, économique, bon marché, durable) par des points supplémentaires dans les instruments actuels de financement du soutien à l'innovation qui visent des questions sociales ou des réponses à des crises.
- Les marchés publics devraient donner la priorité aux solutions à orientation sociale et environnementale. L'adoption par le secteur public pourrait soutenir l'accès au marché, la recherche et le développement (R&D), ainsi que le passage à l'échelle pour des solutions économiquement avantageuses.

**Explorer les meilleures pratiques internationales** afin de renforcer ces innovations au sein de l'UE.

- Identifier les meilleures pratiques ainsi que les facteurs pertinents et facilitants dans les pays ayant réussi à développer des innovations frugales et inversées, comme l'Inde, la Chine, le Japon, le Brésil, et le Mexique, qui pourraient être transposés à l'UE.

## Kurzfassung

Die Schlussfolgerungen des Europäischen Rates zur neuen Europäischen Innovationsagenda betonen, dass Innovation im weiteren Sinne, einschließlich gesellschaftlicher, sozialer, kultureller und öffentlicher Innovationsansätze, ein wesentlicher Faktor für das Erreichen politischer Ziele der Union ist, insbesondere im Hinblick auf den grünen Wandel, die digitale Transformation und die nachhaltigen Entwicklungsziele (SDGs). Frugale und Reverse-Innovationen sind für die Europäische Union (EU) und die mit Horizont Europa assoziierten Länder (HEAC) von großer Bedeutung, da sie Möglichkeiten zur Bewältigung wachsender Herausforderungen und des Innovationspotenzials für weniger innovative Regionen nutzen.<sup>23,24</sup> Durch die Förderung dieser Konzepte kann die EU kosteneffiziente, lokal betriebene Lösungen nutzen und Wettbewerbsvorteile gegenüber dem wachsenden Einfluss der Schwellenländer erlangen, indem sie zugänglichere und nachhaltigere sozioökonomische Ergebnisse fördert.<sup>25,26</sup>

### Ziele der Studie und methodischer Ansatz

Diese Studie untersucht frugale und Reverse-Innovationen im Horizont-Europa-Ökosystem seit 2013<sup>27</sup>. Im Rahmen der Studie werden relevante politische Maßnahmen analysiert und eine einheitliche Definition der verwendeten Begriffe erarbeitet. Basierend auf den Ergebnissen werden Empfehlungen für künftige politische Maßnahmen entwickelt.

Die Studie basierte auf Sekundärforschung und Literaturrecherche. Dabei wurden frugale und Reverse-Innovationen sowie unterstützende politische Maßnahmen in der EU und in assoziierten Horizont-Europa-Ländern (HEAC) erfasst. Ein zentraler Bestandteil der Studie waren zehn Fallstudien zu ausgewählten frugalen und Reverse-Innovationen, die durch Sekundärforschung und Interviews erhoben wurden. Diese Ergebnisse wurden anschließend in einer fallübergreifenden Analyse systematisch ausgewertet. Zusätzlich wurden Interviews mit Innovatoren, Experten, politischen Entscheidungsträgern, Sozialpartnern und Investoren geführt. Eine Fokusgruppe mit Schlüsselexperten diente dazu, zentrale Konzepte zu verfeinern und zu validieren. Abgerundet wurde der Prozess durch einen Policy-Validierungsworkshop mit politischen Entscheidungsträgern und Experten.

### Schlussfolgerungen

#### Definition der Frugalen und Reverse-Innovation

Frugale und Reverse-Innovationen sind sich in vielerlei Hinsicht ähnlich. Reverse-Innovationen teilen die ressourcenoptimierten Eigenschaften frugaler Innovationen. In dieser Studie werden Definitionen verwendet, die für die Anwendbarkeit in der EU und in

<sup>23</sup> Malodia, S., Gupta, S., & Jaiswal, A. (2019). Reverse innovation: a conceptual framework. *Journal of the Academy of Marketing Science*, 48(5), 1009-1029. <https://doi.org/10.1007/s11747-019-00703-4>

<sup>24</sup> Wie in der Neuen Europäischen Innovationsagenda und dem Draghi-Bericht zur Überwindung der Innovationslücke gefordert. Siehe: Draghi, Mario. *The future of European Competitiveness*. Brussels: European Commission, September 2024. Accessed November 7, 2024. [https://commission.europa.eu/topics/strengthening-european-competitiveness/eu-competitiveness-looking-ahead\\_en#paragraph\\_47059](https://commission.europa.eu/topics/strengthening-european-competitiveness/eu-competitiveness-looking-ahead_en#paragraph_47059); European Commission. *Flagship 3: Accelerating and Strengthening Innovation in European Innovation Ecosystems Across the EU and Addressing the Innovation Divide*. New European Innovation Agenda Roadmap. Accessed October 17, 2024. [https://research-and-innovation.ec.europa.eu/strategy/support-policy-making/shaping-eu-research-and-innovation-policy/new-european-innovation-agenda/new-european-innovation-agenda-roadmap/flagship-3-accelerating-and-strengthening-innovation-european-innovation-ecosystems-across-eu-and\\_en](https://research-and-innovation.ec.europa.eu/strategy/support-policy-making/shaping-eu-research-and-innovation-policy/new-european-innovation-agenda/new-european-innovation-agenda-roadmap/flagship-3-accelerating-and-strengthening-innovation-european-innovation-ecosystems-across-eu-and_en).

<sup>25</sup> Fraunhofer ISI & Nesta. (2017). *Study on frugal innovation and reengineering of traditional techniques* (H. Kroll, M. Gabriel, A. Braun, & F. Engasser, Eds.). Directorate-General for Research and Innovation. [https://www.isi.fraunhofer.de/content/dam/isi/dokumente/ccp/2017/Frugal\\_key\\_findings.pdf](https://www.isi.fraunhofer.de/content/dam/isi/dokumente/ccp/2017/Frugal_key_findings.pdf)

<sup>26</sup> Maspons, C. (2021, Juli 5). *Frugal innovation: challenging the orthodox European philanthropic model of funding innovation*. Philanthropy Europe Association. Philanthropy Europe Association. <https://philea.eu/frugal-innovation-challenging-the-orthodox-european-philanthropic-model-of-funding-innovation/>

<sup>27</sup> Innovationen mit Ursprung außerhalb der EU und des HEAC sind von der Studie ausgeschlossen.

den assoziierten Horizont-Europa-Ländern (HEAC) angepasst sowie für den ressourcenbeschränkten Kontext geeignet sind:

**Frugale Innovationen** sind Produkte im weiteren Sinne, die durch einfache Lösungen im Vergleich zu komplexeren Alternativen überzeugen, dabei jedoch einen vergleichbar spezifischen Nutzen und eine hohe Robustheit bieten. Sie zeichnen sich durch bedeutende Gewinne in der Erschwinglichkeit, einen reduzierten Ressourceneinsatz in der Herstellung und Anwendung sowie niedrigere Betriebs- und Nutzungskosten aus.

**Reverse-Innovation** bezeichnet eine kostengünstige Innovation, die entweder in einem Land mit niedrigem Innovationsgrad in Europa entwickelt wurde oder auf solche Länder abzielt. Diese Innovation hat ihre Marktfähigkeit und Skalierbarkeit bereits in europäischen Märkten mit höherem Innovationsgrad unter Beweis gestellt.

Die Ergebnisse der Studie deuten darauf hin, dass das Bewusstsein für diese spezifischen Innovationskonzepte auf der Ebene der Politik und der Investitionen begrenzt ist.

## Überblick über Frugale und Reverse-Innovationen in der EU und den HEAC

Beim Mapping und Scoping frugaler und Reverse-Innovationen in der EU und den assoziierten Ländern wurden mehr frugale Innovationen in Regionen mit hohem Innovationsgrad<sup>28</sup> identifiziert, während es weniger Beispiele für Reverse-Innovationen gab. Hierdurch eröffnen sich Möglichkeiten, das Innovationsökosystem in Regionen mit geringerem Innovationsgrad zu stärken und so breitere Kohäsion in der EU zu fördern. Kleinere, sozial orientierte Unternehmen sind die treibende Kraft hinter frugalen Innovationen. Für größere Unternehmen ist frugale Innovation weniger attraktiv, da sie mit geringerer Rentabilität verbunden ist und unternehmensintern in Konkurrenz zu anderen, nicht-frugalen Innovationen steht, die mit höherer Wahrscheinlichkeit priorisiert werden. Die Beliebtheit frugaler Innovationen in den Bereichen Gesundheit, Automobil, Bauwesen und nachhaltige Technologien verdeutlicht ihr Potenzial, soziale Herausforderungen in der EU anzugehen, eine geeignete Lücke außerhalb gewinnorientierter Märkte zu schließen und die Widerstandsfähigkeit und Autonomie der EU durch lokale, nachhaltige Lieferketten zu stärken. Die Analyse der politischen Maßnahmen ergab, dass frugale und Reverse-Innovationen weder auf EU- noch auf nationaler Ebene politische Prioritäten darstellen und nur wenige gezielte Maßnahmen oder Initiativen zu ihrer Unterstützung existieren. Initiativen, die frugale oder Reverse-Innovationen gezielt fördern, bieten jedoch Chancen für öffentlich-private Partnerschaften und den Kapazitätsaufbau für KMUs und Start-ups. Es wurden einige Beispiele für Maßnahmen gefunden, die indirekt frugale und Reverse-Innovationen unterstützen, meist im Kontext von Nachhaltigkeit oder Kreislaufprinzipien. Die Ergebnisse zeigen, dass die Förderung Frugaler und Reverse-Innovationen verbesserungsbedürftig ist. Sozial- und Nachhaltigkeitspolitik sind geeignete Bereiche, in denen insbesondere frugale Innovationen gezielt unterstützen werden könnten.

## Chancen und Herausforderungen der Frugalen und Reverse-Innovation

Im richtigen Kontext können frugale und Reverse-Innovationen Wettbewerbsvorteile sein, um spezifische Bedürfnisse wie Erschwinglichkeit und Zugänglichkeit zu stillen oder durch vereinfachte Produktionsmethoden zu überzeugen. Fortschritte in der barrierefreien Technologie, der digitalen Infrastruktur und der Open-Source-Innovation könnten das Ökosystem der frugalen Innovation unterstützen und die Inklusivität in der gesamten Union fördern. Zu den wichtigsten Hindernissen für frugale und Reverse-Innovationen gehören regulatorische Bevorzugung zugunsten etablierter Märkte, Fördermittel und Vorschriften, die auf konventionelle oder "Hightech"-Innovationen ausgerichtet sind, eingeschränkte

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<sup>28</sup> Die Klassifizierung von Ländern als ‚innovationsschwache und innovationsstarke Länder‘ in dieser Analyse basiert auf dem Europäischen Innovationsanzeiger (EIS) und dem Globalen Innovationsindex (GII). Weitere Einzelheiten zu diesen Klassifizierungen befinden sich in Abschnitt 2.2.

Investitionsmöglichkeiten, das Gleichgewicht von Kosteneffizienz und hohe F&E-Vorkosten sowie kulturelle Wahrnehmungen. Frugale Innovationen entsprechen den Nachhaltigkeitszielen der EU, da sie Herausforderungen wie die Verringerung der Abhängigkeit von fossilen Brennstoffen, den verbesserten Zugang zur Gesundheitsversorgung und die Stärkung der EU-Eigenständigkeit durch lokale Lösungen angehen. Dies eröffnet der EU die Möglichkeit, ihre Wettbewerbsfähigkeit gegenüber wachsenden, aufstrebenden Märkten zu erhöhen.

## Empfehlungen

Folgende Empfehlungen richten sich an politische Entscheidungsträger auf EU-, nationaler und regionaler Ebene, um europäischen Unternehmen die Nutzung von frugalen und Reverse-Innovationen in Europa zu ermöglichen:

**Sensibilisierung** der politischen Entscheidungsträger auf EU-, nationaler und regionaler Ebene:

- Einrichtung einer europäischen Gruppe, eines Zentrums oder Büros für frugale Innovation, um entsprechende Initiativen zu koordinieren, erfolgreiche Ansätze hervorzuheben, Ressourcen, verfügbare politische oder finanzielle Instrumente bereitzustellen und die Koordination zwischen Organisationen zu unterstützen, die in diesem Bereich arbeiten. Ein europäisches Netzwerk frugaler Innovatoren könnte eingerichtet werden, um Akteure besser miteinander zu vernetzen.
- Einführung gezielter und sektorspezifischer Bildungs- und Sensibilisierungskampagnen über frugale und Reverse-Innovationen zur Förderung der sozialen Innovation auf kommunaler Ebene, wobei besonders die wichtigsten Vorteile wie kosteneffiziente Innovationslösungen sowie Wettbewerbs- und Kohäsionsvorteile hervorgehoben werden.
- Prüfung der Möglichkeit, Preise oder Auszeichnungen für herausragende frugale oder Reverse-Innovationen zu verleihen, um die Sichtbarkeit und Glaubwürdigkeit solcher Projekte zu stärken und deren Wert bei Investoren und Verbrauchern zu steigern.
- Entwicklung eines Modells und Leitlinien für die Integration frugaler Innovationen in Bildungsprogramme (z.B. für Ingenieur- und Wirtschaftsausbildungen), um das Bewusstsein für die Grundsätze frugaler Innovationen bei jüngeren Generationen von Innovator:innen, Unternehmen und Investor:innen zu fördern.

**Sicherstellung der Anerkennung frugaler und Reverse-Innovationen und Förderung innerhalb des politischen Rahmens:**

- Einsatz für integrative, politische Maßnahmen und Vorschriften, die technologie- und materialneutral sind, um verschiedene Innovationsarten zu unterstützen und frugalen Innovatoren Teilnahme zu ermöglichen.
- Aufnahme eines "frugalen Prinzips" in bestehende politische Strukturen (insbesondere im Bereich der Sozial- und Nachhaltigkeitspolitik). Ähnlich wie beim "Innovationsprinzip" könnte die Anwendung von Sparsamkeitskriterien gefördert werden, wenn dadurch Ziele durch kosten- und ressourceneffiziente Methoden erreicht werden können.
- Schaffung von Anreizen für frugale Innovationen durch die Belohnung von Sparsamkeitskriterien (einfach, wirtschaftlich, günstig, nachhaltig) mit zusätzlichen Schwerpunkten in bestehenden Innovationsförderprogrammen für soziale Belange oder Krisenreaktionen.

- Die öffentliche Beschaffung sollte soziale und umweltorientierte Lösungen priorisieren. Die Einführung durch den öffentlichen Sektor könnte den Marktzugang, Forschung und Entwicklung (F&E) sowie die Skalierung kosteneffizienter Lösungen unterstützen.

**Identifizierung international bewährter Verfahren** zur Förderung in der EU.

- Ermittlung bewährter Verfahren, relevanter und unterstützender Erfolgsfaktoren in Ländern, die frugale und Reverse-Innovation erfolgreich implementiert haben, wie zum Beispiel Indien, China, Japan, Brasilien und Mexiko, und die Potenzial für die Übertragbarkeit in die EU aufweisen.

## Abbreviations

AFAD	Disaster and Emergency Management Authority
AI	Artificial Intelligence
BANA	Business Angel Network of Armenia
BEAM	Business with Impact Programme
BIRAC	Biotechnology Industry Research Assistance Council
CC	Creative Commons
CCG	Cormack Consultancy Group
CEE	Central Eastern Europe
CEO	Chief Executive Officer
CHIF	Croatian Health Insurance Fund
CHW	Community Health Worker
COP	Conference of the Parties
CORDIS	Community Research and Development Information Service
DE	Germany
DG-RTD	Directorate-General for Research and Innovation
EBRD	European Bank of Reconstruction and Development
EC	European Commission
EIE	European Innovation Ecosystems
EIS	European Innovation Scoreboard
EISMEA	European Innovation Council and SMEs Executive Agency
EIT	European Institute of Innovation and Technology
EME	Emerging market economies
EU	European Union
EUR	Euro
FARADAI	Frugal and Robust AI for Defence Advanced Intelligence
FR	France
GBP	Great British Pound
GCI	Grand Challenges Israel Incentive Program
GE	General Electric
GII	Global Innovation Index
GIZ	German Corporation for International Cooperation
HE	Horizon Europe
HEAC	Horizon Europe Associated Countries
ICT	Information and Communications Technology
IEEE	Institute of Electrical and Electronics Engineers
IMF	International Monetary Fund
ISBN	International Standard Book Number
IT	Information and Technology
KIS	Knowledge-Intensive Services
LCA	Lifecycle assessments
LEDS	Georgia's Long-Term Low Emission Development Strategy
MASHAV	Israel Agency for International Development Cooperation
MLE	Medium to Large Enterprise

MNC	Multi-national corporation
MSME	Ministry of Micro, Small and Medium Enterprises of India
NATO	North Atlantic Treaty Organisation
NCD	Non-communicable diseases
NEIA	New European Innovation Agenda
NGO	Non-governmental organisation
NHS	National Health Service of England
NIHR ARC NWL	National Institute for Health and Care Research Applied Research Collaboration Northwest London
PAI	Morocco's Industrial Acceleration Plan
PCP	Primary Care Panels
PET	Polyethylene terephthalate
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals
RHU	Relief housing units
RIS	Regional innovation scoreboard
SAP	Systems Applications and Products (Company)
SBIR	Small Business Innovation Research
SDG	Sustainable Development Goals
SECS	Simple, economical, cheap, sustainable
SME	Small and medium-sized enterprises
SMP	Single Market Programme
SOL	Smart Open Lisboa
SP	Solar power
SWOT	Strengths, Weaknesses, Opportunities and Threats
TEMSCON	IEEE Technology and Engineering Management Society
TUHH	Hamburg University of Technology
UAE	United Arab Emirates
UK	United Kingdom
UN	United Nations
UNHCR	United Nations High Commissioner for Refugees
UNICEF	United Nations Children's Fund
UNIDO	United Nations Industrial Development Organization
US	United States
UV	Ultraviolet
VAP	Viability Assessment Projects
VCM	Voluntary carbon market
WADI	Water disinfection device
WEF	World Economic Forum
WFD	Water Framework Directive
WHO	World Health Organisation

# 1. Introduction

The general objective of the study is to produce an overview of frugal and reverse innovation within the Horizon Europe ecosystem, to map policies supporting frugal and reverse innovation in the European Union (EU) and Horizon Europe Associated Countries (HEAC), and to support the development of common definitions for the key concepts. Based on detailed analysis, the study aims to provide recommendations on future policy developments. Specific attention is paid to EU key challenges such as sustainability, circularity, access to healthcare, and security, particularly in the recommendations.

## Scope of the study

The study explores the opportunities of frugal and reverse innovation (as defined in Chapter 2) within the EU, which have the potential to impact both social and economic concerns critical to the Union's future development. The Council Conclusions of 17 September 2022 on the New European Innovation Agenda<sup>29,30</sup> emphasised that innovation, in its broader sense, including societal, social, cultural and public sector innovation, is an essential enabler for achieving the Union's policy objectives, in particular the green transition and digital transformation, as well as the Sustainable Development Goals (SDGs). As such, particular attention in this study is paid to social innovation and innovations most relevant to EU burning issues, including sustainability, circularity, access to healthcare, and security. Moreover, the study considers sectors/areas relevant to the New European Innovation Agenda (NEIA),<sup>31</sup> Draghi report,<sup>32</sup> Letta report,<sup>33</sup> and Competitiveness Compass,<sup>34</sup> such as the innovation divide and improving EU-wide collaboration, scaling and commercialising start-ups and SMEs, regulatory and policy-making issues, resilience and preparedness for future challenges (including competitiveness against emerging markets), social access and inclusivity, and leveraging opportunities in green and health tech.

The **geographic scope** of the study covers EU and Horizon Europe Associated Countries (Armenia, Bosnia and Herzegovina, Georgia, Iceland, Israel, Kosovo, Moldova, Montenegro, North Macedonia, Norway, Serbia, Türkiye, Albania, Faroe Islands, Morocco, Tunisia, Ukraine, and the United Kingdom). The study excludes innovations from outside the EU and HEAC, despite numerous examples of frugal and reverse innovations in these regions, as they were beyond its scope.

While there is no overall **temporal scope** for the study, mapping under Task 1 and Task 2 (data collection for case studies) covers frugal and reverse innovations which have been initiated and/or implemented from 2013 onwards.

<sup>29</sup> Council of the European Union. *Preparation of the Council (Competitiveness (Internal Market, Industry, Research and Space)) on 1-2 December 2022: Conclusions on the New European Innovation Agenda – Approval*. Brussels, 17 November 2022. <https://data.consilium.europa.eu/doc/document/ST-14705-2022-INIT/en/pdf>.

<sup>30</sup> European Commission. "The New European Innovation Agenda." Accessed January 2, 2025. [https://research-and-innovation.ec.europa.eu/strategy/support-policy-making/shaping-eu-research-and-innovation-policy/new-european-innovation-agenda\\_en](https://research-and-innovation.ec.europa.eu/strategy/support-policy-making/shaping-eu-research-and-innovation-policy/new-european-innovation-agenda_en).

<sup>31</sup> European Commission. "The New European Innovation Agenda." Accessed January 2, 2025. [https://research-and-innovation.ec.europa.eu/strategy/support-policy-making/shaping-eu-research-and-innovation-policy/new-european-innovation-agenda\\_en](https://research-and-innovation.ec.europa.eu/strategy/support-policy-making/shaping-eu-research-and-innovation-policy/new-european-innovation-agenda_en).

<sup>32</sup> Draghi, Mario. *The future of European Competitiveness*. Brussels: European Commission, September 2024. Accessed November 7, 2024. [https://commission.europa.eu/topics/strengthening-european-competitiveness/eu-competitiveness-looking-ahead\\_en#paragraph\\_47059](https://commission.europa.eu/topics/strengthening-european-competitiveness/eu-competitiveness-looking-ahead_en#paragraph_47059).

<sup>33</sup> Letta, Enrico. *Much More Than a Market – Speed, Security, Solidarity. Empowering the Single Market to deliver a sustainable future and prosperity for all EU Citizens*. April 2024. Accessed December 9, 2024. <https://www.consilium.europa.eu/media/ny3j24sm/much-more-than-a-market-report-by-enrico-letta.pdf>.

<sup>34</sup> European Commission. *COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE EUROPEAN COUNCIL, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS - A Competitiveness Compass for the EU*. Brussels: European Commission, 2025. Brussels. [https://commission.europa.eu/document/download/10017eb1-4722-4333-add2-e0ed18105a34\\_en](https://commission.europa.eu/document/download/10017eb1-4722-4333-add2-e0ed18105a34_en).

## Methodological approach

The study relied on the following research methods (more details are provided in Annex 1):

- Desk research and literature review. An informative database of sources was compiled and analysed. The list of references used in this report is presented in Annex 5.
- Mapping of frugal and reverse innovations (see Chapter 3 for more details and examples of each type) and policies supporting them (see Chapter 4 for more details). Expanded examples of frugal and reverse innovations and policy landscapes are presented in boxes within the relevant sections, supported by interviews conducted with employees and policy makers.
- Ten case studies were carried out focusing on in-depth analysis of selected frugal and reverse innovations in the EU and HEAC. Case study data was gathered through desk research and interviews. Each case study is presented in Annex 6. Information on the case study selection process, implementation, and methodology is provided in Annex 1. Case study interviews were implemented in a semi-structured manner. In total 69 interviews were conducted as part of case studies (more details are available in Annex 1). The interview questionnaire is provided in Annex 8.
- A cross-case analysis was implemented to systematically analyse the results of the ten case studies. The findings from the interviews and desk research were placed into a dedicated analysis matrix (in the form of an MS Excel file) to ensure that different cases are comparable. A cross-case analysis matrix was developed to analyse the case studies according to the relevant research questions and case types.
- Interviews outside of case studies were conducted to supplement the data gathered through desk research and mapping. Interviewees included frugal innovators, experts in the field of frugal and reverse innovation, policy makers, social partners, and investors. In total, 38 such interviews were conducted.
- A focus group with key experts in the field of frugal and reverse innovation was held on February 13, 2024, to establish a broad understanding of the key concepts in relation to the current EU level policy debate and validate preliminary definitions of frugal and reverse innovation.
- A policy recommendation validation workshop was held on November 13, 2024, to validate the draft policy recommendations. A summary of the workshop is presented in Annex 1.

The specific objectives and related research questions of the study, and the tasks undertaken to address them are presented in Table 1, below.

**Table 1 – Research questions per study objectives and task**

Objective	Research questions	Task
Provide a <b>mapping and scoping</b> of the present volume of support to or implementation of frugal and reverse innovation in the EU and HEAC.	<ul style="list-style-type: none"> <li>• What frugal and reverse innovation can be identified in EU and HEAC? What is the volume of implementation of these innovations?</li> <li>• What policies support frugal and reverse innovation in EU and HEAC? What is the volume (total funding designated) of these policies?</li> <li>• How diverse in terms of market sector and business model are frugal and reverse innovations?</li> <li>• What obstacles (market failures, political or institutional constraints, etc.) prevent the European ecosystem from pursuing frugal and reverse innovation?</li> </ul>	Task 1
Provide <b>orientations</b> to support the development of <b>common definitions/terminology</b> with a sufficiently broad definition of concepts to inform potential future policy measures to support a more comprehensive approach at EU level.	<ul style="list-style-type: none"> <li>• What are the key concepts and terminology related to frugal and reverse innovation? How could they be defined?</li> <li>• What are the main differences in conceptual and linguistic understanding of frugal and reverse innovation in EU/HEAC countries?</li> <li>• What mechanisms related to common definitions/terminology for frugal and reverse innovation can bridge conceptual gaps across different EU/HEAC countries?</li> </ul>	Task 1
<b>Research and present five projects or organisations</b> from the Europe Union or HEAC that successfully implement <b>frugal innovation</b> initiatives with respect to their challenges and opportunities (case studies).	Case-specific questions: <ul style="list-style-type: none"> <li>• How did the case studies unlock the potential for frugal and reverse innovation?</li> <li>• Which obstacles prevented the cases from pursuing frugal/reverse innovation? What specific challenges had the cases to address when pursuing frugal and reverse innovations? Were there any solutions to these challenges (i.e., risk mitigation measures applied)?</li> <li>• What new opportunities pursuing frugal and reverse innovation were created?</li> <li>• How have frugal and reverse innovation of the cases contributed to EU initiatives, such as the European Green Deal and New European Innovation Agenda? Can we identify any specific actions, examples per sector (e.g. energy, food security, circularity, digital, health)?</li> <li>• How has frugal and reverse innovation of the cases complemented to social innovation, social enterprises or other social projects in EU and HEAC?</li> <li>• Is it possible to observe patterns across the case studies in their internal capacities and external conditions conducive to initiating and implementing frugal and reverse innovation?</li> </ul>	Task 2 and Task 3
<b>Research and present five projects or organisations</b> from the Europe Union or HEAC that successfully implement <b>reverse innovation</b> with respect to their challenges and opportunities (case studies).		
<b>Propose future policy developments</b> to enable European companies to take advantage of frugal and reverse innovation in Europe.	<ul style="list-style-type: none"> <li>• How can the Commission include the frugal/reverse innovation in the policy design of the current framework Work Programmes?</li> <li>• How can the Commission develop relevant policy angles in relation to frugal and reverse innovation and the upcoming new European Commission (and Framework Programme 10)?</li> <li>• What are the key opportunities and challenges of frugal/reverse innovation in the European Union and Horizon Europe HEAC?</li> <li>• How European Commission could promote frugal and reverse innovation projects across different policy fields? What strategies and supporting measures the European Commission could undertake?</li> </ul>	Task 4

Source: Visionary Analytics, 2024.

## Structure of the report

The remainder of the report is structured into five sections, including the presentation of the concepts and definitions of frugal and reverse innovation used in the study (Chapter 2); the results of frugal and reverse innovation mapping in the EU and HEAC (Chapter 3); an overview of relevant policies supporting these innovation types (Chapter 4); a discussion on the opportunities and challenges of frugal and reverse innovation based on case studies and relevant findings from the literature review (Chapter 5); and finally, conclusions and recommendations (Chapter 6).

## 2. Concepts of frugal and reverse innovation

This chapter seeks to demonstrate knowledge and understanding of key concepts and definitions used in this study, specifically frugal innovation and reverse innovation. The chapter answers the following research question: *What are the key concepts and terminology related to frugal and reverse innovation? How could they be defined?* These concepts and definitions were based on an extensive literature review and finalised following a focus group discussion with key experts in the field.

Frugal and reverse innovation are two widely used concepts that are marked by significant **ambiguity**, having varying meanings depending on the context in which they are applied.<sup>35</sup> Moreover, similar interpretations of the two concepts are a result of many reverse innovations having a resource-constrained or frugal origin. This was evident in both the focus group discussions and the analysis of the literature. Considering the relevance and applicability of this report for resource-constrained innovators within the EU and HEAC, this report adopts a definition of reverse innovation that embraces notions of cost- and resource-constraints in the European context. Detailed definitions of frugal and reverse innovation and their reasoning are presented below.

### 2.1. Frugal innovation

The term frugal innovation first came to prominence with a 2015 book by Navi Radjou and Jaideep Prabhu on “Frugal Innovation.”<sup>36</sup> This was preceded by earlier work by these authors together with Simone Ahuja on “Jugaad Innovation,”<sup>37</sup> by Prahalad & Hart on “innovation at the bottom of the pyramid,”<sup>38</sup> and by popular managerial accounts such as Carlos Goshn’s reference to “frugal engineering” at Renault-Nissan in 2006,<sup>39</sup> or the Economist’s (2009) report on frugal innovators in India.<sup>40</sup> These accounts prepared the ground for the acceptance that successful innovation did not have to originate from research and development (R&D) labs of Western multinational enterprises wielding high-tech equipment aimed at affluent customers.

However, while frugal innovation has its roots in resource-constrained contexts, it is increasingly practised and implemented by global multinationals.<sup>41</sup> To elevate frugal

<sup>35</sup> Hadengue, Marine, Nathalie de Marcellis-Warin, and Thierry Warin. “Reverse Innovation: A Systematic Literature Review”. *International Journal of Emerging Markets* 12, no. 2 (1 January 2017): 142–82. <https://doi.org/10.1108/IJoEM-12-2015-0272>; Hindocha, Chandni N., Grazia Antonacci, James Barlow, and Matthew Harris. “Defining frugal innovation: a critical review.” *BMJ Innovations* 7, no. 4 (2021).

<sup>36</sup> Radjou, Navi, and Jaideep Prabhu. *Frugal Innovation: How to do more with less*. The Economist, 2015.

<sup>37</sup> Radjou, Navi, Jaideep Prabhu, and Simone Ahuja. *Jugaad innovation: Think frugal, be flexible, generate breakthrough growth*. John Wiley & Sons, 2012.

<sup>38</sup> Prahalad, Coimbatore Krishna. “Bottom of the pyramid as a source of breakthrough innovations.” *Journal of product innovation management* 29, no. 1 (2012): 6-12.

<sup>39</sup> Agarwal, Nivedita, and Alexander Brem. “Frugal innovation-past, present, and future.” *IEEE Engineering Management Review* 45, no. 3 (2017): 37-41.

<sup>40</sup> The Economist. “Lessons from a Frugal Innovator.” *The Economist*, April 16, 2009. Accessed November 22, 2024. <https://www.economist.com/business/2009/04/16/lessons-from-a-frugal-innovator>.

<sup>41</sup> Dabić, Marina, Tena Obradović, Božidar Vlačić, Sreevas Sahasranamam, and Justin Paul. “Frugal innovations: A multidisciplinary review & agenda for future research.” *Journal of Business Research* 142 (2022): 914-929.

innovation from its context-driven, coincidental and unsystematic Jugaad-type environment, various authors<sup>42</sup> proposed **substantial cost reduction, a focus on core functionalities, and optimised performance** as defining features of frugal innovation. Given its association with resource-constrained environments, frugal innovation was soon interpreted as an instrument to improve sustainable development<sup>43</sup> and contribute to industrial efforts on circularity and ecological sustainability. Weyrauch & Herstatt<sup>44</sup> emphasised scalability as an aspect of performance improvement and also noted the increased acceptance of frugal innovations as part of lifestyle choices. In a similar vein, Hussain et al.<sup>45</sup> highlighted that frugal innovation often serves customers otherwise overlooked, raising the potential for frugal innovation to be used as an instrument in social development and innovation.

Socially equitable development is a central ambition of the European Union, and therefore we include in our definition the results of a report conducted for the European Commission.<sup>46</sup> In the 2016 EU-commissioned report, three main criteria were used: a frugal innovation represents a solution that is simple, robust, and fit to requirements; the underlying innovation process is needs-driven, scalable and a creative response to conditions of scarcity; the innovation has socio-economic potential being affordable, resource-efficient, and transformative. Taking this into account, the developed working definition proposed is as follows:

**Frugal innovations** are products in the wider sense that appeal through their simplicity compared to more complex solutions but with sufficiently similar context-specific utility and robustness. Frugal innovations are further characterised by significant gains in affordability, reduced use of resources in manufacturing and application, lowered cost of ownership and use, and greater ecological compatibility.

By “products in the wider sense” we mean to include services and processes that are often either productised or at least serve as components in an eventual customer-facing product system. We thus explicitly recognise the potential of frugal innovation to replace costly and resource-intensive interim products and internal process steps as part of the overall value chain, with the end product remaining indistinguishable from the result of an earlier, non-frugal process. Rendering products, product components, or processes ‘frugal’ (i.e., developing frugal innovations anywhere during the innovation value chain) is therefore often a costly investment that must be counterbalanced by the reduced resource-utilisation and reduce the cost of ownership and maintenance over the ensuing product lifecycle.

Yet, this definition is still broad and difficult to apply empirically. To overcome this, we developed a more precise operationalisation, in which we identified four core mutually exclusive characteristics of frugal innovation. These characteristics are as follows and are abbreviated as the **SECS criteria**:

- **Simple (S)** = reduced functionality, defeatured, focus on core functionality, easy-to-use.
- **Economical (E)** = developed and manufactured under resource-constraints.

<sup>42</sup> Zeschky, Marco, Bastian Widenmayer, and Oliver Gassmann. “Frugal Innovation in Emerging Markets”. *Research-Technology Management* 54, no. 4 (July 2011): 38–45. <https://doi.org/10.5437/08956308X5404007>.

<sup>43</sup> For example: Rosca, Elisabeta, Jennifer Reedy, and J. Claudia Bendul. “Does Frugal Innovation Enable Sustainable Development? A Systematic Literature Review.” *European Journal of Development Research* 30 (2018): 136–157. <https://doi.org/10.1057/s41287-017-0106-3>.

<sup>44</sup> Weyrauch, Timo, and Cornelius Herstatt. “What is frugal innovation? Three defining criteria.” *Journal of frugal innovation* 2 (2017): 1–17.

<sup>45</sup> Hossain, Mokter. “Frugal innovation: a systematic literature review.” *Available at SSRN* 2768254 (2016). <https://doi.org/10.2139/ssrn.2768254>.

<sup>46</sup> European Commission: Directorate-General for Research and Innovation, Fraunhofer ISI and Nesta. *A Conceptual Analysis of Foundations, Trends and Relevant Potentials in the Field of Frugal Innovation (for Europe)*. Brussels: Publications Office, 2016. <https://op.europa.eu/en/publication-detail/-/publication/b05d038d-1c5f-480a-b3ec-f1094e3120ce>.

- **Cheap (C)** = offered at a significantly lower price than comparable reference products, lower cost of ownership for the customer.
- **Sustainable (Su)** = reduced total product lifecycle costs, lowered ecological footprint.

This operationalisation suggests that a frugal innovation is simple to use, economical in its design, cheap compared to alternative products, and sustainable in its life-long use and existence. But importantly, with this operationalisation, we also assume that frugal innovation is not necessarily a dichotomous but rather a polychotomous phenomenon. That is, the frugality of innovation does not simply exist or not but can have different degrees, possessing all characteristics or only some. Based on this, we identify **four degrees of frugality of innovation**:

- A **strongly frugal** innovation meets all four SECS criteria; therefore, it has the highest degree of frugality.
- A **moderately frugal** innovation meets any three of the SECS criteria. For example, this sort of innovation can be simple, economical and cheap but not sustainable. In other words, an innovation can be defeatured, simple to use, developed under resource-constraints and highly affordable but without any contribution to a lowered ecological footprint. Nevertheless, while these innovations lack one of the key criteria, they are characterised by the other three.
- A **weakly frugal** innovation meets only two of the SECS criteria. For example, such an innovation can be cheap and economical but not simple and sustainable. Or it can be economical and sustainable but not simple and cheap. In general, weakly frugal innovations can include a broad range of innovations, which among other characteristics may also have some of those that define frugal innovation.
- And finally, if an innovation meets only one of the SECS criteria, it is **not frugal**. For example, such an innovation can be defeatured and simple or economical in its use of resources, or just cheap, or have a focus on sustainability, but that does not make it frugal.

## 2.2. Reverse innovation

Reverse innovation was first coined by Immelt et al.<sup>47</sup> as an innovation initially designed, developed and produced for and in emerging markets and that subsequently diffuses or trickles up to developed markets. This articulation of reverse innovation limited the scope of reverse innovation strictly to emerging markets. Based on their definition and initial instances they presented (the GE electrocardiogram and the portable ultrasound machine), scholars and practitioners recognised reverse innovation as opposite to glocalisation.<sup>48,49</sup> In addition, the frugal aspect of these cases encouraged scholars to conceptually associate reverse innovation with frugal innovation, which resulted in the view of frugal innovation as a necessary precedent to reverse innovation.<sup>50</sup>

<sup>47</sup> Immelt, Jeffrey R., Vijay Govindarajan, and Chris Trimble. "How GE is disrupting itself." *Harvard business review* 87, no. 10 (2009): 56-65.

<sup>48</sup> As per Immelt et al. (2009), glocalization is an approach where a home-based product is distributed on a global scale, with some modifications to accommodate local preferences.

<sup>49</sup> Immelt, Jeffrey R., Vijay Govindarajan, and Chris Trimble. "How GE is disrupting itself." *Harvard business review* 87, no. 10 (2009): 56-65.

<sup>50</sup> Zeschky, Marco, Bastian Widenmayer, and Oliver Gassmann. "Frugal Innovation in Emerging Markets". *Research-Technology Management* 54, no. 4 (July 2011): 38-45. <https://doi.org/10.5437/08956308X5404007>; Hossain, Mokter. "Frugal innovation: a systematic literature review." Available at SSRN 2768254 (2016). <https://doi.org/10.2139/ssrn.2768254>.

In 2012, Trimble clarified that “a reverse innovation is any innovation that is adopted first in the emerging markets. To be clear: what makes an innovation a reverse innovation has nothing to do with where the innovators are, and it has nothing to do with where the companies are. It has only to do with where the customers are.”<sup>51</sup> Exploring the early conception and product development stages of innovations, von Zedtwitz et al.<sup>52</sup> refined the definition as that “reverse innovation can be any type of global innovation that, at some stage during the innovation process, is characterised by a reversal of flow of innovation from a developing to an advanced country, and that is eventually introduced to an advanced country.”<sup>53</sup> These clarifications framed reverse innovation as an international business phenomenon rather than one derived from the socio-economic context of the markets in which it is conceptualised. Note that while neither Immelt et al.,<sup>54</sup> Trimble,<sup>55</sup> or von Zedtwitz et al.<sup>56</sup> require a reverse innovation to be frugal, Zeschky et al.<sup>57</sup> or Simula et al.<sup>58</sup> suggest that reverse innovations originate as frugal or at least as cost innovations.

Within the scope of this study, innovation flows between EU and HAEC are covered. In addition, to include innovations created outside EU and HEAC (for instance, from China or India) but with potentially meaningful adoption as reverse innovations at the European level, we incorporate the extended reverse innovation model as introduced by von Zedtwitz et al.<sup>59</sup> and focus on low innovator European markets as the target adopters of reverse innovations. Many reverse innovations originate from China and India, but it is not possible to study reverse innovations at the time of creation, as they only become ‘reverse’ once they are introduced in a developed country – typically sometime after a successful launch in their home country. Therefore, we track only those innovations that have eventually been adopted in the EU.

A problem that remains a challenge in operationalising reverse innovation, whether in the European context or worldwide, is the lack of agreement over what constitutes a ‘developing’ or an ‘advanced’ country. Differing definitions between global organisations (e.g. The United Nations, WEF, IMF, etc.) place key countries into different categories, and – to make matters more complicated – their membership switches as underlying economic parameters change from one year to another. Another challenge in operationalising reverse innovation, discussed during the focus group, is the economic differences within countries. Some regions of the country can be advanced while other regions in the same country can be considered developing. While it may be possible to classify regions as ‘developed’ or ‘developing’, this is beyond the scope of this study. Even more difficult is the localisation of innovation (invention, development, market introduction) at such a granular level, for which even the innovating companies themselves often lack sufficient data. Finally, as discussed during the focus group, the same differences could be observed between different economic sectors.

In the context of this study, we used the two most relevant indices to allocate countries to ‘developing’ or ‘advanced’ – the European Innovation Scoreboard (EIS) and the Global Innovation Index (GII). These indices allocate countries into three and four categories, respectively. We used a mixed index of EIS (2023) and GII (2023) to assign EU member

<sup>51</sup> Trimble, Chris. "Reverse innovation and the emerging-market growth imperative." *Ivey Business Journal* 76, no. 2 (2012): 19-21.

<sup>52</sup> Von Zedtwitz, Max, Simone Corsi, Peder Veng Søberg, and Romeo Frega. "A typology of reverse innovation." *Journal of Product Innovation Management* 32, no. 1 (2015): 12-28. <https://doi.org/10.1111/jpim.12181>.

<sup>53</sup> *Ibid.*

<sup>54</sup> Immelt, Jeffrey R., Vijay Govindarajan, and Chris Trimble. "How GE is disrupting itself." *Harvard business review* 87, no. 10 (2009): 56-65.

<sup>55</sup> Trimble, Chris. "Reverse innovation and the emerging-market growth imperative." *Ivey Business Journal* 76, no. 2 (2012): 19-21.

<sup>56</sup> Von Zedtwitz, Max, Simone Corsi, Peder Veng Søberg, and Romeo Frega. "A typology of reverse innovation." *Journal of Product Innovation Management* 32, no. 1 (2015): 12-28. <https://doi.org/10.1111/jpim.12181>.

<sup>57</sup> Zeschky, Marco B., Stephan Winterhalter, and Oliver Gassmann. "From cost to frugal and reverse innovation: Mapping the field and implications for global competitiveness." *Research-Technology Management* 57, no. 4 (2014): 20-27.

<sup>58</sup> Simula, Henri, Mokter Hossain, and Minna Halme. "Frugal and Reverse Innovations – Quo Vadis?" *Current Science* 109, no. 9 (2015): 1567–72.

<sup>59</sup> Von Zedtwitz, Max, Simone Corsi, Peder Veng Søberg, and Romeo Frega. "A typology of reverse innovation." *Journal of Product Innovation Management* 32, no. 1 (2015): 12-28. <https://doi.org/10.1111/jpim.12181>.

states and HEACs into one of two categories: 'high innovators' have a (rounded) EIS score of at least 100 and a (rounded) GII score of at least 50; all other countries are part of the 'low innovator' group. This results in the following country allocation (detailed innovation scores are presented in Annex 2):

- **High innovators:**
  - EU countries: Austria, Belgium, Denmark, Estonia, Finland, France, Germany, Ireland, Luxembourg, Netherlands, Sweden.
  - HEAC: Iceland, Israel, Norway, Switzerland, United Kingdom.
- **Low innovators:**
  - EU countries: Bulgaria, Croatia, Cyprus, Czech Republic, Greece, Hungary, Italy, Latvia, Lithuania, Malta, Poland, Portugal, Romania, Slovakia, Slovenia, Spain.
  - HEAC: Albania, Armenia, Bosnia and Herzegovina, Faroe Islands, Georgia, Kosovo, Moldova, Montenegro, Morocco, North Macedonia, Serbia, Tunisia, Türkiye, Ukraine.

Regional differences are not considered within the study as no scientific or systematic conceptualisation of 'reverse innovation' at the regional level was found. We furthermore do not consider sectoral differences among countries as no reliable measures to compare innovation performance at the sectoral level exist across industries. The above definition of high/low innovator membership permits mapping and accounting for reverse innovation flows within Europe.

Hence, stemming from the classification of EU and HEAC and the scope of the report we provide the following definition:

**Reverse innovation** is a frugal innovation that is either developed by a low innovator country in Europe or targeted at low innovator countries in Europe, and that has demonstrated marketability and scalability in other high innovator markets in Europe.

We acknowledge the potential of this definition to include foreign innovating entities to target European markets with products developed in their own, resource-constrained home countries and remind the reader that European policy is not likely interested in supporting the import of low-cost products from abroad. This, however, is a problem to be solved at the policy level, not the definition level.

The classification of EU and HEAC by innovation capabilities is also useful for another purpose. All countries classified as low innovators, except for Italy, Portugal and Spain, which experience economic hardship of a different nature, are also representatives of a type that in the economic development and innovation literature<sup>60</sup> is commonly defined as 'emerging market economies' (EME). These economies are of particular interest to the current study because one of its specific aims is to build a deeper understanding of the existing market conditions and potential policy interventions for frugal and reverse innovation in emerging economies.

As a general category, EMEs are typically defined as those economies, which due to high speeds of market liberalisation, industrialisation, economic growth and integration into the World economy, experience a fast transition towards the middle-income or high-income

<sup>60</sup> Govindarajan, Vijay, and Ravi Ramamurti. "Reverse innovation in emerging markets." *Innovation in Emerging Markets* (2016): 140-157. [https://doi.org/10.1057/9781137480293\\_8](https://doi.org/10.1057/9781137480293_8).

status. Yet, some ambiguity exists when it comes to empirical operationalisation, as exact country groupings may differ depending on the specific purpose and criteria used. This is well evident from country classifications by international development organisations. The World Bank, based on the national income per capita, classifies all EU countries as High-Income economies, except for Bulgaria, which is classified as Upper Middle Income. Similarly, all HEACs, except for Iceland, Israel, Norway, Switzerland, and the United Kingdom are classified as either Upper Middle Income or Lower Middle Income.<sup>61</sup> Similarly, the International Monetary Fund differentiates between Advanced Economies and Emerging Market and Developing Economies.<sup>62</sup> The latter category includes all new EU member states from Central Eastern Europe (CEE), West Balkan countries as well as HEACs from East Europe, Middle East and North Africa. These countries are also viewed as EMEs by the European Bank for Development and Reconstruction.<sup>63</sup>

The existing ambiguity with regards to classifying new EU member states from CEE is particularly important. While all of them have experienced high rates of economic convergence with advanced economies, their industrial structures and innovation capacities still resemble emerging economies more than advanced economies. Thus, their process of catching up is not yet complete. Their success will strongly depend on their ability to innovate and escape the so-called middle-income trap.<sup>64</sup> In this regard, CEE countries should be considered a special case of emerging economies, while the results of the current study will constitute a productive contribution to steering structural changes in these countries.

### 3. Overview of frugal and reverse innovation in the EU and HEAC

This chapter aims to answer two research questions. First, *what frugal and reverse innovations can be identified in EU and HEAC, and what is the volume of implementation of these innovations?* Second, *how diverse in terms of market sector and business model are frugal and reverse innovations?* The study does not consider innovations originating outside of the EU and HEAC. While there are abundant examples of frugal and reverse innovations outside of the EU and HEAC, this was deemed outside of the scope of the study. To answer these questions, the chapter draws on the database of examples of frugal and reverse innovations developed for the purpose of this study. In addition, findings from the database are complemented by findings from the existing literature.

#### 3.1. Methodological note

To gain an overview of recent developments of frugal and reverse innovations in the EU and HEAC, and to reflect their existing variety, examples of these innovations were collected in a database. This process involved several methods, including leveraging the expert knowledge and network of the project team, conducting a literature review,

<sup>61</sup> Hamadeh, Nada, Catherine Van Rompaey, Eric Metreau, and Shwetha Grace Eapen. "New World Bank Country Classifications by Income Level: 2022-2023." *World Bank Blogs*, July 1, 2022. <https://blogs.worldbank.org/en/opendata/new-world-bank-country-classifications-income-level-2022-2023>.

<sup>62</sup> International Monetary Fund. *World Economic Outlook: April 2021*. Washington, DC: International Monetary Fund, April 2021. <https://www.imf.org/en/Publications/WEO/Issues/2021/03/23/world-economic-outlook-april-2021>.

<sup>63</sup> European Bank for Reconstruction and Development. *Transition Report 2020-21*. London: European Bank for Reconstruction and Development, 2020. <https://www.ebrd.com/news/publications/transition-report/transition-report-202021.html>.

<sup>64</sup> For example, Radosevic, Slavo, Deniz E. Yoruk, and Esin Yoruk. "Technology upgrading and growth in Central and Eastern Europe." In *Social and Economic Development in Central and Eastern Europe*, pp. 178-204. Routledge, 2019; Kalanta, Marius. "Middle-income trap and the Baltic States: common challenges, different strategies." *Politologija* 2 (110) (2023): 8-47. <https://doi.org/10.15388/Polit.2023.110.1>; Györfy, Dóra. "The middle-income trap in Central and Eastern Europe in the 2010s: institutions and divergent growth models." *Comparative European Politics* 20, no. 1 (2022): 90-113. <https://doi.org/10.1057/s41295-021-00264-3>.

performing web searches, using AI tools to collect additional suggestions, and conducting an online survey of relevant people in the field.

All entries in the database were assessed according to the definitions of frugal and reverse innovation used in this study (Chapter 2). The criteria for operationalising these definitions are presented in Table 2. Additional information on frugal and reverse innovations was collected across several relevant dimensions, based on the existing literature. These dimensions included innovation type, industrial sector, type of entity, and degree of frugality, among others, and are presented in full in Table 2. Based on the existing research and typologies, each dimension was presumed to have several categories (or sub-types). For the innovation type dimension, a well-established typology is used which differentiates between product/service, process, and business model innovations.<sup>65</sup> For industrial sectors, the classification used by the European Commission is applied, which groups economic activities by technology and knowledge intensity.<sup>66</sup> As frugal and reverse innovation can be developed by various types of entities and for different purposes, there is an attempt to distinguish between firm-led for-profit innovations, NGO- and social enterprise-led innovations aimed at solving certain societal challenges, and innovations that are led by local communities to address their needs.<sup>67</sup> This allows for the inclusion of social innovation in the scope of the mapped innovations.

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<sup>65</sup> For example: Prabhu, Jaideep. "Frugal innovation: doing more with less for more." *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences* 375, no. 2095 (2017): 20160372.

<sup>66</sup> Eurostat. "High-Tech Classification of Manufacturing Industries." Accessed October 17, 2024.

[https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:High-tech\\_classification\\_of\\_manufacturing\\_industries](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:High-tech_classification_of_manufacturing_industries); Eurostat. "Knowledge-Intensive Services (KIS)." Accessed October 17, 2024. [https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Knowledge-intensive\\_services\\_\(KIS\)](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Knowledge-intensive_services_(KIS)).

<sup>67</sup> Knorringa, Peter, and Saradindu Bhaduri. *Frugal Innovation in EU Research and Innovation Policy*. Written for DG Research and Innovation, European Commission. CFIA Working Paper Series, 2020.

**Table 2 – Criteria and analytical dimensions for mapping frugal and reverse innovations.**

Dimension	Criteria/presumed categories
<b>Membership criteria for frugal innovation</b>	
<b>Has at least some degree of frugality</b>	<ul style="list-style-type: none"> <li>• <b>Simple</b> = reduced functionality, defeatured, focus on core functionality, easy-to-use.</li> <li>• <b>Economical</b> = developed and manufactured under resource-constraints.</li> <li>• <b>Cheap</b> = offered at a significantly lower price than comparable reference products, lower cost of ownership for the customer.</li> <li>• <b>Sustainable</b> = reduced total product lifecycle costs, lowered ecological footprint.</li> </ul>
<b>Membership criteria for reverse innovation</b>	
<b>Types of innovation flows</b>	<ul style="list-style-type: none"> <li>• <b>Low EU/HEAC – low EU/HEAC – high EU/HEAC type:</b> innovation developed by entities from <b>lower</b> innovator EU/HEA countries for <b>lower</b> innovator EU/HEA countries (mainly Eastern, Central Eastern and Southern European) and later introduced in <b>higher</b> innovator EU/HEA countries (mainly Western European).</li> <li>• <b>High EU/HEAC – low EU/HEAC – high EU/HEAC type:</b> innovation developed by entities from <b>higher</b> innovator EU/HEA countries for <b>lower</b> innovator EU/HEA countries (mainly Eastern, Central Eastern and Southern European) and later introduced in <b>higher</b> innovator EU/HEA countries (mainly Western European).</li> <li>• <b>EU/HEAC – low non-EU/HEAC – EU/HEAC type:</b> innovation developed by EU/HEAC entities or their subsidiaries for other developing countries (e. g. India) and later introduced in the EU/HEAC.</li> </ul>
<b>Additional analytical dimensions</b>	
<b>Innovation types</b>	<ul style="list-style-type: none"> <li>• Product/service</li> <li>• Process</li> <li>• Business model</li> </ul>
<b>Industrial sectors</b>	<ul style="list-style-type: none"> <li>• High- and medium high-technology manufacturing</li> <li>• Low- and medium low-technology manufacturing</li> <li>• Knowledge-intensive services</li> <li>• Non-knowledge-intensive services</li> </ul>
<b>Innovating entity and intend</b>	<ul style="list-style-type: none"> <li>• Firm-led profit-driven</li> <li>• NGO- &amp; social enterprise-led societal challenges-driven</li> <li>• Community-led local constraints-driven</li> </ul>

Source: Visionary Analytics, 2024.

After collecting the initial data, senior expert team members validated each example and only those examples that successfully achieved expert consensus were included in the final database. The database of mapped innovations can be found in Annex 3 of this report.

It is important to stress the limitations of the resulting database. Initial extensive desk research and discussions with the project experts have shown that **no reliable and exhaustive sources of frugal and reverse innovations exist**, meaning that a representative quantitative mapping of *all* frugal and reverse innovations developed in the EU and HEAC, or elsewhere, is not possible. This is mainly due to frugal and reverse innovations being a relatively small fraction of all innovation activities. As such, they are not subject to any formal reporting for taxation or statistical purposes.

In addition, how innovations are labelled depends on the company marketing them, and they may not use the terms 'frugal' and 'reverse' in association with their products for various market-specific reasons. Furthermore, entities developing frugal and reverse innovation are highly heterogeneous in organisational form, size and sector, and for many of them, frugal and/or reverse innovation constitutes only a part of their activities. These entities do not share many common interests, which possibly explains why there are no dedicated business associations or other forms of organised interests, such as consultancy

networks.<sup>68</sup> This is different from, for example, deep-tech start-ups, which are well-mobilised and whose associations typically produce relevant statistical data. Finally, like all products, frugal or reverse innovations have limited product lifecycles. Thus, existing frugal and reverse innovations were harder to identify if they were no longer actively marketed at the time of research in 2024, as supporting information from product and sales websites was unavailable. Due to these limitations, the database cannot be considered fully exhaustive and representative of all frugal and reverse innovations developed in the EU and HEAC over the last decade. Nevertheless, the mapping was run until relatively full saturation had been achieved, and the resulting database can be considered a good representation of the landscape of this sort of innovation.

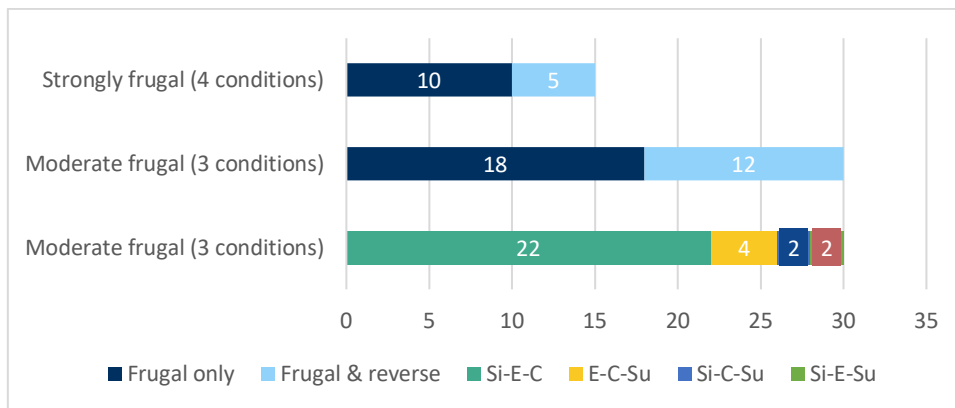
### 3.2. Results of mapping frugal and reverse innovation

An extensive search of relevant innovations resulted in a database of 186 examples developed in the EU and HEAC. Among them, 78 examples were developed before 2013, while 108 examples had only a limited degree of frugality and were considered 'normal' innovations but with some elements of frugality. These examples were excluded and after the data validation procedure, 45 examples were identified to fully meet the scope of the current study. That is, they were developed during the last decade (2013-2023) and possess a sufficiently large degree of frugality, which equals at least three SECS characteristics. These 45 innovations, representing the core database of examples, are analysed in more detail below.

Figure 1 shows the distribution of innovations in the core database by the degree of frugality and whether the innovations are reverse. The database contains 15 examples of strongly frugal and 30 examples of moderately frugal innovations. Among them, 17 innovations, or slightly above one-third, represent the reverse type. The bottom bar in Figure 1 shows the distribution of combinations of different criteria of frugality among the moderately frugal innovations. Here, two-thirds of innovations represent the Si-E-C combination, that is, these innovations, in their core characteristics, are simple, economical and cheap. Importantly, the distribution also shows that sustainability (Su), at least among moderately frugal innovations in the core database of this study, is a less widespread feature. It suggests that **if an innovation is to lack some features of frugality, this is most likely to be sustainability**. This finding might seem somewhat contradictory to the findings in the existing literature, where frugal innovation, due to its resource-constrained nature, has been commonly perceived as an instrument to increase circularity and ecological sustainability.<sup>69</sup> Thus, two explanations are relevant. First, many examples of frugal innovation collected in the database demonstrate that sustainability was not the primary motivation for their development but emerged as a byproduct of the innovation's frugality. Second, as the database is based on publicly available information, the sustainability dimension was only assessed at a surface level, indicated by such characteristics as the reduction of resources used or waste generated. However, more industrial sector-specific characteristics of sustainability were not possible to assess.

<sup>68</sup> Interview with expert. August 14, 2024.

<sup>69</sup> Kroll, Henning, and Madeleine Gabriel. "Frugal innovation in, by and for Europe." *International Journal of Technology Management* 83, no. 1-3 (2020): 34-54; 2020.

**Figure 1: Distribution of innovations by the degree and combination of frugality**

Source: Visionary Analytics, 2024.

Among the reverse innovations in the database, the dominant type of global innovation flow, with 15 represented innovations, is EU/HEAC - low non-EU/HEAC - EU/HEAC. This type of innovation flow, also known as **weak reverse 'Spill-Back Innovation'** in the existing literature,<sup>70</sup> characterises innovations designed and developed in advanced EU/HEAC countries for developing non-EU/HEAC markets and later re-introduced (commercialised) to advanced EU/HEAC countries. mOm baby incubators,<sup>71</sup> Renault Kwid cars,<sup>72</sup> and Desolenator<sup>73</sup> are good examples of this. For example, Desolenator (presented as a mini-case in Box 1) shows how global challenges and EU sustainability goals might influence further 'Spill-Back Innovation' as the needs, and therefore markets, of advanced EU/HEAC countries change. The other two reverse innovations in the database represent a low EU/HEAC - low EU/HEAC - high EU/HEAC flow, also known as 'Reverse Product Lifecycle' innovation, but only geographically restricted to EU/HEAC countries. This type involves innovations that were developed in low innovator EU/HEAC countries for home or other low innovator EU/HEAC countries' markets and later successfully introduced in high innovator EU/HEAC countries. The two examples of this type are Continest foldable containers,<sup>74</sup> first developed and introduced in Hungary and later marketed in Western European countries, and LITUA furniture<sup>75</sup> developed in Lithuania for the purpose of equipping bomb-shelters, military field hospitals and command posts in Ukraine and now demonstrating a high prospect of becoming a NATO supplier. LITUA furniture is analysed in more detail as a case study (see Annex 6).

### Box 1. Desolenator 'SP40'

**Desolenator, a Dutch SME founded in 2014, addresses global water scarcity with its solar-powered desalination system, the SP40.** The green technology is designed to convert seawater and brackish water into safe, drinkable water, offering a sustainable, zero-emission alternative to traditional desalination methods.<sup>76</sup> The SP40 has been implemented in regions such as the United Arab Emirates (UAE), South America and India, tackling water scarcity in arid climates.<sup>77</sup>

It uses simple solar technology, avoiding the need for complex chemicals, fossil fuels and costly infrastructure used in traditional methods,<sup>78</sup> aligning it well with the Water Framework Directive's

<sup>70</sup> Von Zedtwitz, Max, Simone Corsi, Peder Veng Søbørg, and Romeo Frega. "A typology of reverse innovation." *Journal of Product Innovation Management* 32, no. 1 (2015): 12-28. <https://doi.org/10.1111/jpim.12181>.

<sup>71</sup> mOm. "Keeping baby close, keeping baby warm." Accessed February 13, 2025. <https://www.momincubators.com/>.

<sup>72</sup> Renault India. "Renault Kwid." Accessed February 13, 2025. <https://www.renault.co.in/cars/renault-kwid.html>.

<sup>73</sup> Desolenator. "The water crisis." Accessed February 13, 2025. <https://www.desolenator.com/impact/the-water-crisis>.

<sup>74</sup> Continest. "Continest." Accessed February 13, 2025. <https://www.continest.com/>.

<sup>75</sup> LITUA-kartu. "About us." Accessed February 13, 2025. <https://lituakartu.lt/en/home/#about-us>.

<sup>76</sup> Desolenator. "Impact." 2020. Accessed November 22, 2024. <https://www.desolenator.com/impact/the-water-crisis>.

<sup>77</sup> Jagannathan, N. Vijay, Ahmed Shawky Mohamed, and Alexander Kremer. *Water in the Arab world: management perspectives and innovations*. No. 49593. The World Bank, 2009.

<sup>78</sup> Interview with employee. May 28, 2024.

(WFD) focus on efficient water use.<sup>79</sup> Its frugal characteristics focused on maximum outputs under resource-constraints lead to significant cost savings.<sup>80</sup>

**Desolenator's business model provides desalinated water as a utility rather than selling the device.** Their main stakeholders include communities in water-stressed regions, as well as private sector partners interested in sustainable water provisioning, having achieved notable success by securing contracts with major stakeholders like the Dubai Electricity and Water Authority and Silal in Abu Dhabi. They install, operate, and finance desalination plants, offering a model for ownership after 15 years, its long-term value being substantial, with the system expected to operate efficiently for over 20 years.<sup>81</sup> This approach helps to overcome challenges faced in scaling its production and meeting regional market needs due to high upfront costs, which can also be a limitation for uptake from smaller companies and municipalities.

Manufacturing is currently carried out in the UAE, but development in the modularity of the technology can increase its scalability, with a focus on close-to-shore applications,<sup>82</sup> **making it a candidate for deployment in less economically developed regions within the EU.** While demand for disruptive desalination technologies may be limited in EU regions with well-established water management systems, Desolenator might be well placed to address broader EU sustainability and water security agendas, particularly in regions experiencing greater water scarcity, such as Southern Europe.<sup>83</sup>

Table 3 presents some other descriptive characteristics of the innovations included in the core database. Among these innovations, manufactured product innovations prevail, and they are distributed quite evenly between high- and medium-high-technology products and low- and medium-low-technology products. Interestingly, most of the low- and medium-low-technology product innovations (12 out of 20) are strongly frugal and possess all four characteristics of frugality, while a typical high- and medium-high-technology product innovation (16 out of 18) is moderately frugal and possesses three characteristics of frugality. In the latter, the Si-E-C combination is dominant, with 12 examples. Such a distribution leads to an important conclusion that when it comes to high- and medium-high-technology products, **a key driver of innovation is to make a high- or medium-technology product more accessible (simpler) and affordable (cheaper) via simplified construction and features and by using more economical materials and components.** Sustainability motives seem to play a smaller role. Yet, when it comes to low- and medium low-technology innovations, sustainability appears to become an important driver through the usage of alternative materials or designs capable of reducing the ecological footprint. Examples of this include easy-to-transport and assemble modular construction (ISIBRIX<sup>84</sup>), foldable containers (Continest<sup>85</sup>) and furniture (LITUA, Room in a box<sup>86</sup>), and paper-based packaging to replace glass bottles (Frugalpac<sup>87</sup>).

In addition to products, the database also includes four service innovations, two business model innovations and two process innovations. All service, business model and process innovations are **ICT-based offerings to final customers or ICT-based improvements to the process or the business model** underpinning services provision. These include a new annual subscription-based frugal business model of banking services (Nickel<sup>88</sup>); a community-based car-pooling delivery model (Gepek<sup>89</sup>); a simpler and more efficient

<sup>79</sup> European Parliament and Council. *Directive 2000/60/EC of 23 October 2000 Establishing a Framework for Community Action in the Field of Water Policy.* 2000 O.J. L 327/1. 2000. <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32000L0060>.

<sup>80</sup> European Investment Bank. "How Saltwater is Made Drinkable: Desalination." *European Investment Bank.* Accessed September 9, 2024. <https://www.eib.org/en/stories/saltwater-drinkable-water-desalination>.

<sup>81</sup> *Ibid.*

<sup>82</sup> Interview with employee. May 28, 2024.

<sup>83</sup> Climate-KIC. "Water Scarcity in Southern Europe." Accessed September 10, 2024. <https://www.climate-kic.org/opinion/water-scarcity-in-southern-europe-problems-and-solutions/>.

<sup>84</sup> ISIBRIX. "ISIBRIX." Accessed February 13, 2025. <https://www.isibrix.it/>.

<sup>85</sup> Continest. "Continest." Accessed February 13, 2025. <https://www.continest.com/>.

<sup>86</sup> Room in a box. "Sustainable furniture." Accessed February 13, 2025. <https://www.roominabox.com/pages/about-us>.

<sup>87</sup> Frugalpac. "Innovation." Accessed February 13, 2025. <https://frugalpac.com/innovation/>.

<sup>88</sup> Nickel. "Who we are." Accessed February 13, 2025. <https://nickel.eu/en-fr/who-we-are>.

<sup>89</sup> Gepek. "Carpooling for packages." Accessed February 13, 2025. [https://thegepek.com/#link\\_acc-1-2-d](https://thegepek.com/#link_acc-1-2-d).

process of providing help to earthquake victims (Deprem.io,<sup>90</sup> presented as a mini-case in Box 2), a simplified process of management of medical records (Croatian Health Insurance Fund Primary Care Panels,<sup>91</sup> presented as a min-case in Box 3), an easy to use mobility service for people with disabilities (GoOV<sup>92</sup>); a simple to use app to help people improve their mental wellbeing (Inuka,<sup>93</sup> see the Philips case study in Annex 6); an improved access to healthcare in remote areas thanks to a web mapping app and mobile hospitals (Medtrucks<sup>94</sup>); and a simplified patient monitoring system providing more proactive care and intervention in low-resource settings (GOAL3,<sup>95</sup> presented as a mini-case in Box 4).

**Table 3 – Key characteristics of innovations in the core database.**

<b>Type of innovation</b>	<ul style="list-style-type: none"> <li>• 35 product innovations</li> <li>• 4 service innovations</li> <li>• 2 business model innovations</li> <li>• 2 process innovations</li> </ul>
<b>Industrial sector</b>	<ul style="list-style-type: none"> <li>• 20 low- and medium low-technology manufacturing</li> <li>• 18 high- and medium high-technology manufacturing</li> <li>• 7 knowledge-intensive services</li> </ul>
<b>Motivation</b>	<ul style="list-style-type: none"> <li>• 24 firm-led profit-driven</li> <li>• 18 NGO- &amp; social enterprise-led societal challenges-driven</li> <li>• 3 community-led local constraints-driven</li> </ul>
<b>Developed by entity</b>	<ul style="list-style-type: none"> <li>• 15 SMEs</li> <li>• 15 start-ups</li> <li>• 15 large companies</li> </ul>
<b>Regionality</b>	<ul style="list-style-type: none"> <li>• 20 from capital regions</li> <li>• 24 from non-capital regions</li> <li>• 37 from Innovation Leader and Strong Innovator regions as per RIS</li> <li>• 8 from Moderate and Emerging Innovator regions as per RIS</li> </ul>
<b>Countries covered</b>	<ul style="list-style-type: none"> <li>• 37 EU countries</li> <li>• 8 HEAC</li> </ul>
<b>EU burning issues</b>	<ul style="list-style-type: none"> <li>• 13 reducing the reliance on fossil fuels</li> <li>• 9 mastering the digital transformation</li> <li>• 4 both fossil fuels and digital transformation</li> <li>• 1 increasing food security</li> </ul>
<b>Supported by policy</b>	<ul style="list-style-type: none"> <li>• 14 supported by policies</li> </ul>
<b>Social orientation</b>	<ul style="list-style-type: none"> <li>• 30 socially oriented</li> </ul>

*Note:* Numbers do not always add up to 45 innovations, due to missing data on characteristics.

*Source:* Visionary Analytics, 2024.

<sup>90</sup> Deprem.io. "Deprem.io." Accessed February 13, 2025. <https://deprem.io/>.

<sup>91</sup> World Health Organization. "Homegrown, Low-Cost Innovation Improves NCD Treatment in Croatia." January 19, 2018. <https://who-sandbox.squiz.cloud/en/health-topics/noncommunicable-diseases/obesity/news/news/2018/01/homegrown,-low-cost-innovation-improves-ncd-treatment-in-croatia>.

<sup>92</sup> GoOV. "Home." Accessed February 13, 2025. <https://www.go-ov.nl/>.

<sup>93</sup> Inuka Coaching. "Inuka." Accessed February 13, 2025. <https://inukacoaching.com/>.

<sup>94</sup> MedTrucks. "MedTrucks." Accessed February 13, 2025. <https://medtrucks.com/>.

<sup>95</sup> GOAL3. Accessed August 19, 2024. <https://www.GOAL3.org/>.

## Box 2. Deprem.io

**Deprem.io<sup>96</sup> is a start-up in the information and technology (IT) sector aiming to provide rapid and effective disaster relief through a frugal emergency-tracking app.** The app, built using the simple no-code platform Bubble,<sup>97</sup> was created and launched in the immediate aftermath of the February 2023 earthquake in Türkiye to streamline communication and coordination of rescue operations,<sup>98</sup> connecting disaster victims with rescuers and volunteers efficiently. The minimalist design simplifies features with just two main buttons for requesting or offering help, allowing users to quickly navigate the platform during crises.<sup>99</sup> Those requesting help are prompted to provide their location and first name, and those providing help are prompted to enter their contact details and available resources<sup>100</sup> enabling critical data to be captured without delay and to establish a network of resource distribution.<sup>101</sup>

Deprem.io quickly gained high levels of attention and use from survivors, volunteers, celebrities and humanitarian organisations on social media, particularly Twitter (now X). The app received more than 70,000 requests in its first six days.<sup>102</sup> The Disaster and Emergency Management Authority's (AFAD) response was delayed and uncoordinated and their own website was non-operational for a time.<sup>103</sup> In an attempt to prevent the spread of misinformation related to rescue operations, AFAD also temporarily shut down Twitter,<sup>104</sup> driving more users to Deprem.io, acting as a neutral third-party site. However, similar to Twitter, the Turkish government eventually blocked the Deprem.io site, citing concerns over potential fraud as the website included a donations module.<sup>105</sup> The founders received no formal communication that the website had been blocked and learned about the incident through their users.<sup>106</sup> After contacting government employees, public access was restored, however, **because the platform received no additional governmental support it was unable to operate in an official capacity.**<sup>107</sup>

Despite facing challenges, as both Deprem.io's founders and its servers were located outside of Türkiye and because its no-code platform was made for flexible product development, the platform was able to adapt quickly to upload real-time data on detected earthquakes in Türkiye. Moreover, its micro workforce of two people supported rapid decision making and adoption of suggested improvements from the community and end-users, a flexibility that larger projects could not achieve.<sup>108</sup> **While server costs could limit its expansion to other countries, its frugal design makes it transferable to other earthquake-prone regions.**<sup>109</sup> Furthermore, the platform is prepared to serve as a relief tool in the event of future earthquakes in Türkiye.<sup>110</sup>

<sup>96</sup> Deprem.io. "Deprem.io." Accessed February 13, 2025. <https://deprem.io/>.

<sup>97</sup> Bubble. "Bubble Official Website." Accessed October 17, 2024. <https://bubble.io>.

<sup>98</sup> Deprem.io. Interview with employee. May 16, 2024.

<sup>99</sup> Chen, Vivienne. "This No-Code App Expedited Türkiye's Earthquake Rescue From Half a World Away." *Bubble*. 2023. Accessed November 22, 2024. <https://forum.bubble.io/t/this-no-code-app-expedited-turkeys-earthquake-rescue-from-half-a-world-away/251652>.

<sup>100</sup> *Ibid.*

<sup>101</sup> *Ibid.*

<sup>102</sup> Deprem.io. Interview with employee. May 16, 2024.

<sup>103</sup> *Ibid.*

<sup>104</sup> Burga, Solcyré. "The Failures of Türkiye's Earthquake Response." *TIME*. 2023. Accessed November 22, 2024. <https://time.com/6255634/earthquake-turkiye-syria-erdogan-rescue/>.

<sup>105</sup> Deprem.io. Interview with employee. May 16, 2024; Deprem.io. Interview with employee. July 22, 2024.

<sup>106</sup> *Ibid.*

<sup>107</sup> *Ibid*; Solaker, Gülsen. "AFAD Büyük Bir Depreme Ne Kadar Hazırdı?" *DW*. 2023. Accessed November 22, 2024. <https://www.dw.com/tr/afad-b%C3%BCy%C3%BCk-bir-depreme-ne-kadar-haz%C4%B1rd%C4%B1-a-64639121>.

<sup>108</sup> Deprem.io. Interview with employee. May 16, 2024.

<sup>109</sup> Deprem.io. Interview with employee. July 22, 2024.

<sup>110</sup> *Ibid.*

### Box 3. Primary Care Panels

Primary Care Panels (PCPs), a frugal process innovation initially developed by a primary care centre in Breznica, a small town in Croatia,<sup>111</sup> helps general practitioners monitor patients and assess risk for non-communicable diseases (NCDs) in an approach that is **simple, economical, and cheap**.<sup>112</sup> In 2014, the Croatian Health Insurance Fund (CHIF), a large public enterprise responsible for the administration and financing of public health insurance, formally integrated the information technology solution into the national healthcare system.<sup>113</sup> While originally developed for Croatia, PCPs are a frugal solution that have the potential to be integrated into other public health care systems, and countries in Southeastern and Eastern Europe have expressed interest.<sup>114</sup>

Initially managed on Microsoft Excel, through the encouragement of the CHIF, large IT companies provided financial support to further develop the programme as a software-as-a-service tool for general practitioners.<sup>115</sup> The development of PCPs as a process innovation has greatly benefitted the healthcare sector by reducing specialist referrals, as primary care physicians can more confidently diagnose patients' NCDs.<sup>116</sup> **From 2012 to 2016, referral rates dropped from 23% to 16.5%<sup>117</sup> and there was a 40-fold decrease in diabetes-related amputations.**<sup>118</sup> Likewise, the knowledge of patients with NCDs has increased by 9% from 2013 to 2017 through the registration of biometric data on PCPs.<sup>119</sup> Importantly, the simple design requires no training, guiding doctors through patient questions and allowing them to input data and provide comprehensive advice based on the patient's NCD risk.<sup>120</sup>

Six software developers were licensed to build PCPs for the national stage and doctors received financial and non-financial incentives, such as a bonus of approximately 2% of their salary<sup>121</sup> or a higher CHIF rating,<sup>122</sup> to adopt the software in their practices. Due to their low financial and administrative costs, PCPs became integrated into daily healthcare monitoring within a month.<sup>123</sup> Quick expansion of the PCPs was aided by pre-existing contracts with software developers eliminating the need for new negotiations,<sup>124</sup> no cost or training requirements for doctors to implement the panels, and because policy changes were quickly implemented without deliberation. Moreover, as PCPs were initially developed by a medical practice, the design was intuitive and specific to the needs of doctors.<sup>125</sup> **The uptake of PCPs saw no substantive obstacles and was successfully integrated into the Croatian health system, highlighting**

<sup>111</sup> World Health Organization. "Homegrown, Low-Cost Innovation Improves NCD Treatment in Croatia." January 19, 2018. <https://who-sandbox.squiz.cloud/en/health-topics/noncommunicable-diseases/obesity/news/news/2018/01/homegrown.-low-cost-innovation-improves-ncd-treatment-in-croatia>.

<sup>112</sup> Maravich, Zoran, and Altnai Satylganova, "Primary Care Panels in Croatia: An information solution for more proactive primary health care services" World Health Organization (2017): <https://iris.who.int/bitstream/handle/10665/345708/WHO-EURO-2017-3319-43078-60292-eng.pdf?sequence=3>.

<sup>113</sup> Interview with employee. July 15, 2024.

<sup>114</sup> *Ibid.*

<sup>115</sup> Interview with employee. July 15, 2024.; Maravich, Zoran, and Altnai Satylganova, "Primary Care Panels in Croatia: An information solution for more proactive primary health care services" World Health Organization (2017): <https://iris.who.int/bitstream/handle/10665/345708/WHO-EURO-2017-3319-43078-60292-eng.pdf?sequence=3>.

<sup>116</sup> World Health Organization. "Homegrown, Low-Cost Innovation Improves NCD Treatment in Croatia." January 19, 2018. <https://who-sandbox.squiz.cloud/en/health-topics/noncommunicable-diseases/obesity/news/news/2018/01/homegrown.-low-cost-innovation-improves-ncd-treatment-in-croatia>.

<sup>117</sup> Maravich, Zoran, and Altnai Satylganova, "Good Practice Brief: Primary Care Electronic Panels in Croatia" World Health Organisation (2017): <https://iris.who.int/bitstream/handle/10665/345708/WHO-EURO-2017-3319-43078-60292-eng.pdf?sequence=3&isAllowed=y>.

<sup>118</sup> Croatian Health Insurance Fund. Interview with employee. July 15, 2024.

<sup>119</sup> Maravich, Zoran, and Altnai Satylganova, "Good Practice Brief: Primary Care Electronic Panels in Croatia" World Health Organisation (2017): <https://iris.who.int/bitstream/handle/10665/345708/WHO-EURO-2017-3319-43078-60292-eng.pdf?sequence=3&isAllowed=y>.

<sup>120</sup> World Health Organization. "Homegrown, Low-Cost Innovation Improves NCD Treatment in Croatia." January 19, 2018. <https://who-sandbox.squiz.cloud/en/health-topics/noncommunicable-diseases/obesity/news/news/2018/01/homegrown.-low-cost-innovation-improves-ncd-treatment-in-croatia>.

<sup>121</sup> Croatian Health Insurance Fund. Interview with employee. July 15, 2024.

<sup>122</sup> Maravich, Zoran, and Altnai Satylganova, "Good Practice Brief: Primary Care Electronic Panels in Croatia" World Health Organisation (2017): <https://iris.who.int/bitstream/handle/10665/345708/WHO-EURO-2017-3319-43078-60292-eng.pdf?sequence=3&isAllowed=y>.

<sup>123</sup> Croatian Health Insurance Fund. Interview with employee. July 15, 2024.

<sup>124</sup> *Ibid.*

<sup>125</sup> Maravich, Zoran, and Altnai Satylganova, "Good Practice Brief: Primary Care Electronic Panels in Croatia" World Health Organisation (2017): <https://iris.who.int/bitstream/handle/10665/345708/WHO-EURO-2017-3319-43078-60292-eng.pdf?sequence=3&isAllowed=y>.

**the benefits of local frugal innovations.** Furthermore, it demonstrates how technical solutions can be simple and leverage a professional's existing knowledge to facilitate efficacy.

#### Box 4. The GOAL3 IMPALA system

**GOAL3, a Dutch med-tech start-up, aims to empower health workers and improve access to quality care**<sup>126</sup> by addressing the global societal challenge of reducing preventable deaths through accessible health services. Its focus is patient and resource management through its innovative IMPALA system.<sup>127</sup>

The IMPALA system consists of three components: the monitor, the app, and the server. The low-cost and user-friendly monitor measures vital signs at the patient's bedside, feeding information to the tablet-based app, which intuitively visualises patient data. The server connects up to 20 monitors to two tablets, allowing patient data within a ward to be managed from a single tablet, reducing the time needed to check vitals on individual patient bed-side monitors, reducing the time spent on checking individual monitors and directing attention to the most in-need patients, providing proactive care and intervention.<sup>128</sup>

The innovation targets low- and middle-income countries in East Africa, with pilots having taken place in Malawi, Tanzania and Rwanda from 2019 to 2022.<sup>129</sup> **IMPALA exemplifies frugal innovation, offering a cost-effective, sustainable and simplified technology**<sup>130</sup> compared to similar Western technologies, designed to suit low-resource environments where there is a need to prioritise efficiency. Its success stems from product and service innovation, collaborating with local healthcare workers in the target regions<sup>131</sup> to create a technology-advanced yet practical system in its operational context.<sup>132</sup>

While exploring future opportunities in higher-income markets, GOAL3 faces challenges, including, **uncertainty about the demand and compatibility in European healthcare systems,**<sup>133</sup> and **regulatory requirements in healthcare.** While GOAL3 has secured EU funding, partnerships with major healthcare technology players could support expansion into new regions, refine the IMPALA system's technological components, open avenues for additional resources, and strengthen the system's credibility. The partnership with Philips Foundation Impact Investments B.V., since May 2022, aims to support clinical trials and market introduction.<sup>134</sup> Future prospects include expanding to new African countries and exploring European and Ukrainian markets, where adaptation may be required due to ongoing conflict.<sup>135</sup> GOAL3's alignment with EU agendas on improving healthcare efficiency and accessibility provides a favourable policy and funding context for its continued development.

At the sectoral level, almost half of the innovations in the database, 20, were developed in the health sector. These include eye treatment products and services, mobile hospitals and temporary shelters, 3D printed ventilator valves and prosthetics, and X-ray devices. Such a **high presence of health-related frugal innovations** resonates well with findings from the

<sup>126</sup> GOAL3. Accessed August 19, 2024. <https://www.GOAL3.org/>.

<sup>127</sup> *Ibid.*

<sup>128</sup> GOAL3. Interview with employee. June 13, 2024.

<sup>129</sup> GOAL3. Interview with employee. June 13, 2024. See also: GOAL3. Accessed August 19, 2024. <https://www.GOAL3.org/>.

<sup>130</sup> Designboom. "Portable, Durable Pediatric Monitoring System Improves Healthcare Access in Africa." 2023. Accessed November 22, 2024. <https://www.designboom.com/design/portable-durable-pediatric-monitoring-system-healthcare-access-africa-goal-3-mango-07-10-2023/>.

<sup>131</sup> IMPALA project. "Improving Healthcare Access with the IMPALA System." Accessed September 18, 2024. <https://www.projectimpala.org/project-news/blog-post-title-one-ygm54>.

<sup>132</sup> GOAL3. Interview with employee. June 13, 2024.

<sup>133</sup> *Ibid.*

<sup>134</sup> Eindhoven University of Technology. "Goal 3 Takes Steps in the Fight Against Needless Mortality in Africa." 2022. Accessed November 22, 2024. <https://www.tue.nl/en/news-and-events/news-overview/17-05-2022-goal-3-takes-steps-in-the-fight-against-needless-mortality-in-africa>.

<sup>135</sup> GOAL3. Interview with employee. June 13, 2024.

literature, which sees healthcare as a prominent arena for frugal innovation since its inception.<sup>136</sup>

Another two sectors prominent in the database are **food and consumer goods and services** represented by seven and six innovations respectively. While water purification and extraction devices dominated the food sector, the latter sectors included products and services ranging from phones, furniture, stoves and car-pooling services. The remaining 12 innovations are distributed equally between the **automobile, construction, energy and security sectors**. Being represented by a limited number of innovations, some of these sectors fail to realise the full potential of frugal innovation. While automobiles have been one of the earliest sectors for adopting frugal innovation, as documented by the famous Dacia example,<sup>137</sup> and many car producers in Europe started introducing at least some frugal elements, the trend is still mixed. On the one hand, electric vehicles, because of simpler drivetrains, have moved towards stronger frugality, but on the other hand, their electronic systems have become more complex. Furthermore, hybrid vehicles demonstrate an opposing direction towards increased complexity and sophistication.

Energy is another sector where frugal innovation could play a more prominent role. As frugal innovation is characterised as creating more value with fewer resources, its **broader adoption in the EU's energy sector could help to meet sustainability goals and address energy poverty**. Despite limited examples in the energy sector, they nevertheless demonstrate a high potential for frugal innovation. One such example is Solar2Go,<sup>138</sup> an intelligent monitoring solution to enhance the accessibility of solar energy systems for households. Another example is Qarnot Computing<sup>139</sup> (see Box 17), which uses waste heat from high-performance computing for domestic heating.

In the security sector, frugal innovation has a broad range of applications. They can be used in products directly aimed at defence, for example, drone detection devices by Drone Spices.<sup>140</sup> However, more commonly, **frugal innovation is used to help fight the negative consequences of military or environmental disasters**. Here examples are more numerous and include the Deprem.io<sup>141</sup> app for accessing help during earthquakes (see Box 2), temporary shelters by Better Shelter<sup>142</sup> (see Box 5) and Continest,<sup>143</sup> Kalvis stoves<sup>144</sup> made from old wheel rims, and LITUA furniture for equipping military and humanitarian facilities.

Innovations in the database are distributed equally by entity size and type. Among them, 15 were developed by start-ups, 15 by SMEs and 15 by large companies. However, this distribution can also be seen as reflecting the relative reluctance of MNCs, despite their larger resources, to introduce frugal innovation to Europe because of the fear of cannibalisation of their more premium products.<sup>145</sup> Thus, **start-ups and SMEs can be in a more favourable position to harness ideas of frugal innovation** to create products or

<sup>136</sup> Arshad, Hareem, Marija Radic, and Dubravko Radic. "Patterns of Frugal Innovation in Healthcare". *Technology Innovation Management Review* 8 (24 April 2018): 28–37. <https://doi.org/10.22215/timreview/1150>.

<sup>137</sup> See: Dacia. "Spring City Car." Accessed February 13, 2025. <https://www.dacia.co.uk/hybrid-and-electric-range/spring-city-car.html>; Padeanu, A. "The New Dacia Spring Is A Cheap And Funky EV." 2024. Motor1. Accessed February 13, 2025. <https://www.motor1.com/news/709441/2024-dacia-spring-debut/>.

<sup>138</sup> Fortum. "Fortum, Futurice and Boond launch first Solar2Go pilot project in India." January 19, 2018. Accessed February 13, 2025. <https://www.fortum.fi/media/2018/01/fortum-futurice-ja-boond-aloittavat-ensimmaisen-solar2go-pilottiprojektin-intiassa>.

<sup>139</sup> Qarnot. "Qarnot." Accessed August 7, 2024. <https://qarnot.com/en>.

<sup>140</sup> Drone Spices. "Drone Spices." Accessed February 13, 2025. <https://drone-spices.com/>.

<sup>141</sup> Deprem.io. "Deprem.io." Accessed February 13, 2025. <https://depremio/>.

<sup>142</sup> Better Shelter. "Better Shelter." Accessed February 13, 2025. <https://bettershelter.org/>.

<sup>143</sup> Continest. "Continest." Accessed February 13, 2025. <https://www.continest.com/>.

<sup>144</sup> See: Kalvis. "Homepage." Accessed February 13, 2025. <https://www.kalvis.lt/en/homepage-2/>; Mizgirdė, A. "Carcasses are made from rims for Ukrainians - Šiauliai residents send heat to soldiers and civilians." 2022. LRT. Accessed February 13, 2025. <https://www.lrt.lt/naujienos/lietuvoje/2/1840475/krosneles-ukrainieciams-gamina-is-ratlankiu-siaulieciai-siuncia-siluma-kariams-ir-civiliams>.

<sup>145</sup> Krohn, Malte, Finn Petersen, Dustin Hochmuth, and Cornelius Herstatt. *The deliberative frugal mindset: A model of managerial opportunity recognition for frugal innovation*. No. 109. Working Paper, 2020.

services intended for the European market.<sup>146</sup> However, to some extent, this can be dictated by the nature of frugal innovation itself. In many instances, frugal innovations are designed with a local, low-income or resource-constrained community in mind.<sup>147</sup> In this regard, they typically come from smaller entities such as start-ups or local NGOs.

By motivation, around half of the innovations in the database, 24, were developed by firms and seemingly motivated by profit. These are innovations developed for certain market niches and competition with other similar products or services. In this regard, frugal features may be seen as part of these firms' **competitive strategies through better usability, economy of resources, higher affordability or ecological sustainability**. This finding is supported by the case studies, whereby frugal innovations were primarily developed to introduce low-cost and sustainable products to the market. Many cases were motivated to fill market gaps by offering more accessible and cost-effective solutions without sacrificing efficiency, often using environmentally friendly materials and methods to reduce waste and emissions.

A further 18 innovations in the database were developed by NGOs and social enterprises. In these examples, the primary **motivation is to address certain societal challenges**, most commonly in developing Asian and African countries or countries under violence such as Ukraine. These challenges include issues related to health, temporary accommodation (see Better Shelter,<sup>148</sup> presented as a mini-case in Box 5), and clean water production.

The remaining three innovations in the database were developed by local communities to address local constraints or help other communities. These examples were developed for extreme disaster situations, such as the earthquake in Türkiye (Deprem.io,<sup>149</sup> see Box 2) or the war in Ukraine (Drone Spices,<sup>150</sup> Kalvis stoves<sup>151</sup>).

The distinction between for-profit and not-for-profit innovations hides another important dimension prominent among innovations collected in the database. **Addressing societal challenges is an inherent motivation** not only for innovations developed by NGOs, social enterprises or communities but also for many innovations developed by profit-seeking firms, as indicated by the last row in Table 3. This finding was also expressed by an interviewed expert who highlighted the core social and community aspects associated with all frugal innovations<sup>152</sup> and is fully in line with the definition of frugal innovation presented in Chapter 2 of this report. Almost half of the innovations in this analysis have this aspect by targeting poorer communities with simpler, more economical and cheaper products such as 3D printed prosthetics, highly affordable glasses or water purification devices. In the case studies, most innovations were also socially driven and were **heavily motivated to address social challenges and improve quality of life**. Humanitarian missions related to conflict and health were also found in the case studies, which were driven to provide affordable products in conflict zones (such as LITUA furniture and TeReFa assistive devices from Handicap International<sup>153</sup>) or enhance healthcare accessibility in less developed countries (such as the cases of Good Vision<sup>154</sup> and TeReFa).

The social orientation of many frugal innovations developed by firms strongly resonates with findings in the literature which suggests that even when developed by profit-seeking firms many of these innovations have a social dimension that goes beyond the simple pursuit of profit. This is especially pronounced for local firms, that is those located where the

<sup>146</sup> The Long and Short. "Think Frugal." Accessed October 10, 2024. <https://thelongandshort.org/margins/frugal-innovation.html>.

<sup>147</sup> Le Bas, Christian. "Frugal Innovation, Sustainable Innovation, Reverse Innovation: Why Do They Look Alike? Why Are They Different?": *Journal of Innovation Economics & Management* n°21, no. 3 (9 September 2016): 9–26. <https://doi.org/10.3917/jie.021.0009>.

<sup>148</sup> Better Shelter. "Better Shelter." Accessed February 13, 2025. <https://bettershelter.org/>.

<sup>149</sup> Deprem.io. "Deprem.io." Accessed February 13, 2025. <https://deprem.io/>.

<sup>150</sup> Drone Spices. "Drone Spices." Accessed February 13, 2025. <https://drone-spices.com/>.

<sup>151</sup> Kalvis. "Homepage." Accessed February 13, 2025. <https://www.kalvis.lt/en/homepage-2/>.

<sup>152</sup> KTH Royal Institute of Technology. Interview with expert. August 26, 2024.

<sup>153</sup> Handicap International. "Innovation." Accessed February 13, 2025. <https://www.hi.org/en/innovation>.

<sup>154</sup> Ein Dollar Brille. "Good vision for all people." Accessed February 13, 2025. <https://www.eindollarbrille.de/en/home>.

innovation is introduced. For example, research shows that four out of five local firms are more likely to have a socially or sustainability-oriented motivation.<sup>155</sup> This is due to local entities being more in contact with their consumers and understanding the social needs of an area.<sup>156</sup> Personal ambitions can also play a role, particularly in start-ups whereby founders witness or learn of an underserved community or service and seek to provide affordable and accessible solutions.<sup>157</sup>

### Box 5. Better Shelter's Relief Housing Units

**Better Shelter**,<sup>158</sup> a small Swedish non-profit, **provides temporary modular shelters, called relief housing units (RHUs) to refugees and displaced people worldwide.** Better Shelter has grown from a partnership model between the Ikea Foundation, providing funding, UNHCR, which tests and implements the shelters, and Better Shelter, which does research, development, and production.<sup>159</sup> First piloted in 2014, the current version was released in 2018, and since then, nearly 100,000 shelters have been distributed across over 80 countries.<sup>160</sup>

These shelters have been deployed in refugee camps, camps for internally displaced people and after disasters, aiming to offer long-term and temporarily displaced people more dignified living conditions. **Better Shelter recognises the right to shelter as a human right for displaced people and aligns itself with Sustainable Development Goals (SDGs),**<sup>161</sup> such as promoting sustainable cities and focusing on environmental sustainability, using recyclable materials, conducting lifecycle assessments (LCAs), and aligning strategies with the Paris Agreement.<sup>162</sup> Recently, Better Shelter introduced the concept of "Deploy, Upgrade, Upcycle," a design strategy to make its shelters more modular and adaptable to evolving needs, including recycling or using them for other purposes once they are no longer needed.<sup>163</sup>

Better Shelter's RHUs have been acknowledged to be a frugal innovation in previous European Commission<sup>164</sup> reports because of their modularity and cost-effective design,<sup>165</sup> positioned between more expensive structured shelters and cheaper, less durable options, such as tents or tarps (often used for temporary shelters). RHUs are lightweight, easy to transport, and reusable for multiple iterations and more advanced than conventional shelters because they solve issues such as safety, dignity and durability.<sup>166</sup> Through incremental innovation, Better Shelter has reduced its production costs and price, improving performance, combining existing technologies and enhancing the characteristics of their shelter, increasing its efficiency.<sup>167</sup>

However, labelling Better Shelter's innovation as 'frugal' is complex. Its relative affordability depends on the context of its use and while the innovation could be expanded into other markets (e.g. events, festivals or other business-to-business operations), it conflicts with Better Shelter's humanitarian mission. According to an interviewee from Better Shelter, they do not consider the innovation to be frugal as they strive to raise the standards of humanitarian relief by providing

<sup>155</sup> De Marchi, Valentina, Maria A. Pineda-Escobar, Rachel Howell, Michelle Verheij, and Peter Knorrninga. "Frugal Innovation and Sustainability Outcomes: Findings from a Systematic Literature Review". *European Journal of Innovation Management* 25, no. 6 (2022): 984–1007. <https://doi.org/10.1108/EJIM-02-2022-0083>.

<sup>156</sup> Reinhardt, Ronny, Sebastian Gurtner, and Abbie Griffin. "Towards an Adaptive Framework of Low-End Innovation Capability – A Systematic Review and Multiple Case Study Analysis". *Long Range Planning* 51, no. 5 (October 2018): 770–96. <https://doi.org/10.1016/j.lrp.2018.01.004>.

<sup>157</sup> Hossain, Mokter, Nivedita Agarwal, Yasser Bhatti, and Jarkko Levänen. "Frugal Innovation: Antecedents, Mediators, and Consequences". *Creativity and Innovation Management* 31, no. 3 (September 2022): 521–40. <https://doi.org/10.1111/caim.12511>.

<sup>158</sup> Better Shelter. "Better Shelter." Accessed February 13, 2025. <https://bettershelter.org/>.

<sup>159</sup> Interview with employee. May 24, 2024.

<sup>160</sup> Group interview with two employees. August 14, 2024.

<sup>161</sup> Terne, Märta. "About Us." 2023. Accessed November 22, 2024. <https://bettershelter.org/about-us/>.

<sup>162</sup> Group interview with two employees. August 14, 2024.

<sup>163</sup> *Ibid.*

<sup>164</sup> European Commission: Directorate-General for Research and Innovation, Fraunhofer ISI and Nesta. *Study on Frugal Innovation and Reengineering of Traditional Techniques*. Publications Office: Brussels, 2017. <https://data.europa.eu/doi/10.2777/94587>.

<sup>165</sup> IKEA Foundation. "Better Shelter, IKEA Foundation and UNHCR Ready to Improve Life for Thousands of Refugee Families." Accessed September 20, 2024. <https://ikeafoundation.org/press/better-shelter-ikea-foundation-and-unhcr-ready-to-improve-life-for-thousands-of-refugee-families/>.

<sup>166</sup> European Commission: Directorate-General for Research and Innovation, Fraunhofer ISI and Nesta. *Study on Frugal Innovation and Reengineering of Traditional Techniques*. Publications Office: Brussels, 2017. <https://data.europa.eu/doi/10.2777/94587>.

<sup>167</sup> *Ibid.*

more dignified temporary shelters (RHUs) than alternatives, and in this context, they provide more high-tech and costly responses to needs.<sup>168</sup> Compared with frugal designs, which are often de-featured, Better Shelter responds to the needs of local users by working to implement additional features that might best support them in their local context.<sup>169</sup> **These factors highlight the nuances associated with the perception of frugality** which is often shaped by market, context and its intended use.

Another important dimension manifesting a broader impact of innovations collected in the database is their **relevance to EU burning issues such as mastering the digital transition, reducing reliance on fossil fuels and increasing food security**. In the database, 27 innovations have this relevance, with mastering the digital transition and reducing the reliance on fossil fuels being the most common. Many of these innovations directly target reducing the reliance on fossil fuels, including reducing transportation costs via, for example, the modular design of temporary homes and containers (Room in a Box,<sup>170</sup> Continest<sup>171</sup>) and space (Garcon Wines<sup>172</sup>) and weight-saving (Frugalpac<sup>173</sup>) package designs. Meanwhile, mastering digital transformation is commonly achieved via improved accessibility and affordability of communication devices (Nokia G22,<sup>174</sup> Fairphone<sup>175</sup>) and digital services (Nickel,<sup>176</sup> Croatian Health Insurance Fund<sup>177</sup> (see Box 3)).

Geographically, 37 innovations were developed in the EU and dominate the database, with only eight innovations developed in HEAC (see Figure 2). Within the EU, four-fifths of examples come from high innovator countries, heavily represented by France, Germany and the Netherlands with 21 innovations in total. The remaining eight innovations from the EU represent low innovator countries, which include Croatia, Italy, Hungary, Lithuania and Romania. A similar trend is observable among the HEAC, where the United Kingdom dominates with five examples. The remaining three come from Türkiye and Ukraine.

<sup>168</sup> Interview with employee. May 24, 2024.

<sup>169</sup> *Ibid.*

<sup>170</sup> Room in a box. "Sustainable furniture." Accessed February 13, 2025. <https://www.roominbox.com/pages/about-us>.

<sup>171</sup> Continest. "Continest." Accessed February 13, 2025. <https://www.continest.com/>.

<sup>172</sup> Garcon Wines. "About." Accessed February 13, 2025. <https://www.garconwines.com/about>.

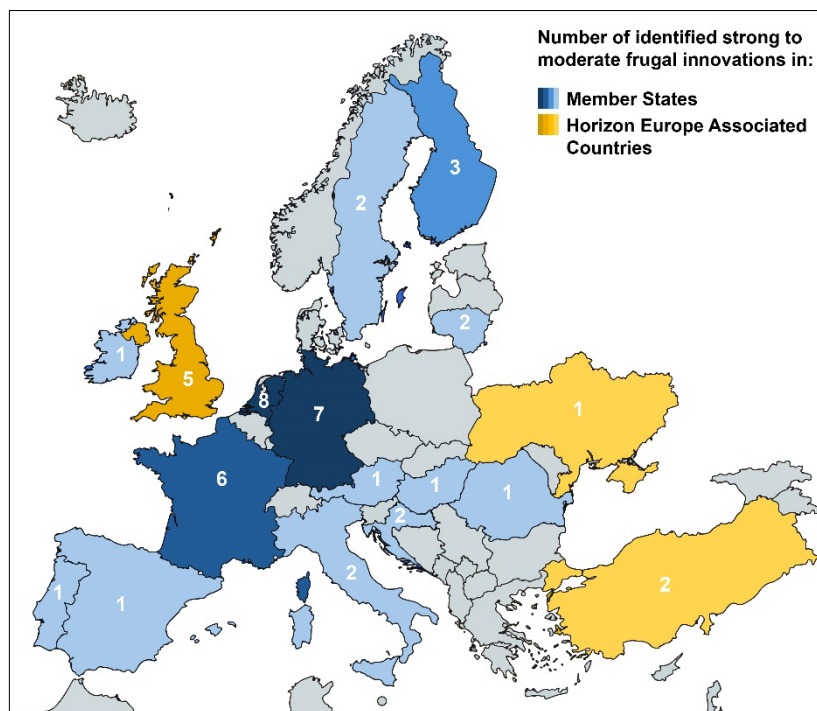
<sup>173</sup> Frugalpac. "Innovation." Accessed February 13, 2025. <https://frugalpac.com/innovation/>.

<sup>174</sup> HMD. "Nokia G22." Accessed February 13, 2025. [https://www.hmd.com/en\\_int/nokia-g-22?sku=101S0609H001](https://www.hmd.com/en_int/nokia-g-22?sku=101S0609H001).

<sup>175</sup> Fairphone. "About us." Accessed February 13, 2025. <https://shop.fairphone.com/fr/about-us>.

<sup>176</sup> Nickel. "Who we are." Accessed February 13, 2025. <https://nickel.eu/en-fr/who-we-are>.

<sup>177</sup> World Health Organization. "Homegrown, Low-Cost Innovation Improves NCD Treatment in Croatia." January 19, 2018. <https://who-sandbox.squiz.cloud/en/health-topics/noncommunicable-diseases/obesity/news/news/2018/01/homegrown-low-cost-innovation-improves-ncd-treatment-in-croatia>.

**Figure 2: Strong to moderate frugal innovations identified in EU and HEAC**

Distribution of identified strong to moderate frugal innovations mapped for this study (n=45). Note: Numbers do not add up to 45 because some innovations were developed by more than one country.

Source: Author's own elaboration, 2024.

At the regional level, the results show that most **innovations were found in more innovative regions**. 20 innovations were developed in capital regions, while the other 24 came from non-capital regions.<sup>178</sup> However, the Regional Innovation Scoreboard classification shows that the majority of innovations (37) were developed in Innovation Leader and Strong Innovator regions, while Moderate and Emerging Innovator regions were responsible for only eight innovations.

## 4. Overview of policies supporting frugal and reverse innovation in the EU and HEAC

### 4.1. Policy mapping

This section presents the results of the policy mapping to provide an overview of the policies which support or promote frugal and reverse innovation. The results are based on desk research and seek to answer the research question: *What policies support frugal and reverse innovation in the EU and HEAC? What is the volume (total funding designated) of these policies?* This section analyses the identified examples of support, considering the beneficiaries of support, key sectors (including green, digital, health and security) and contributions to the EU sustainability agenda, social innovation, and EU burning issues. The analysis highlights **well-supported areas of green and digital sectors but points to gaps in the policy landscape**.

The remainder of this section includes the methodological note and summary of findings, followed by analysis of policies and then programmes or projects which support and/or promote frugal and reverse innovation.

<sup>178</sup> The regionality of one innovation was not available because of its military nature.

## Methodological note and summary of findings

The aim of policy mapping was to establish the **current state of play of policy which supports or promotes frugal and reverse innovation in the EU and HEAC** across different levels (EU, national and regional levels) and sectors. The task was undertaken through desk research via web searching (Google) key terms<sup>179</sup> across EU and HEAC countries,<sup>180</sup> aiming to find policies within the last ten years (2013-2023). To capture the range of available support, **relevant initiatives, programmes and projects were also included in the policy mapping as well as broader policy**. The mapping revealed that while some examples refer explicitly to frugal and/or reverse innovation, many examples do not explicitly refer to these terms but do promote or support the key characteristics of frugal and/or reverse innovation.

The list of mapped examples, available in Annex 4 of this document, is non-exhaustive and presents a wide overview of the various types of policy support available for frugal and/or reverse innovation. Mini-cases, informed by additional desk research and interviews with policy makers and social partners, showcase various policy landscapes and initiatives supporting frugal or reverse innovation and provide a more in-depth exploration of the policy landscape.

In total, **136 examples across 40 countries were gathered**. The majority of examples were found at the national and EU/HEAC level. Fewer examples were noted at the regional level. Most mapped examples originated in high innovator countries,<sup>181</sup> in particular France, Belgium, Finland, Germany and the United Kingdom. An interviewed expert complements this finding, suggesting that countries with strong innovation design communities, such as Germany and the Netherlands, have strong frugal innovation ecosystems supported by designers who are more likely to engage in critical issues.<sup>182</sup> However, several examples were also sourced from low innovator countries such as Spain, Italy and Portugal. No examples were found in Croatia, Greece, Lithuania, Morocco, Romania, and Tunisia. The majority of examples were related to frugal innovation, with fewer relating to both frugal and reverse innovation and just some relating only to reverse innovation. Of the mapped examples, 31 were found that explicitly referred to frugal (29), reverse (1), or both frugal and reverse (1) innovation with the remaining examples demonstrating the potential to indirectly support or promote frugal and reverse innovation values.

In terms of the volume of support provided by policy, it is not possible to generalise based on the data gathered from the mapping. No explicit examples were found of policies which devote specific funding to frugal or reverse innovation. However, contributions (e.g. for specific programmes or projects) are provided where possible in the policy mapping database in Annex 4 of this report.

## Policies which support and/or promote frugal and reverse innovation

The lack of **policy documents** found that directly cite frugal and reverse innovation indicates that these concepts are not a focal point of innovation strategies across the EU

<sup>179</sup> Search terms included: 'frugal innovation policy', 'reverse innovation policy', 'frugal product development', 'reverse innovation product', 'grassroots innovation', 'social innovation, social enterprises', 'innovation policy', 'policy promoting innovation', 'innovation promotion', 'innovation strategies', 'innovation funding policies', 'research and development policies', 'European Innovation Council', 'innovation support policy', 'local invention support', 'SME policy support', 'enterprise support', 'innovation partnership', 'innovative ecosystem development', 'innovation clusters', 'innovative venture initiatives', 'innovative SME support', 'emerging markets', 'internationalisation support', 'emerging economy collaboration', 'technology transfer initiatives', 'global competitiveness', 'sustainable innovation', 'bottom of the pyramid innovation', 'constraint-based innovation', 'lean innovation', 'affordable innovation', 'deep-tech innovation', 'social enterprise support', 'local innovation policy', 'regional innovation policy', 'cross-border networking', 'social enterprise funding', 'funding social enterprise solutions'

<sup>180</sup> The list of countries covered during desk research includes the EU 27 Member States and Albania, Armenia, Bosnia and Herzegovina, Faroe Islands, Georgia, Iceland, Israel, Kosovo, Moldova, Montenegro, Morocco, North Macedonia, Norway, Serbia, Switzerland, Tunisia, Türkiye, Ukraine and the United Kingdom.

<sup>181</sup> Classifications for 'low' and 'high' innovator countries are based on the European Innovation Scoreboard (EIS) and the Global Innovation Index (GII). Detailed innovation scores are presented in Annex 2.

<sup>182</sup> KTH Royal Institute of Technology. Interview with expert. August 26, 2024.

and HEAC. Additional interviews with policy makers in Lithuania, Croatia and Morocco, where no direct or indirect policies or initiatives were mapped, revealed that the concepts of frugal and reverse innovation are not well understood nor prioritised at a policy level.<sup>183</sup> Box 6 and Box 7 elaborate on the specific policy landscape in these countries. Notably, these examples suggested that low innovator countries or new Member States are more likely to focus their innovation policies on broader national or EU priorities to support and advance their innovation landscape. In the case of Croatia, it was also highlighted that innovation policy is heavily dictated by reliance on EU structural funds, which leaves little room for more diverse support for, for example, frugal or reverse innovation. An additional example from Finland, a high innovator country, further demonstrates how policy priorities can influence the funding and development context of frugal and reverse innovation (see Box 8).

### Box 6. The policy landscape relating to frugal and reverse innovation in Croatia

Examples of policies supporting or promoting frugal and reverse innovation in Croatia were difficult to identify. The terms are not perceived to be widely known in Croatia and there are no specific policies which directly support or promote them.<sup>184</sup>

An interviewee from the Croatian Agency for SMEs, Innovations and Investments emphasised that frugal and reverse innovation are not within the scope of policy makers at the time this report was drafted. One reason for this is the **knowledge gap which hinders potential policy development related to frugal and reverse innovation**.<sup>185</sup> In addition, Croatia's current development stage influences policy priorities, which are focused on national level burning issues,<sup>186</sup> opposed to targeted and niche innovation support. Indeed, Croatia's relatively small industry, inherited post-Yugoslavia, and limited venture capital participation compound this issue, slowing down innovation development. While there are several local incubators and accelerators, they are not perceived to yet be robust on a national level in Croatia.<sup>187</sup>

Moreover, the country's reliance on EU funding (such as European Structural and Investment Funds and European Regional Development Funds) limits the capacity to freely innovate or design national programmes outside of EU frameworks. While Croatia has experienced success in EU programmes such as Horizon 2020, the difficulty of increasing participation suggests that more nuanced instruments could help Croatia's SMEs and start-ups to attract financial support.<sup>188</sup> As it stands, most calls from the Croatian Agency for SMEs, Innovations and Investment are EU funded and designed in line with these agreed objectives. As a result, Croatian policies tend to be reactive to EU directives, as opposed to proactive in innovation.

While general national grants<sup>189</sup> or EU-level programmes such as Eureka<sup>190</sup> and Eurostars<sup>191</sup> can indirectly support frugal or reverse innovation, **cultural barriers, such as perceived risk aversion among SMEs and start-ups, might hinder such innovation development**.<sup>192</sup> However, successful entrepreneurial role models could help to shift this mindset.<sup>193</sup>

<sup>183</sup> Lithuanian Ministry of Economy and Innovation. Interview with policy maker. August 6, 2024; Croatian Agency for SMEs, Innovations and Investments. Interview with policy maker. August 13, 2024; Interview with policy maker. August 13, 2024.

<sup>184</sup> Croatian Agency for SMEs, Innovations and Investments. Interview with policy maker. August 13, 2024; Group interview with three policy makers. September 19, 2024.

<sup>185</sup> Croatian Agency for SMEs, Innovations and Investments. Interview with policy maker. August 13, 2024.

<sup>186</sup> Burning issues within the Croatian Agency for SMEs, Innovations and Investments were elaborated as technology transfer within Croatia, boosting cooperation and scientific interest in innovation and commercialisation of research, SME life-cycle sustainability, and international relevance of innovations.

<sup>187</sup> Group interview with three policy makers. September 19, 2024.

<sup>188</sup> Group interview with three policy makers. September 19, 2024.

<sup>189</sup> E.g. National commercialisation grants that provide opportunities for companies to attend international fairs and exhibitions, promoting Croatian products in more developed markets, [Proof of Concept \(PoC\) programme for scientists and researchers](#) which supports the creation of spin-offs from universities and research institutes to create knowledge-based companies.

<sup>190</sup> Eureka. Accessed August 19, 2024. <https://eurekanetwork.org/>.

<sup>191</sup> Eureka. "Eurostars". Accessed August 19, 2024. <https://eurekanetwork.org/programmes/eurostars/>.

<sup>192</sup> Interview with policy maker. August 13, 2024.

<sup>193</sup> *Ibid.*

Based on the data gathered, there is no indication that policies which directly promote or support frugal or reverse innovation will be implemented in Croatia in the near future.<sup>194</sup> Limited national funding and cultural factors suggest that, without targeted EU support, these innovations are unlikely to be prioritised. The Croatian example highlights that the country's development stage, cultural context, and external funding dependencies influence its approach to frugal and reverse policy objectives.

### Box 7. The policy landscape relating to frugal and reverse innovation in Morocco

**The case of Morocco highlights the absence of policy support for frugal and reverse innovation, with no current specific initiatives that support or promote them.** There seems to be a desire to push the concepts forward, but they still remain outside the current scope of policymaking. Without education and the demonstration of successful case studies, they would not become a priority in the policy landscape. Nevertheless, private sector initiatives and collaborations with the Moroccan diaspora could help promote reverse innovation in the future.<sup>195</sup>

In an interview with a representative of a public research institution in Morocco, it was noted that **the term 'reverse innovation' is not well known at the policy level.** The ministry's focus is primarily on industrial sectors such as plastics and rubber, where reverse engineering has been applied in limited cases.<sup>196</sup> This narrow focus, combined with **Morocco's innovation culture being heavily influenced by short-term goals,** makes it challenging to establish longer-term projects that could support frugal and reverse innovation. Although Morocco, as an Associated Country to the Horizon Europe programme, benefits from the broader EU research and innovation ecosystem,<sup>197</sup> local support for such initiatives remains underdeveloped.<sup>198</sup>

**The Ministry of Industry has devised programmes that support research and innovation (R&I) in the industrial sector, offering financial reimbursement for consultancy and R&D activities,** yet the availability of such funding remains limited and often inaccessible due to bureaucracy and delays.<sup>199,200</sup> The country's needs are largely informed by the government's Industrial Acceleration Plan (PAI),<sup>201</sup> which seeks to attract foreign investment, enhance local production capabilities, and create jobs in key sectors, which may limit the resources dedicated to fostering a more expansive research landscape.<sup>202</sup>

Furthermore, Morocco's classification as a relatively low innovator within global innovation rankings constrains its capacity to prioritise longer-term research and development projects.<sup>203</sup> Its focus on immediate economic needs may stem from a strategic emphasis on building national resiliency and strengthening specific industrial sectors deemed vital for economic stability and growth rather than scaling innovation initiatives.<sup>204</sup> Additionally, the country's regulatory environment lacks the infrastructure to support technology transfer effectively, which poses a challenge to scaling innovation from lab to market.<sup>205</sup> The national discourse tends to focus primarily on university-industry collaborations, often overlooking the potential contributions of

<sup>194</sup> *Ibid.*

<sup>195</sup> Interview with policy maker. August 22, 2024.

<sup>196</sup> *Ibid.*

<sup>197</sup> Morocco World News. "Morocco Joins EU Funding Program Horizon Europe." 2021. Accessed November 22, 2024. <https://www.morocoworldnews.com/2021/04/339638/morocco-joins-eu-funding-program-horizon-europe>.

<sup>198</sup> Morocco World News. "UN Report: Morocco on Rise in Industry and Innovation." Accessed July 9, 2024. <https://www.morocoworldnews.com/2024/07/363662/un-report-morocco-on-rise-in-industry-and-innovation>.

<sup>199</sup> Projects can receive funding up to 60% of costs, but only for industry-based initiatives, not digital or other innovation sectors.

<sup>200</sup> Interview with policy maker. August 22, 2024.

<sup>201</sup> Oxford Business Group. "Focus Point: Reforms Channel Foreign Investment into Key Economic Sectors." Accessed September 23, 2024. <https://oxfordbusinessgroup.com/reports/morocco-report/economy/focus-point-reforms-channel-foreign-investment-into-key-economic-sectors-2>.

<sup>202</sup> United Nations Industrial Development Organization (UNIDO). *Program for Country Partnership (PCP) Morocco: Annual Report 2020*. [https://www.unido.org/sites/default/files/files/2021-07/PCP\\_Morocco\\_2020%20AR\\_0.pdf](https://www.unido.org/sites/default/files/files/2021-07/PCP_Morocco_2020%20AR_0.pdf).

<sup>203</sup> World Intellectual Property Organization. *Global Innovation Index 2021: Tracking Innovation through the COVID-19 Crisis*. Geneva: WIPO, 2021. [https://www.wipo.int/edocs/pubdocs/en/wipo\\_pub\\_gii\\_2021/ma.pdf](https://www.wipo.int/edocs/pubdocs/en/wipo_pub_gii_2021/ma.pdf).

<sup>204</sup> World Bank. "Morocco Economic Update: Navigating a New Reality." Accessed July 16, 2022.

<https://documents1.worldbank.org/curated/en/099826007162422517/pdf/IDU12f69bf581e7fa144061b0cf15dc97f2b2bbd.pdf>

<sup>205</sup> Interview with Policy maker. August 22, 2024.

local firms, while activities are concentrated in a limited number of urban areas, risking the exclusion of less-developed regions from the country's industrialisation efforts.<sup>206</sup>

Addressing these imbalances would be crucial for Morocco to enhance its innovation competitiveness in the global market. Moreover, external partnerships provide a strong framework, but national investment and policy focus are crucial to making full use of international collaborations.

### Box 8. The policy landscape relating to frugal and reverse innovation in Finland

In Finland (as in the other Nordic countries), the topic of frugal innovation became very popular among researchers around two decades ago.<sup>207</sup> This resulted in a variety of research projects, collaboration networks and support programmes, such as the **New Global Platform** at Aalto University,<sup>208</sup> Frugal Innovation Society **InnoFrugal**,<sup>209</sup> the Business with Impact (**BEAM**) Programme,<sup>210</sup> and its successor the **Developing Markets Platform**,<sup>211</sup> along with number of innovation-related development programmes funded by the Ministry for Foreign Affairs.<sup>212</sup>

These activities created a rather large and active ecosystem of dedicated researchers, civil servants and agencies, as well as larger and smaller companies around the topic of frugal innovation. Several large events were organised to launch new measures or calls, to present the results of studies and evaluations and to discuss new policy directions.

Over the last few years, there has been less attention paid to frugal innovation. The mainstream of innovation policy attention has pulled away from frugal innovation topics, it is not equally much on the agenda of development policy and there is less money dedicated to related research, too. Some likely reasons for this shift of focus are:

- For the researchers **the novelty of frugal innovation as a subject has somewhat worn out**. Among policy makers, frugal innovation is not a widely known concept and there is a lack of 'policy champions' in Europe to drive the topic or fund related research.
- **It has not been easy for policy makers to promote frugal innovation**. Frugal innovation has been a difficult concept to master. Despite studies and research, the conceptualisation of frugal innovation is not harmonious.
- Many frugal innovations tend not to upscale, and the **impact of measures can remain limited**. National policy measures supporting frugal innovations, have shifted their (limited resources) to projects with larger impact and scalability or other types of measures are emphasised.
- Many frugal innovations are set up with social objectives, and less with commercial objectives. Current **economic and innovation policy puts more weight on immediate/concrete returns**, exports and domestic business collaboration in development policy (than in supporting small local businesses in developing markets). In line with this, the attention of the innovation and export agencies has shifted from emerging

<sup>206</sup> Jabri, Khadjia. *Advancing Technology Transfer in Morocco*. United Nations Economic Commission for Africa. 2024. [https://www.uneca.org/eca-events/sites/default/files/resources/documents/TCND/ARFSD2024/STI/case\\_studies/morocco\\_tt\\_report\\_august.pdf](https://www.uneca.org/eca-events/sites/default/files/resources/documents/TCND/ARFSD2024/STI/case_studies/morocco_tt_report_august.pdf).

<sup>207</sup> The topic gained popularity largely after the publication of C.K. Prahalad's book *The Fortune at the Base of the Pyramid* in 2004.

<sup>208</sup> New Global. Accessed November 22, 2024. <https://newglobal.aalto.fi/>.

<sup>209</sup> InnoFrugal. "About Us." Accessed November 22, 2024. <https://innofrugal.org/about-us/>.

<sup>210</sup> Ministry of Foreign Affairs of Finland. "Developmental Evaluation of Business with Impact (BEAM) Programme." 2017. Accessed November 22, 2024. [https://um.fi/development-cooperation-evaluation-reports-comprehensive-evaluations/-/asset\\_publisher/nBPqGHSLrA13/content/business-with-impact-beam-ohjelma-kehittava-evaluointi/384998](https://um.fi/development-cooperation-evaluation-reports-comprehensive-evaluations/-/asset_publisher/nBPqGHSLrA13/content/business-with-impact-beam-ohjelma-kehittava-evaluointi/384998).

<sup>211</sup> Business Finland. "Sustainable Opportunities in Growth Markets." Accessed November 22, 2024. <https://www.businessfinland.fi/suomalaisille-asiakkaille/palvelut/ohjelmat/developing-markets-platform>.

<sup>212</sup> For example the SAIS, TANZICT, STIFIMO, IIP, SAFIPA programmes by MFA in Africa and Asia.

markets to further developed markets, where it is easier to do business/larger business opportunities.

- Overall, budgets for the direct innovation support measures in the development context have been cut, and the emphasis is more on measures that support technological collaboration.

The relevance of frugal innovation remains in trade and export policies. Developing markets provide a growing market opportunity for many Finnish businesses that invest there and adapt to local needs, which sometimes means providing frugal solutions. For many parts, the **aspects of frugal innovation have been mainstreamed** into Finnish economic, innovation and development policies.

**Policy documents** which were identified as promoting frugal innovation often did so in an indirect and general manner relating to the key characteristics of the innovation type (e.g. by encouraging innovation relating to sustainability, user-centricity, or efficiency). In terms of reverse innovation, even fewer examples were found and could only be loosely considered to promote reverse innovation through generalised promotion of, for example, cross-border collaborations. Interviewed stakeholders from an innovation agency in Belgium highlighted that, in their view, reverse innovation is not well supported and there are no regional competencies to include such foreign relations and international policies to support reversing innovations that originate outside of Belgium.<sup>213</sup>

**Only one example of a policy document was found to have explicitly referred to frugal innovation: Malta's National Research and Innovation Strategic Plan 2023-2027**<sup>214</sup> (see Box 9), however, the document does not elaborate or provide actions to support this. This further supports that there is a limited prioritisation and conceptual understanding of frugal and reverse innovation at a national level.

#### Box 9. Malta's National Research and Innovation Strategic Plan 2023-2027

**Malta's National Research and Innovation Strategic Plan 2023-2027**<sup>215</sup> outlines the country's priorities for research and innovation, aiming to drive growth in various sectors (including agriculture, transport, tourism, and health). Developed by the Ministry for Education, Sport, Youth, Research and Innovation,<sup>216</sup> the Parliamentary Secretariat for Youth, Research and Innovation<sup>217</sup> and the Malta Council for Science and Technology,<sup>218</sup> the Plan emphasises the role of R&I in driving the green and digital transitions.

In the SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis of Malta's R&I performance, the Plan presents opportunities to build high-value-added sectors. It highlights the **need for start-ups and enterprises to align with EU agendas and exploit opportunities** from NextGenerationEU<sup>219</sup> and the European Green Deal,<sup>220</sup> given the limitations of the local market. In this context, the Plan notes that the Maltese diaspora in global innovation hubs presents an opportunity to enhance R&I internationalism, suggesting the **promotion of Malta's R&I initiatives in social, health, educational and frugal innovation.**

<sup>213</sup> Group interview with two policy makers. October 11, 2024.

<sup>214</sup> Government of Malta. *Malta's National Research and Innovation Strategic Plan 2023-2027*. The Malta Council for Science & Technology. <https://mcst.gov.mt/wp-content/uploads/2023/01/%E2%80%A2RI-Report-Final.pdf>.

<sup>215</sup> *Ibid.*

<sup>216</sup> The Ministry for Education, Sport, Youth, Research and Innovation. Accessed October 17, 2024. <https://education.gov.mt/>.

<sup>217</sup> Parliamentary Secretariat for Youth, Research and Innovation. Accessed October 17, 2024. <https://youths.gov.mt/parliamentary-secretary/>.

<sup>218</sup> Malta Council for Science and Technology. Accessed October 17, 2024. <https://mcst.gov.mt/>.

<sup>219</sup> European Commission. *NextGenerationEU*. Accessed October 17, 2024. [https://commission.europa.eu/strategy-and-policy/eu-budget/eu-borrower-investor-relations/nextgenerationeu\\_en](https://commission.europa.eu/strategy-and-policy/eu-budget/eu-borrower-investor-relations/nextgenerationeu_en).

<sup>220</sup> European Commission. *The European Green Deal*. Accessed October 17, 2024. [https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal\\_en](https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en).

The Plan's mention of frugal innovation highlights the potential to **promote both frugal and reverse innovation, by driving innovation from Malta to higher innovator EU countries.** However, the Plan does not elaborate on frugal innovation, include it in recommendations, or identify related policy actions.

While frugal innovation may not be prioritised in R&I development in Malta, the document highlights an **awareness of the concept and its relevance to green and digital transitions.** Moreover, the Plan indicates that EU strategies such as the NextGenerationEU<sup>221</sup> and the Green Deal<sup>222</sup> can be opportunities for targeted support for frugal innovation.

Some policies were identified that related to frugal innovation and they demonstrate a **focus on innovative solutions which contribute to the green and digital transition, which are well aligned with the EU Green Deal<sup>223</sup> and NEIA.<sup>224</sup>** In addition, several policies specifically address social aspects such as accessibility, affordability and social innovation. Box 10 below highlights some examples of policies that have the potential to support or promote frugal innovation. However, the examples are highly generalisable, and while they do support some of the tenets of frugal innovation, policy documents that target frugal or reverse innovation more deliberately are not prevalent.

#### Box 10. Policies which indirectly support or promote frugal innovation

- **Georgia's Long-term Low Emission Development Strategy<sup>225</sup>** (2023) puts forward Georgia's long-term vision for low emission development with a specific focus on cost-effectiveness and the development of innovative technology which also reduces cost and improves sustainability.
- **Reykjavik's Economic and Innovation Policy 2022-2030<sup>226</sup>** has specific goals to approach innovation not just as the development of high-tech services and products, but also to include social innovation, democratic input, and creativity.
- **Estonia 2035: Action Plan of the Government of the Republic<sup>227</sup>** promotes innovative changes to administrative processes through decentralisation and regional cooperation. As an example, it includes the establishment of joint digital museum repositories for the preservation and digitisation of Estonian state collections, which is cost-saving, efficient, and improves accessibility.

Programmes or projects which support and/or promote frugal and reverse innovation

Most commonly, examples supporting and promoting frugal and reverse innovation were initiatives such as **funding programmes or specific projects.** In some cases, frugal and reverse innovation are explicitly mentioned in programme or project descriptions and are highly targeted towards such innovations. **Examples directly supporting frugal and reverse innovation are described in Box 11.** These demonstrate the breadth of the

<sup>221</sup> European Commission. *NextGenerationEU*. Accessed October 17, 2024. [https://commission.europa.eu/strategy-and-policy/eu-budget/eu-borrower-investor-relations/nextgenerationeu\\_en](https://commission.europa.eu/strategy-and-policy/eu-budget/eu-borrower-investor-relations/nextgenerationeu_en)

<sup>222</sup> European Commission. *The European Green Deal*. Accessed October 17, 2024. [https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal\\_en](https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en)

<sup>223</sup> European Commission. *The European Green Deal*. Accessed October 17, 2024. [https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal\\_en](https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en)

<sup>224</sup> European Commission. "The New European Innovation Agenda." Accessed January 2, 2025. [https://research-and-innovation.ec.europa.eu/strategy/support-policy-making/shaping-eu-research-and-innovation-policy/new-european-innovation-agenda\\_en](https://research-and-innovation.ec.europa.eu/strategy/support-policy-making/shaping-eu-research-and-innovation-policy/new-european-innovation-agenda_en)

<sup>225</sup> Government of Georgia. *Georgia's Long-Term Low Emission Development Strategy*. 2023. <https://unfccc.int/sites/default/files/resource/Georgia%27s%20LT-LEDS%202023-eng.pdf>

<sup>226</sup> Office of the Mayor and Chief Executive Officer of the City of Reykjavik. *Reykjavik City of Economic and Innovation Strategy 2022–2030*. [https://reykjavik.is/sites/default/files/2022-04/Nyskopun\\_kynning\\_vinnuskjal\\_ENS\\_290422\\_3.pdf](https://reykjavik.is/sites/default/files/2022-04/Nyskopun_kynning_vinnuskjal_ENS_290422_3.pdf)

<sup>227</sup> Office of the Government of the Czech Republic. *Innovation Strategy of the Czech Republic 2019–2030*. Council for Research, Development and Innovation, 2019. <https://vyzkum.gov.cz/FrontClanek.aspx?idsekce=867922&ad=1&attid=867987>

sectors and activities covered by the mapped projects/programmes, which include knowledge building and sharing, climate, security, advanced technology, and health. Core elements of these examples are sustainability and environmentally friendly solutions as well as low-cost, future-focused, and efficient innovations. Moreover, examples such as the 'Adoption of Frugal Innovations in the NHS',<sup>228</sup> among others, embed social values such as community-driven solutions.

### Box 11. Programmes or projects which explicitly refer to frugal and/or reverse innovation

Examples which reference frugal innovation:

- **Hands-on citizen science and frugal innovation**<sup>229</sup> is a Science with and for Society (SwafS) Horizon 2020 topic with a specific sub-topic (B) on frugal innovation. The sub-topic aims to support activities to develop frugal innovations with a focus on citizen science. The topic recognises that frugal innovations often use state-of-the-art technologies while minimising costs within low-income populations and works to showcase and evaluate impacts on society, democracy, the economy, and innovation processes. Projects from the topic (including sub-topic A on citizen science) include FRANCIS Frugal Innovation by Citizens for Citizens (2021-2024)<sup>230</sup> which aimed to leverage citizen science for the development of frugal innovations.
- **The Innovation for a Better World – Advanced Solutions for Sustainable Development**<sup>231</sup> (2020) is a joint collaboration between the Austrian Development Agency and the Austrian Research Promotion Agency which aims to contribute towards Sustainable Development Goals (SDGs) by funding projects specifically focused on finding innovative frugal solutions in Austria and the West Balkans.
- **FUTURE is Frugal**<sup>232</sup> (2021) is a German initiative from the Ministry of Economy, Industry, Climate Protection and Energy which facilitates workshops and other events to inform SMEs about frugal innovations and foster cooperation between innovators.
- **Frugal and Robust AI for Defence Advanced Intelligence (FARADAI)**<sup>233</sup> (2021 – 2024) is a European Defence Fund project aimed at developing frugal AI methods to reduce the need for human supervision and reduce the costs of detection and identification defence systems.

An example which references reverse innovation:

- **Knowledge and Innovation in, to and from Emerging Markets**<sup>234</sup> (2017 – 2019) is a Horizon 2020 project (programme: Excellent Science Marie Skłodowska-Curie Actions and Stimulating innovation by means of cross-fertilisation of knowledge) aimed at understanding knowledge generation in emerging markets, how emerging markets can learn from advanced markets and how advanced markets can profit from knowledge and innovations made in emerging markets.

<sup>228</sup> National Institute for Health and Care Research Applied Research Collaboration Northwest London. "Adoption of Frugal Innovations in the NHS." Accessed October 17, 2024. <https://www.arc-nwl.nihr.ac.uk/research/innovation-and-evaluation/adoption-of-frugal-innovations-in-the-nhs>.

<sup>229</sup> European Commission. "Hands-on citizen science and frugal innovation." CORDIS. Accessed November 18, 2024. [https://cordis.europa.eu/programme/id/H2020\\_SwafS-27-2020/en](https://cordis.europa.eu/programme/id/H2020_SwafS-27-2020/en).

<sup>230</sup> European Commission. "Frugal Innovation by Citizens for Citizens." CORDIS. Accessed November 18, 2024. <https://cordis.europa.eu/project/id/101006220>.

<sup>231</sup> The Austrian Research Promotion Agency FFG. "ADA and FFG Support Frugal Innovations from Austria and the Western Balkans." 2020. Accessed November 22, 2024. <https://www.ffg.at/presse/frugale-innovation>.

<sup>232</sup> Open Innovation City Bielefeld. "Future Is Frugal." Accessed October 17, 2024. <https://openinnovationcity.de/information/frugale-innovation>.

<sup>233</sup> FARADAI. "Frugal and Robust AI for Defence Advanced Intelligence." Accessed October 17, 2024. <https://faradai.eu/>.

<sup>234</sup> European Commission. *Knowledge and Innovation in, to and from Emerging Markets*. CORDIS. Accessed October 17, 2024. <https://cordis.europa.eu/project/id/734447>.

An example which references both frugal and reverse innovation:

- **The Adoption of Frugal Innovations in the NHS**<sup>235</sup> (2019 – 2024) is a National Institute for Health and Care Research Applied Research Collaboration Northwest London (NIHR ARC NWL) initiative which funds three streams of research to identify, understand, and pilot frugal innovations within the NHS and across local health and care systems in Northwest London. Their outputs include publications to better understand knowledge diffusion and reverse innovation and the adoption of the Community Health Worker (CHW) pilot in Westminster.

As demonstrated, while there are examples of initiatives that directly refer to frugal or reverse innovation, the majority of mapped examples do not. Instead, they have been included in the database because they display potential to, or evidence of, impact in providing support or promoting frugal and reverse innovation values. Importantly, this means that the majority of examples mapped provide support to a broad range of innovations, not only those that are frugal or reverse. Box 12 provides some examples of programmes or projects that demonstrate the potential to support or promote frugal or reverse innovation.

### Box 12. Initiatives which do not refer to frugal and/or reverse innovation

Examples of frugal innovation focused initiatives:

- **The EU LIFE Programme**<sup>236</sup> is a funding instrument focused on environment and climate action. As a result of funding received from the LIFE Programme,<sup>237</sup> the Life Nieblas project (2020 – 2024) has developed a frugal design of Fog Water Collectors which reduce degradation of the environment and allow for more sustainable water collection practices which benefit the local community and businesses.<sup>238</sup>
- **SmartCap**,<sup>239</sup> a small fund manager and subsidiary of the Estonian Business and Innovation Agency, manages the SmartCap Green Fund which provides capital to new green technologies from startups. The green fund provided funding for the frugal innovation CupLOOP,<sup>240</sup> a smart kiosk for the circular use of reusable cups.

Examples of reverse innovation focused initiatives:

- **SAP Startup Factory**<sup>241</sup> (2020), made up of the software company SAP and the government agency German Corporation for International Cooperation (GIZ) works alongside the Business Angel Network of Armenia (BANA) to advise Armenian start-ups on business model development and expansion of their customer base to areas outside of Armenia. SAP provides start-ups in Armenia, a low innovator country, with the opportunities to access the international market and make their digital innovations available globally, including in high innovator countries.
- **BIRAC-Tekes: Enhancing Competitiveness**<sup>242</sup> (2013) was a collaborative programme from the Biotechnology Industry Research Assistance Council (BIRAC) in India and the Finnish Funding Agency for Innovation, Tekes, which provided the funding. While the programme has ended, the collaboration made funding available for industrial and

<sup>235</sup> National Institute for Health and Care Research Applied Research Collaboration Northwest London. "Adoption of Frugal Innovations in the NHS." Accessed October 17, 2024. <https://www.arc-nwl.nihr.ac.uk/research/innovation-and-evaluation/adoption-of-frugal-innovations-in-the-nhs>.

<sup>236</sup> Life Nieblas. "The Project." Accessed October 17, 2024. <https://www.lifenieblas.com/project>.

<sup>237</sup> This project also receives 55% of its funds from the European Commission (Life Programme) and 33% from Cabildo de Gran Canaria, the remaining funds are from additional contributors.

<sup>238</sup> The Life Nieblas project has been developed into a case study for this study, presented in Annex 6.

<sup>239</sup> SmartCap. "About Us." Accessed October 17, 2024. <https://smartcap.ee/about-us/>.

<sup>240</sup> Cuploop. Accessed October 17, 2024. <https://cuploop.com>.

<sup>241</sup> BANA Angels. "SAP Startup Factory." Accessed October 17, 2024. <https://www.bana.am/the-factory/project/1>.

<sup>242</sup> Biotechnology Industry Research Assistance Council. "BIRAC-TEKES: Enhancing Competitiveness." Accessed October 17, 2024. [https://www.birac.nic.in/desc\\_new.php?id=268](https://www.birac.nic.in/desc_new.php?id=268).

academic projects aiming to find solutions to problems which would impact both Indian and Finnish social or economic society. The programme also aimed to increase the competitiveness of both industries and build collaboration within the innovation chain.<sup>243</sup> More context on the funding landscape for frugal and reverse innovation is provided in Box 8.

- **The Grand Challenges Israel Incentive Programme<sup>244</sup>** (2020) is part of the wider Grand Challenges in Global Health international initiative, operated in Israel by the Israel Innovation Agency and partnered with the Israel Agency for International Development Cooperation (MASHAV). The programme supports R&D innovation targeting humanitarian health challenges in developing countries which also have commercial potential in developed countries.

Examples of both frugal and reverse innovation focused initiatives:

- **Small Business Innovation Research (SBIR) in Developing Markets<sup>245</sup>** is a programme from the Netherlands Enterprise Agency which runs calls for Dutch entrepreneurs to find innovative solutions to challenges in developing countries.
- **French-Norwegian strategic partnership on green industrial transformation<sup>246</sup> (2024)** is a partnership which aims to achieve the goals of the Paris Agreement and the Sustainable Development Goals (SDGs) through collaboration related to the green industrial transition in the two countries. The partnership has a focus on promoting sustainability and cost-effective development of critical materials projects and mining.

The examples provided align with policy themes of the green and digital transition, as well as cross-border partnerships which encourage knowledge sharing and localised solutions. While some examples demonstrate a capacity to indirectly support reverse innovation by increasing the competitiveness of small businesses and start-ups, they are mostly targeted at international partnerships between EU countries and developing countries outside of the EU. As shown in the innovation mapping (see Chapter 3), small companies are more likely to engage in frugal innovation due to their singular focus on solving socially orientated problems. This is also supported by interview findings, with one stakeholder suggesting that (in their country) examples of frugal innovations are often eclectic and stemming from individual efforts, with little policy coherence.<sup>247</sup> The examples from the policy mapping show that projects and initiatives can support frugal innovations by promoting more efficient green and digital solutions, giving **smaller companies or start-ups the opportunities to disrupt currently accepted solutions**. This is evidenced in the Smart Open Lisboa<sup>248</sup> (SOL) programme in Portugal (see Box 13). Supported by the local municipality, the programme supports innovators with piloting disruptive solutions within Lisbon, promoting sustainable and socially driven innovations.

### Box 13. Smart Open Lisboa (SOL)

Smart Open Lisboa<sup>249</sup> (SOL) is a startup programme focused on integrating innovative solutions to upgrade citizens' lives. Started in 2015 by Lisbon City Hall and developed in partnership with Beta-I (among others), **SOL facilitates partnerships between mature startups, corporations,**

<sup>243</sup> BioSpectrum. "Funding for Indo-Finnish Collaboration." Accessed October 17, 2024.

<https://www.biospectrumindia.com/news/95/3452/funding-for-indo-finnish-collaboration.html>.

<sup>244</sup> Israel Innovation Authority. "GCI – Grand Challenges Israel Incentive Program." Accessed October 17, 2024.

<https://innovationisrael.org.il/en/programs/gci-grand-challenges-israel-incentive-program-2>.

<sup>245</sup> Netherlands Enterprise Agency. "Small Business Innovation Research (SBIR) in Developing Markets." Accessed October 17, 2024. <https://projects.rvo.nl/programmes/nl-kvk-27378529-4000002602>.

<sup>246</sup> Ministry of Economy, Finance and Industrial and Digital Sovereignty. "France and Norway Sign Strategic Partnership to Strengthen Their Cooperation on Green Industrial Transformation". 2024. Accessed October 17, 2024.

<https://presse.economie.gouv.fr/la-france-et-la-norvege-signent-un-partenariat-strategique-pour-renforcer-leur-cooperation-en-matiere-de-transformation-industrielle-verte/>.

<sup>247</sup> Interview with policy maker. August 22, 2024.

<sup>248</sup> Smart Open Lisboa. "SOL – Smart Open Lisboa." Accessed February 13, 2025. <https://smartopenlisboa.com/>.

<sup>249</sup> *Ibid.*

**and public entities,<sup>250</sup> providing early-stage pilot and implementation opportunities in the city.** Due to the focus on disruptive and sustainable solutions, the supported innovations often align well with frugal principles. Examples include Cinderela, which transforms construction waste into low-cost building materials, and eParkio, which offers intelligent, affordable parking management solutions to reduce congestion and emissions.<sup>251</sup>

**SOL contributes to the EU's sustainability goals, promoting urban innovations in line with the European Green Deal.<sup>252</sup>** Solutions related to mobility, crowd management, and urban transportation and infrastructure directly impact city life and help reduce emissions,<sup>253</sup> supporting the EU's climate goals and circular economy principles.<sup>254</sup>

Despite SOL's support, obstacles challenge the development and scaling of innovations through the programme. First, startups do not receive direct funding through SOL, relying instead on contracts and revenue streams post-pilot.<sup>255</sup> **This can be a deterrent for startups looking for initial funding to develop their solutions.** Additionally, investors often demand equity, posing a challenge for founders seeking to retain control of their companies.<sup>256</sup> Another barrier is the broader policy environment, particularly the complex and ever-changing European Commission grant processes.

**SOL serves as an example of how support schemes can help innovative start-ups flourish.** By providing piloting schemes and networking opportunities, SOL has an essential role for frugal start-ups in Lisbon. **The initiative highlights the need for greater awareness and understanding among investors and policy makers.** Streamlined policy initiatives and more accessible funding mechanisms could help unlock even greater potential for innovation in Lisbon and beyond.

The policy mapping showed that green and digital policy areas were most represented, particularly relating to **circular economy, reducing the reliance on fossil fuels and mastering the digital transformation.** The case studies also highlighted that **frugal innovations align well with the EU's sustainability agenda,** such as the EU Green Deal<sup>257</sup> and Circular Economy Action Plan.<sup>258</sup> Frugal innovations emphasise resource efficiency, carbon reduction, sustainable materials, localised supply chains and circularity. The case studies also illustrated how frugal innovations have the capacity to contribute to the NEIA<sup>259</sup> by **reducing the innovation divide through technology democratisation** (e.g. via open-source technology) and enabling socially driven and community innovation, further contributing to the social agenda. The area of health was also prevalent in the policy mapping results but to a lesser extent, with examples promoting better access to medical care and equipment, well-being, or increasing food security through more sustainable water and agriculture practices. In the case studies, this was also evident, as the cases emphasised the potential for frugal innovations to bridge gaps in accessibility to goods and services, in particular in health services and technology.

Notably, examples in the mapping related to security were not readily found but did include, for example, the aforementioned FARADAI project and the UK-Ukraine twinning grants

<sup>250</sup> Interview with policy maker. August 22, 2024.

<sup>251</sup> Smart Open Lisboa. "Alumni Housing." Accessed October 17, 2024. <https://smartopenlisboa.com/housing/alumni-housing/>.

<sup>252</sup> European Commission. *The European Green Deal*. Accessed October 17, 2024. [https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal\\_en](https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en).

<sup>253</sup> *Ibid.*

<sup>254</sup> *Ibid.*

<sup>255</sup> Interview with social partner. September 5, 2024.

<sup>256</sup> *Ibid.*

<sup>257</sup> European Commission. *The European Green Deal*. Accessed October 17, 2024. [https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal\\_en](https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en).

<sup>258</sup> European Commission. *A New Circular Economy Action Plan for a Cleaner and More Competitive Europe*. Brussels: European Commission, 2020. <https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1583933814386&uri=COM:2020:98:FIN>

<sup>259</sup> European Commission. "The New European Innovation Agenda." Accessed January 2, 2025. [https://research-and-innovation.ec.europa.eu/strategy/support-policy-making/shaping-eu-research-and-innovation-policy/new-european-innovation-agenda\\_en](https://research-and-innovation.ec.europa.eu/strategy/support-policy-making/shaping-eu-research-and-innovation-policy/new-european-innovation-agenda_en).

scheme<sup>260</sup> project 'Inclusive and Frugal Innovation System for Military Technologies and Needs in Ukraine'<sup>261</sup> which established a new model for inclusive and frugal military technologies. More generally, the UK-Ukraine twinning initiative also presents an interesting case for opportunities to promote resilience, knowledge transfer and inclusive innovation ecosystems which can reduce inequalities across the EU and HEAC. Box 14 further elaborates on the UK-Ukraine Twinning Initiative and its relevance to frugal and reverse innovation. The absence of security-related initiatives suggests that there are opportunities to promote frugal innovative solutions within this sector.

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<sup>260</sup> Universities UK. "UK-Ukraine R&I Twinning Grants Scheme." 2023. Accessed October 17, 2024. <https://www.universitiesuk.ac.uk/topics/international/international-research-collaboration/uk-ukraine-ri-twinning-grants-scheme>.

<sup>261</sup> University of Portsmouth. "Inclusive and Frugal Innovation System for Military Technologies and Needs in Ukraine." Accessed October 17, 2024. <https://researchportal.port.ac.uk/en/projects/inclusive-and-frugal-innovation-system-for-military-technologies->.

#### Box 14. UK-Ukraine Twinning Initiative

**The UK-Ukraine Twinning Initiative**,<sup>262</sup> launched by the Cormack Consultancy Group (CCG)<sup>263</sup> shortly after Russia's 2022 invasion of Ukraine, aims to support Ukrainian universities through partnerships with UK higher educational institutions. **The initiative seeks to build resilience in Ukraine's higher education system, providing resources and skills to support education and opportunities for students and academics during the conflict and post-war recovery.** The initiative currently supports 174 universities, offering a unique platform for collaboration.<sup>264</sup>

The initiative has raised over GBP 100 million in private (alumni) and university funding, as well as GBP 3.5 million from private sector donations. Recently, it secured funding from the Foreign, Commonwealth & Development Office,<sup>265</sup> **creating financial momentum for academic partnerships.**<sup>266</sup> However, government funding, ideally through a joint UK-Ukraine body, is needed to ensure the initiative's long-term sustainability.<sup>267</sup> Despite ambitions for international engagement from Ukraine, it is not a priority.<sup>268</sup> An interviewee also noted that without the CCG, UK government support for such a partnership would likely be minimal.<sup>269</sup> **The initiative has opened several pathways to facilitate support in the absence of supporting policy, driven by both UK and Ukraine research communities and increased availability of funds.**<sup>270</sup>

The partnerships enhance resilience in Ukraine's education and research infrastructure, creating lasting opportunities<sup>271</sup> for **research exchanges, technology transfer<sup>272</sup> and business opportunities in new markets,**<sup>273</sup> particularly as Ukraine moves towards EU accession.<sup>274</sup> The Twinning Initiative also helps Ukrainian researchers overcome barriers imposed by COVID-19 and the war,<sup>275,276</sup> **re-engaging them with long-term prospects for innovation.**<sup>277</sup> A Ukrainian policy maker noted that beyond the war, Ukraine could leverage heightened external awareness to stimulate the spread of innovations, potentially in a reverse nature.<sup>278</sup>

A notable project funded through the UK-Ukraine Research and Innovation Twinning Grants Scheme<sup>279,280</sup> is the **'Inclusive and Frugal Innovation System for Military Technologies and Needs in Ukraine' (2023),**<sup>281</sup> which directly targeted frugal innovation in military technologies, developing scalable and affordable solutions defence solutions. The grant scheme has funded projects which align with the **EU green and digital transition and the promotion of social inclusion,** such as 'Efficacy and Prospects of Digital Healthcare in Ukraine During and Post-conflict,'<sup>282</sup> which promotes digital health as a low-resource and cost-effective alternative in the face of infrastructure challenges.

The Twinning Initiative will intensify its focus on innovation by developing grant networks and addressing strategic priorities of the Ukrainian government, such as **innovation, knowledge transfer, and skills development.** Partnerships with the European Bank of Reconstruction and Development (EBRD) are expected to provide additional support.<sup>283</sup> The UK-Ukraine Twinning Initiative **provides a platform for collaboration, fostering knowledge transfer and opening up new markets for both the UK and Ukraine.** By sustaining research activities and infrastructure in Ukraine throughout the war it supports the development of frugal innovation and has the potential to promote reverse innovation post-war.

**Overall, the policy mapping highlighted that there are few examples of specific initiatives which directly support or promote frugal innovation and even fewer which do so for reverse innovation.** This is supported by the case studies where it was found

<sup>262</sup> The Ukraine Twinning Initiative is coordinated by Cormack Consultancy Group and with support of UUKi, the President's Fund of Ukraine for Education, Science, and Sports, and the Ministry of Education and Science Ukraine. See: Twinning Ukraine. "Ukraine Twinning Initiative." Accessed October 17, 2024. <https://www.twinningukraine.com/>.

<sup>263</sup> Cormack Consultancy Group. Accessed October 17, 2024. <https://www.consultcormack.com/>.

<sup>264</sup> *Ibid.*

<sup>265</sup> Gov.uk. "Foreign, Commonwealth & Development Office." Accessed October 17, 2024. <https://www.gov.uk/government/organisations/foreign-commonwealth-development-office>.

<sup>266</sup> Cormack Consultancy Group. Interview with employee. August 7, 2024.

<sup>267</sup> Interview with policy maker. September 6, 2024.

<sup>268</sup> University of Nottingham. Interview with employee. September 6, 2024.

<sup>269</sup> *Ibid.*

<sup>270</sup> *Ibid.*

<sup>271</sup> University of Nottingham. Interview with employee. September 6, 2024; Interview with policy maker. September 6, 2024.

that policy support was limited. In particular, the policy documents analysed in the mapping did not demonstrate specific or targeted references to frugal and reverse innovation or provide actionable policy goals which promote them. However, the case studies also demonstrated that EU-wide general policies (for example, relating to sustainability or circular principles) had the potential to indirectly create favourable conditions for the marketing of frugal and reverse innovations by encouraging uptake. One example, ECOFARIO<sup>284</sup> (presented as a mini-case in Box 15), further demonstrates how shifting EU priorities, for example in response to a crisis, can impact small ventures and their access to support.

Moreover, the mapping indicates that there are many programmes and projects which indirectly support or promote frugal and reverse innovation. This finding was supported by interviews with policy makers who suggested that funding programmes can support frugal innovation indirectly through non-specific measures related to, for example, simplicity, cost-effectiveness, or the demand for cheaper products.<sup>285</sup> The funding and network or knowledge-sharing spaces provided by the example initiatives found in the policy mapping create valuable opportunities for SMEs, start-ups and entrepreneurs or research and educational institutions to develop or market their innovations in highly competitive green and digital technology sectors. However, as the examples of SOL and the UK-Ukraine Twinning Initiative highlight, social partners such as private agencies and universities, can have a significant role in driving frugal and reverse innovation, with national and EU-level support. Some case studies also pointed to support from public servants suggesting that political advocacy and public sector endorsement are valuable tools for driving and supporting innovation in specialised fields which may not otherwise receive wide support.

#### Box 15. ECOFARIO's filtration system

ECOFARIO, a small German start-up with five employees, that designs and implements a filtration system to remove microplastics (and other contaminants) from water.<sup>286</sup> While firm-led and profit-driven, its mandate is socially orientated: to end microplastic pollution.<sup>287</sup> ECOFARIO's filtration system, developed in 2018 and launched in 2022, is being implemented in Germany and Central Europe within the microplastic removal sector with application potential in seawater desalination and paper industries. The innovative high G separator uses rotational force to separate substances based on density, redefining the functionality of a traditional hydro-cyclone<sup>288</sup> used in wastewater treatment.<sup>289</sup> Offering enhanced efficiency and material choice<sup>290</sup> it delivers **high**

<sup>272</sup> Longer-term research partnerships have already been established, including faculties applying for joint research grants which are anticipated to extend beyond the current conflict. Interview with policy maker. September 6, 2024

<sup>273</sup> University of Nottingham. Interview with employee. September 6, 2024.

<sup>274</sup> *Ibid.*

<sup>275</sup> Mariupol University. Interview with employee. August 16, 2024.

<sup>276</sup> Interview with policy maker. September 6, 2024; Mariupol University. Interview with employee. August 16, 2024.

<sup>277</sup> Interview with policy maker. September 6, 2024.

<sup>278</sup> *Ibid.*

<sup>279</sup> Universities UK. "UK-Ukraine R&I Twinning Grants Scheme." 2023. Accessed October 17, 2024.

<https://www.universitiesuk.ac.uk/topics/international/international-research-collaboration/uk-ukraine-ri-twinning-grants-scheme>.

<sup>280</sup> Calls opened under the scheme in November 2022 with selected projects ending no later than August 2023

<sup>281</sup> Undertaken by the University of Portsmouth in the UK and Odesa Polytechnic in Ukraine, see: University of Portsmouth. "Inclusive and Frugal Innovation System for Military Technologies and Needs in Ukraine." Accessed October 17, 2024.

<https://researchportal.port.ac.uk/en/projects/inclusive-and-frugal-innovation-system-for-military-technologies->

<sup>282</sup> Odesa Polytechnic National University. "Efficacy and Prospects of Digital Healthcare in Ukraine During and Post-Conflict." 2023. Accessed October 17, 2024. <https://op.edu.ua/en/international/projects/uk-ukraine-twinning-initiative-18>.

<sup>283</sup> Cormack Consultancy Group. Interview with employee. August 7, 2024.

<sup>284</sup> ECOFARIO. "About - ECOFARIO." Accessed August 12, 2024. <https://www.ecofario.eco>.

<sup>285</sup> Group interview with two policy makers. October 11, 2024; Interview with policy maker. October 15, 2024.

<sup>286</sup> ECOFARIO. "About - ECOFARIO." Accessed August 12, 2024. <https://www.ecofario.eco>.

<sup>287</sup> *Ibid.*

<sup>288</sup> ScienceDirect. "Hydrocyclone." Accessed September 20, 2024. <https://www.sciencedirect.com/topics/materials-science/hydrocyclone>.

<sup>289</sup> ECOFARIO. Interview with employee. July 1, 2024.

<sup>290</sup> ECOFARIO. "About - ECOFARIO." Accessed August 11, 2024. <https://www.ecofario.eco>.

**performance using a cost-effective and simplified approach**, reducing both production and operational costs.<sup>291</sup>

The company faces challenges due to the slow industry adaptation and shifting EU priorities, exacerbated by COVID-19 and the invasion of Ukraine.<sup>292</sup> **Recent EU focus on clean energy, has meant that support for initiatives aimed at removing microplastics, such as funding opportunities, has dwindled, as environmental and climate protection goals do not always align.**<sup>293,294</sup> Although ECOFARIO's initiative aligns with The EU's Zero Pollution Action Plan<sup>295</sup> and Circular Economy Action Plan,<sup>296</sup> legislative proposals targeting microplastics pollution lack effectiveness in their scope.<sup>297</sup> Despite the less favourable regulatory environment for the wastewater treatment industry, ECOFARIO hopes that laws like the REACH regulation,<sup>298</sup> to restrict microplastics in consumer goods, will promote funding and awareness.

ECOFARIO advocates for increased government funding in the sector and easier access to financial resources, including **governmental support to young companies to secure loans from risk-averse banks.**<sup>299</sup> While ECOFARIO's frugal innovation has the potential to contribute to key societal and environmental challenges, the sector requires prioritisation and investment to fully realise its impact. Governmental support would ease the burdens faced in this conservative investment environment and boost ECOFARIO's ability to continue and enhance its efforts.<sup>300</sup>

Future policy development which more concretely supports frugal and reverse innovation could **promote the competitive EU and HEAC landscape and more evenly contribute to EU agendas of the green and digital transition, reducing the innovation divide by supporting a more flexible innovation flow.** Supporting frugal solutions could better enable the development and market entry of truly frugal innovations, which currently are pooled in competition for support from more general green or digital policies and initiatives. An interviewed stakeholder at an innovation agency expressed that different types of innovations are not prioritised, and approaches are topic-driven. In their view, while innovation can be interpreted differently, "innovation is innovation" and support is more likely to be granted to those ventures which are more likely to succeed and provide the most added value.<sup>301</sup> This points to the potential risk that if frugal innovations do not meet conventional measures of innovation due to their sometimes low-tech or traditional methods and features, or because of their potentially low-profit margins and scaling opportunities (if meeting niche needs) they would miss out on public support. An interviewed stakeholder from an innovation agency in Estonia highlighted that, often, the goal when selecting applicants from funding calls is to create added value but that this value is often based on return on investment and not potential social impact.<sup>302</sup>

Some interviewed policy makers expressed that funding ecosystems prioritise high-tech, deep-tech or smart specialisation solutions (e.g. biotechnology and cyber security),<sup>303</sup> and that low-tech solutions can be poorly perceived.<sup>304</sup> A policy maker in Lithuania highlighted that to promote frugal innovations they could be prioritised within procurement frameworks,

<sup>291</sup> ECOFARIO. Interview with employee. August 2, 2024

<sup>292</sup> *Ibid.*

<sup>293</sup> Clean Energy Wire. "EU Sets Focus on Climate-Friendly Industry in 2040 Climate Target Proposal." Accessed August 10, 2024. <https://www.cleanenergywire.org/news/eu-sets-focus-climate-friendly-industry-2040-climate-target-proposal>.

<sup>294</sup> Snelson, Benedict. "EU Member States Seek to Dismantle EU Rules Protecting Water." 2024. Accessed November 22, 2024. <https://eeb.org/eu-member-states-seek-to-quietly-dismantle-eu-rules-protecting-water/>.

<sup>295</sup> European Commission. "Zero Pollution Action Plan." Accessed January 2, 2025.

[https://environment.ec.europa.eu/strategy/zero-pollution-action-plan\\_en](https://environment.ec.europa.eu/strategy/zero-pollution-action-plan_en).

<sup>296</sup> European Commission. *A New Circular Economy Action Plan for a Cleaner and More Competitive Europe*. Brussels:

European Commission, 2020. <https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1583933814386&uri=COM:2020:98:FIN>

<sup>297</sup> POLITICO. "Commission Falls Short on Pledge to Beat Microplastic Pollution." Accessed August 10, 2024.

<https://www.politico.eu/article/eu-commission-falls-short-pledge-beat-microplastic-pollution-action-plan/>.

<sup>298</sup> European Commission. "REACH Regulation." Accessed September 19, 2024.

[https://environment.ec.europa.eu/topics/chemicals/reach-regulation\\_en](https://environment.ec.europa.eu/topics/chemicals/reach-regulation_en).

<sup>299</sup> ECOFARIO. Interview with employee. August 2, 2024.

<sup>300</sup> *Ibid.*

<sup>301</sup> Interview with policy maker. October 15, 2024.

<sup>302</sup> *Ibid.*

<sup>303</sup> Group interview with two policy makers. October 11, 2024; Lithuanian Ministry of Economy and Innovation. Interview with policy maker. August 6, 2024; Interview with policy maker. November 14, 2024.

<sup>304</sup> Group interview with two policy makers. October 11, 2024;

for example by specific criteria and scoring incentives for applicants to demonstrate the frugality of their innovation or process.<sup>305</sup> One such example which demonstrates having specific considerations relating to frugal innovation is the Eureka Innowwide<sup>306</sup> programme supporting international market feasibility projects for innovative SMEs (see Box 16). Innowwide provides a useful example of how the inclusion of a frugal innovation concept within public funding calls can provide support to existing frugal innovation ventures, encourage SMEs and start-ups to include frugal innovation concepts in their development and implementation and promote frugal innovation projects and ideas on a wider scale. One interviewed policy maker working with Innowwide in Sweden noted that, in their experience, this is the only call which includes mention of frugal innovation and normally this concept is not applied in funding calls for SMEs.<sup>307</sup> Moreover, it was highlighted that to raise the profile of frugal innovations it would be important to first inform on the concept but also to measure the impact of such programmes to understand if they support true frugal innovation.<sup>308</sup> This points to a potential risk that companies innovating cheaper or simpler products and services might have competitive advantages over truly frugal innovations that, because they consider social and environmental sustainability, might present as more technical and expensive, despite being more truly frugal.

### Box 16. Innowwide

Innowwide<sup>309</sup> is a Eureka<sup>310</sup> programme funded by Horizon Europe, as part of the European Partnership on Innovative SMEs.<sup>311</sup> Through the programme, innovative SMEs are able to apply for a grant of up to EUR 600 000 to assess the viability of their research or commercial goals in international markets, choosing a target country and partnering with a local expert. Innowwide aims to provide SMEs with the opportunity to develop Viability Assessment Projects (VAPs) to assess the international marketability of their solution within their selected target market outside of Europe, in Africa, the Americas, Asia or Oceania.<sup>312</sup>

Included within the Innowwide calls is the suggestion to consider frugal innovation, encouraging applicants to highlight aspects of or develop frugal innovation, particularly if their selected target country is a developing country.<sup>313</sup> While not mandatory, the inclusion supports the consideration of frugal innovation within the selected project activities and proposed solutions.<sup>314</sup> When reviewing a sample of completed projects for Innowwide calls,<sup>315</sup> around half of the projects included frugal characteristics in their descriptions, including being user-friendly and easy to use, focused on core functionality, having minimised material and financial resource use, and reduced cost of ownership.

GOAL3, a frugal approach to patient monitoring systems, has received funding from the Innowwide calls (see Box 4). Some additional project examples are presented below:

- **Sea-change technology for the diagnosis of genetic disorders in Egypt:** The gMendel initiative by Onyx Pharma introduces the Phivea system for cost-effective, non-invasive neonatal screening of Klinefelter syndrome, targeting North Africa and the Middle East.

<sup>305</sup> Lithuanian Ministry of Economy and Innovation. Interview with policy maker. August 6, 2024.

<sup>306</sup> Eureka. "Innowwide." Accessed November 7, 2024. <https://eurekanetwork.org/programmes/innowwide/>.

<sup>307</sup> Interview with policy maker. November 14, 2024.

<sup>308</sup> *Ibid.*

<sup>309</sup> Eureka. "Innowwide." Accessed November 7, 2024. <https://eurekanetwork.org/programmes/innowwide/>.

<sup>310</sup> Eureka. "Innovation beyond borders." Accessed November 7, 2024. <https://eurekanetwork.org/>.

<sup>311</sup> European Commission. "European Partnerships in Horizon Europe." Accessed November 7, 2024. [https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/european-partnerships-horizon-europe\\_en#partnership-candidates-and-contact-details](https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/european-partnerships-horizon-europe_en#partnership-candidates-and-contact-details).

<sup>312</sup> Eureka. "Innowwide call for market feasibility projects." Accessed November 7, 2024.

<https://eurekanetwork.org/opencalls/innowwide-call-for-market-feasibility-projects-3/>.

<sup>313</sup> Eureka Innowwide. "European Partnership on Innovative SMEs / Innowwide." Accessed November 7, 2024.

<https://eurekanetwork.org/app/uploads/2024/04/innowwide-call-text.pdf>

<sup>314</sup> Group interview with three policy makers. November 19, 2024.

<sup>315</sup> Selected projects for Innowwide Call 1 can be found here: <https://eurekanetwork.org/app/uploads/innowwidecall1-finalrankinglistafrica.pdf>; <https://eurekanetwork.org/app/uploads/innowwidecall1-finalrankinglistrestoftheworld.pdf>

Looking at Innowwide Call 1 which was focused on Africa, where 25 of 50 projects involved subcontracted partners in Africa, 38 projects were reviewed (excluding projects targeting developed countries as frugal criterion was less relevant). 22 of 38 projects selected the activity "Definition of a complementary joint RTDI project for co-creation or technology adaptation (including, where appropriate, frugal innovation) with the local strategic subcontractor." Of these, 16 to 19 projects included at least one potential frugal characteristic, according to subjective analysis presented by Eureka (November 2024).

The project utilises advanced AI technology to fit local healthcare needs, providing a quick and user-friendly platform for diagnosis.

- **Circular Materials and Infill Innovation for Prefabricated Housing in Suriname:** RD&S explored the feasibility of a circular infill mixture using rice husk waste ('padikaf') to create a more sustainable and affordable lightweight concrete for prefabricated homes in Suriname. This cost-efficient innovation makes use of existing materials designated as waste (rice husk), reducing waste to meet local housing needs.
- **Automated, real-time monitoring of insect pests for inclusive agriculture:** The Spanish start-up, AgroPestAlert, aims to introduce an Internet of Things-based monitoring solution to predict pest outbreaks in Colombia. The cost-effective pest control technology reduces the reliance on time-consuming and scarce manual labour and minimises the use of chemicals for pest control, making it a sustainable and efficient innovation contribution to the reduction of food insecurity.

The policy mapping also suggests that there is little direct support which encourages reverse innovation. As some examples demonstrate, EU-wide networking and marketing support to SMEs and start-ups in low innovator countries has the potential to ease market entry for low innovator EU and HEAC countries and bridge the innovation divide, as prioritised in, for example, Flagship 3 of the NEIA<sup>316</sup> to accelerate and strengthen innovation in the European Innovation Ecosystem or the Draghi report,<sup>317</sup> and the Competitiveness Compass.<sup>318</sup> An interviewed policy maker in Morocco suggested that gathering data on global innovation (e.g. through patent databases) could help to identify and adapt foreign innovations to meet local needs, in particular for innovations which are not restricted by intellectual property rights.<sup>319</sup> While this stakeholder was referring to re-engineering available innovations, the principle applies to reverse innovations principles, allowing resource-constrained or low innovator regions to leverage external innovations, mitigating barriers to innovation development such as high costs and poor infrastructure. More generally, prioritising reverse innovation could help to reduce costs within the EU. A repository of global innovation data, as suggested by the interviewee, would greatly facilitate this and act to identify global solutions which could be reversed to suit other markets.

## 4.2. The use of terms frugal and reverse innovation in policy documents

This section presents an analysis of the use of the terms frugal and reverse innovation found in policies, programmes and projects which explicitly reference the terms in their descriptions. The results are based on the policy mapping results and seek to answer the research questions: *What are the main differences in conceptual and linguistic understanding of frugal and reverse innovation in EU/HEAC countries?* and *What mechanisms related to common definitions/terminology for frugal and reverse innovation can bridge conceptual gaps across different EU/HEAC countries?* The findings suggest that in programmes specifically geared towards frugal innovation, the concept is generally well understood. However, due to the scarcity of examples explicitly referencing reverse

<sup>316</sup> European Commission. "Flagship 3: Accelerating and Strengthening Innovation in European Innovation Ecosystems Across the EU and Addressing the Innovation Divide. New European Innovation Agenda Roadmap." Accessed October 17, 2024. [https://research-and-innovation.ec.europa.eu/strategy/support-policy-making/shaping-eu-research-and-innovation-policy/new-european-innovation-agenda/new-european-innovation-agenda-roadmap/flagship-3-accelerating-and-strengthening-innovation-european-innovation-ecosystems-across-eu-and\\_en](https://research-and-innovation.ec.europa.eu/strategy/support-policy-making/shaping-eu-research-and-innovation-policy/new-european-innovation-agenda/new-european-innovation-agenda-roadmap/flagship-3-accelerating-and-strengthening-innovation-european-innovation-ecosystems-across-eu-and_en).

<sup>317</sup> Draghi, Mario. *The future of European Competitiveness*. Brussels: European Commission, September 2024. Accessed November 7, 2024. [https://commission.europa.eu/topics/strengthening-european-competitiveness/eu-competitiveness-looking-ahead\\_en#paragraph\\_47059](https://commission.europa.eu/topics/strengthening-european-competitiveness/eu-competitiveness-looking-ahead_en#paragraph_47059).

<sup>318</sup> European Commission. *COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE EUROPEAN COUNCIL, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS - A Competitiveness Compass for the EU*. Brussels: European Commission, 2025. Brussels. [https://commission.europa.eu/document/download/10017eb1-4722-4333-add2-e0ed18105a34\\_en](https://commission.europa.eu/document/download/10017eb1-4722-4333-add2-e0ed18105a34_en).

<sup>319</sup> Interview with policy maker. August 22, 2024.



Source: Authors elaboration of project/programme descriptions, generated by ChatGPT 4.0, 2024.

The word cloud illustrates that key terms most often relate to **resources, sustainability, locality, cost, and customers**. Most commonly, the analysed examples are concerned with lowering costs, mostly for consumers, and increasing the affordability of products or services. Resource efficiency and innovating in a resource-constrained manner to create simple or 'more-for-less' products or services were also highlighted.

Locality was stressed in the sense of the **efficient use of local resources, making innovations more accessible to local users, applying, and sharing local knowledge, or simply providing local solutions**. Relatedly, a key component also included user-centricity with innovations focused on local or customer needs which are user-friendly and socially suitable. Several examples also included strong elements of community or grassroots-driven solutions.

Finally, sustainability was at the core of several of the analysed examples. This includes using more **ecologically compatible resources, more sustainable production and use (and reuse), and more socially sustainable innovations** which are appropriate to the user (e.g. low-income customers) and are fit-for-future.

These descriptions of frugal-focused projects and programmes align with the common understanding of frugal innovation, inclusive of the key elements as defined in this study: Simple, Economical, Cheap, and Sustainable. The majority of the examples used for this analysis are Horizon 2020 or Horizon Europe projects and are well aligned with wider EU agendas of environmental and social sustainability. However, as suggested by an interviewed expert, despite there being progress within the Horizon ecosystem through some targeted calls for frugal innovations, there is not a singular conceptual or systematic approach to frugal innovation, instead, it is often approached from an ad hoc perspective.<sup>326</sup>

## 5. Opportunities and challenges of frugal and reverse innovation

This chapter provides an overview of the central opportunities and challenges of frugal and reverse innovation in the EU and HEAC, including the enabling and limiting factors that contribute to the successful implementation of innovation projects at EU, national, and regional level and the future potential of such innovations. Information mainly comes from case studies and relevant findings from the literature review. The data reveals enabling factors and barriers relating to specific market conditions and intense competitive landscapes, cultural acceptance and market preferences, the role of open-source technology, and unsupportive policy, regulatory and investment frameworks. However, these are highly dependent on the sector of the product and the type of innovations. Notably, while some factors are unique to frugal and reverse innovations, several of the opportunities and challenges highlighted in this section are similar to those faced by SMEs and start-ups in general.

The chapter will cover the following research questions:

- What obstacles (market failures, political or institutional constraints, etc.) prevent the European ecosystem from pursuing frugal and reverse innovation?
- How did the case studies unlock the potential for frugal and reverse innovation?

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<sup>326</sup> Interview with expert. August 14, 2024.

- Which obstacles prevented the cases from pursuing frugal/reverse innovation? What specific challenges had the cases to address when pursuing frugal and reverse innovations? Were there any solutions to these challenges (i.e., risk mitigation measures applied)?
- What new opportunities pursuing frugal and reverse innovation were created?
- How have frugal and reverse innovation of the cases contributed to EU initiatives, such as the European Green Deal and New European Innovation Agenda? Can we identify any specific actions, examples per sector (e.g. energy, food security, circularity, digital, health)?
- How has frugal and reverse innovation as described in the cases contributed to social innovation, social enterprises or other social projects in the EU and HEAC?
- Is it possible to observe patterns across the case studies in their internal capacities and external conditions conducive to initiating and implementing frugal and reverse innovation?

## 5.1. Enabling factors of frugal and reverse innovation

### The role of market conditions as an enabling factor

Frugal innovations can face challenges in accessing funding and scaling their solutions, especially when competing against established or conservative markets or attempting to access funding geared towards traditional concepts of innovation and success (e.g. high-tech, high-profit solutions). Having said this, case studies illustrated how frugal innovations can **take advantage of gaps in the market where there are no product alternatives or significant competition** in their sectors. Frugal innovations present opportunities to meet niche needs which may otherwise be overlooked. The particular characteristics of frugal innovations can be advantageous for gaining market access over their competitors. In several examples presented in the case studies (see Annex 6), such as in the LITUA furniture, TeReFa by Handicap International, e-NABLE<sup>327</sup> and RepRap<sup>328</sup> cases, there was a **demand for more affordable, accessible and sustainable products or services compared to conventional options**. This finding is consistent with previous research, which highlights cost-conscious consumers as key contributors to the success of both frugal and reverse innovations.<sup>329</sup> However, data from a 2015 EU study suggests that an increased demand for frugal innovations has yet to be realised in EU markets.<sup>330</sup> Nonetheless, other scholars argue that rising cost awareness, particularly during periods of economic downturn, is a growing trend in high-income markets and predicts demand for frugal and reverse innovations in these contexts.<sup>331</sup> This finding is also supported by an interview with an expert who pointed to the need for affordable solutions in the European market.<sup>332</sup> This includes reverse innovations coming to Europe from low-cost developing countries that may

<sup>327</sup> E-NABLE. "About us." Accessed February 13, 2025. <https://enablingthefuture.org/about/>.

<sup>328</sup> RepRap. "RepRap." Accessed February 13, 2025. <https://reprap.org/wiki/RepRap>.

<sup>329</sup> Hadengue, Marine, Nathalie de Marcellis-Warin, and Thierry Warin. "Reverse Innovation: A Systematic Literature Review". *International Journal of Emerging Markets* 12, no. 2 (1 January 2017): 142–82. <https://doi.org/10.1108/IJoEM-12-2015-0272>; Han, Xiaomei, and Shanshan Liu. "Research on the Path of Reverse Innovation: A Case Study of High-Tech Industry Latecomer Firms in China". *International Journal of Economics, Finance and Management Sciences* 8, no. 4 (2020): 138. <https://doi.org/10.11648/j.ijefm.20200804.12>; Simula, Henri, Mokter Hossain, and Minna Halme. "Frugal and Reverse Innovations – Quo Vadis?" *Current Science* 109, no. 9 (2015): 1567–72.

<sup>330</sup> European Commission: Directorate-General for Research and Innovation, Fraunhofer ISI and Nesta. *Study on Frugal Innovation and Reengineering of Traditional Techniques*. Publications Office: Brussels, 2017. <https://data.europa.eu/doi/10.2777/94587>.

<sup>331</sup> Simula, Henri, Mokter Hossain, and Minna Halme. "Frugal and Reverse Innovations – Quo Vadis?" *Current Science* 109, no. 9 (2015): 1567–72.

<sup>332</sup> Interview with expert. August 14, 2024.

not be frugal by design but nevertheless are offered at price points comparable to frugal innovations, given their lower creation and manufacturing costs. In some of the case studies, this included offering cheaper options to the market or introducing products which were more easily implemented in rural or resource-constrained markets (such as in the Good Vision and Life Nieblas case studies) or where demand for affordable products exceeded the supply (as in the Handicap International case study).

**Partnerships are important tools for SMEs and large companies to leverage market opportunities and mitigate obstacles.** Case studies showed that innovators often use networks to support development, strengthen market access and diversify revenue streams. For example, for socially orientated ventures, collaborations with NGOs or private sector organisations seeking to fulfil corporate social responsibilities can help to secure funding or create new commercial and distribution opportunities. Even MNCs will, in their pursuit of frugal innovation, seek outside partnerships either for co-funding projects characterised by high social value but low profitability prospects or need to rely on endorsements of public partners (e.g. inclusion in recommended solutions lists mandated by international organisations such as WHO) for marketability of their innovations in target markets. Furthermore, previous research suggests that local partnerships can help frugal innovators optimise their production and operational processes for greater environmental sustainability, and in doing so better enable them to meet the social-environmental needs of consumers.<sup>333</sup>

## The role of technology as an enabling factor

The case studies showed that **accessible technology was a key factor in the successful development and implementation of frugal ventures.** Access to affordable technology can support the development stage of projects, and the case studies demonstrated that 3D printing technology, in particular, made for cost-effective R&D (e.g. through rapid prototyping and more efficient manufacturing). Importantly, technology was made more accessible through open-source hardware and software, which was cited as integral to the development of frugal innovations in both the case studies and the academic literature.<sup>334</sup> For example, research finds that open-source hardware allows innovators to adapt and replicate designs in response to local needs and resource-constraints.<sup>335</sup> The findings demonstrate the value of **facilitating open innovative ecosystems by increasing the availability of technology.**

However, some case studies also demonstrated that in-house development of supporting technologies (e.g. software) led to more economical development and implementation of frugal innovations and reduced external dependencies. Moreover, for frugal innovations incubated by institutional innovation agencies or companies, intensive R&D in the initial stages was a vital success factor, providing access to technology, infrastructure, and highly specialised skill sets (such as presented in the Philips and ISIBRIX case studies). Corporate incubators supported the transition of some frugal innovations from R&D to market, especially when these innovations were outside the parent company's strategic focus and required additional effort to adapt to local technology, institutions and infrastructure. Business incubators have played a critical role in this context, as highlighted by the

<sup>333</sup> Rossetto, Dennys Eduardo, Felipe Mendes Borini, Roberto Carlos Bernardes, and Gary L. Frankwick. "Measuring Frugal Innovation Capabilities: An Initial Scale Proposition". *Technovation* 121 (March 2023): 102674. <https://doi.org/10.1016/j.technovation.2022.102674>.

<sup>334</sup> European Commission: Directorate-General for Research and Innovation, Fraunhofer ISI and Nesta. *Study on Frugal Innovation and Reengineering of Traditional Techniques*. Publications Office: Brussels, 2017. <https://data.europa.eu/doi/10.2777/94587>; Hadengue, Marine, Nathalie de Marcellis-Warin, and Thierry Warin. "Reverse Innovation: A Systematic Literature Review". *International Journal of Emerging Markets* 12, no. 2 (1 January 2017): 142–82. <https://doi.org/10.1108/IJoEM-12-2015-0272>; Corsini, Lucia, Valeria Dammicco, Lin Bowker-Lonnecker, and Robbie Blythe. "The Maker Movement and Its Impact in the Fight against COVID-19". 2020. <https://doi.org/10.17863/CAM.60248>; Rossetto, Dennys Eduardo, Felipe Mendes Borini, Roberto Carlos Bernardes, and Gary L. Frankwick. "Measuring Frugal Innovation Capabilities: An Initial Scale Proposition". *Technovation* 121 (March 2023): 102674. <https://doi.org/10.1016/j.technovation.2022.102674>.

<sup>335</sup> Corsini, Lucia, Valeria Dammicco, Lin Bowker-Lonnecker, and Robbie Blythe. "The Maker Movement and Its Impact in the Fight against COVID-19". 2020. <https://doi.org/10.17863/CAM.60248>.

European Commission's analysis of regional policy for smart growth, which emphasised their importance in driving frugal innovation by fostering necessary technological and business support for early-stage companies.<sup>336</sup>

Research also indicates that consumers often experience feature fatigue, where an excess of features diminishes a product's usability, driving demand for simpler alternatives.<sup>337</sup> For example, smartphones may inspire feature fatigue in consumers as many new devices offer increasing and advanced capabilities which may drive users towards simpler more affordable alternatives such as OPPO,<sup>338</sup> Xiaomi<sup>339</sup> and Huawei,<sup>340</sup> and entices other firms, such as Apple,<sup>341</sup> to offer defeated phone models at lower prices (e.g. the iPhone SE).<sup>342</sup> In the implementation of frugal innovations, **accessible and simplified characteristics of technology were shown to provide an advantage over competitors**, expanding their market access. In some cases, the modularity of innovations provides the potential to access different markets and diversify their business, whereas in other cases, simplicity was achieved through integrated design and reduced reliance on the efficiency of local logistic and value chains (e.g. lack of reliable recycling of replaceable batteries in developing countries in sub-Saharan Africa).

### The role of professional skills as an enabling factor

Access to knowledge and skills can greatly support the development and implementation of frugal innovations, as indicated in the case studies. In particular, the development of **strategic partnerships and advantageous networks**, including with universities or same-sector companies, and the **availability of skilled professionals or volunteers** with specialised knowledge. Knowledge sharing through partnerships supports problem-solving and market knowledge in the development and implementation of innovative ventures and can also be leveraged to overcome regulatory and bureaucratic challenges. These findings reinforce those of earlier studies which identify strategic partnerships, especially those with local actors, and the knowledge sharing they enable, as critical factors in the success of frugal and reverse innovations.<sup>343</sup> An interviewed social partner also highlighted how partners can provide credibility and validation to startups and better attract investors.<sup>344</sup>

In some studies, scholars find that the simple design features of frugal and reverse innovation make these innovations easier to mass-produce and export, and therefore contribute to their overall success.<sup>345</sup> The data from the case studies builds on this by demonstrating that, because simple design features reduced the skill requirements for

<sup>336</sup> European Commission. Directorate-General for Regional Policy. Regional Policy for Smart Growth in Europe 2020. LU: Publications Office, 2011. <https://data.europa.eu/doi/10.2776/39233>.

<sup>337</sup> Rust, Roland T., Debora Viana Thompson, and Rebecca W. Hamilton. "Defeating feature fatigue." *Harvard business review* 84, no. 2 (2006): 37-47; Simula, Henri, Mokter Hossain, and Minna Halme. "Frugal and Reverse Innovations – Quo Vadis?" *Current Science* 109, no. 9 (2015): 1567–72; Wu, Mingxing, Liya Wang, Huijun Long, and Ming Li. "Feature Fatigue Analysis in Product Development". *Total Quality Management & Business Excellence* 26, no. 1–2 (February 2015): 218–32. <https://doi.org/10.1080/14783363.2013.860697>.

<sup>338</sup> OPPO. "OPPO." Accessed February 13, 2025. <https://www.oppo.com/uk/>.

<sup>339</sup> Xiaomi. "Xiaomi Global." Accessed February 13, 2025. <https://www.mi.com/global/>.

<sup>340</sup> Huawei. "Huawei." Accessed February 13, 2025. <https://consumer.huawei.com/uk/>.

<sup>341</sup> Apple. "Apple United Kingdom." Accessed February 13, 2025. <https://www.apple.com/uk/>.

<sup>342</sup> Debora Viana Thompson, Rebecca W. Hamilton, and Roland T. Rust, "Feature Fatigue: When Product Capabilities Become Too Much of a Good Thing," *Journal of Marketing Research* 42, no. 4 (October 4, 2005): 431–42, <https://doi.org/10.1509/jmkr.2005.42.4.431>; de Villiers Scheepers, Margarietha J., and Martie-Louise Verreynne. "The new iPhone SE is the cheapest yet: smart move, or a premium tech brand losing its way?." *The Conversation* 17 (2020).

<sup>343</sup> Dubiel, Anna, and Holger Ernst. "Success factors of new product development for emerging markets." *The PDMA handbook of new product development* 3 (2013): 100-114; Corsi, Simone, Alberto Di Minin, and Andrea Piccaluga. "Reverse Innovation at Speres: A Case Study in China". *Research-Technology Management* 57, no. 4 (1 July 2014): 28–34. <https://doi.org/10.5437/08956308X5704215>; Crisp, Nigel. "Mutual Learning and Reverse Innovation—Where Next?" *Globalization and Health* 10, no. 1 (28 March 2014): 14. <https://doi.org/10.1186/1744-8603-10-14>; Hadengue, Marine, Nathalie de Marcellis-Warin, and Thierry Warin. "Reverse Innovation: A Systematic Literature Review". *International Journal of Emerging Markets* 12, no. 2 (1 January 2017): 142–82. <https://doi.org/10.1108/IJoEM-12-2015-0272>.

<sup>344</sup> Beta-i. Interview with social partner. September 15, 2024.

<sup>345</sup> Zeschky, Marco, Bastian Widenmayer, and Oliver Gassmann. "Frugal Innovation in Emerging Markets". *Research-Technology Management* 54, no. 4 (July 2011): 38–45. <https://doi.org/10.5437/08956308X5404007>; Niroumand, Marjan, Arash Shahin, Amirreza Naghsh, and Hamid Reza Peikari. "Frugal Innovation Enablers: A Comprehensive Framework". *International Journal of Innovation Science* 12, no. 1 (3 February 2020): 1–20. <https://doi.org/10.1108/IJIS-10-2019-0099>.

production and manufacturing they facilitate the scaling of these innovations. For example, compared to other types of innovative ventures, the **simplistic characteristics of frugal innovations can make it easier to mobilise local workforces**, without the need for specialised skills. The basic technology and skills required in the production and manufacturing stages of frugal ventures can support the scaling of ventures and introduce localised solutions or on-site manufacturing. Moreover, ventures distributing outside of their operational headquarters are able to train local skills forces and bolster their business viability by creating self-sustaining systems, as demonstrated in the case studies.

## 5.2. Challenges of frugal and reverse innovation

### Policy and regulatory obstacles

The literature and case studies indicate that policy and regulatory frameworks are prominent challenges faced by frugal and reverse innovations.<sup>346</sup> As highlighted in the Draghi report, SMEs face significant regulatory obstacles which add costs and administrative burdens, impeding their success.<sup>347</sup> For socially orientated companies, as is often the case with frugal innovations, limited funding and resources make these hurdles especially limiting. **Regulatory bias can favour established markets and capital-intensive products**, making it difficult for frugal innovators to operate within frameworks that are not designed for low-cost or grassroots ideas.<sup>348</sup> For example, in the case of Termex,<sup>349</sup> construction regulation is not material neutral and therefore supports established material solutions and excludes others. This was also the case for Kuidas.Works<sup>350</sup> that found national construction regulations favoured sustainable wooden timber constructions and limited market potential for alternative sustainable material use, such as construction waste and earth. Similarly, in the ISIBRIX case study, lengthy and costly certification processes were faced when using new sustainable materials (e.g. laminated veneer lumber) for construction. Such regulatory biases can delay market entry, discourage investment<sup>351</sup> and risk market exclusion, suggesting a need for neutral regulation to be established.

Furthermore, **financial exclusion can occur due to ineligibility for tax breaks, subsidies, or public procurement**. For example, one case study highlighted that public procurement processes or outdated compliance standards can favour ‘high-tech’ innovations or conventional standards, risking the exclusion of frugal innovative technology from the market. In this example, when applying for trade promotion support from a public agency, LITUA furniture, developed by DUV in Lithuania, was faced with the challenge of proving the value and potential of its ‘low-tech’ innovation to access support. In addition, this case faced barriers to participating in public procurement tenders because it did not meet ‘common sense’ technical requirements which exclude innovative products which deviate from conventional methods.

Finally, **an absence of focused regulations, especially in low- and middle-income countries, as well as institutional inefficiencies and bureaucratic processes, can**

<sup>346</sup> Mokter Hossain, “Frugal Innovation: Conception, Development, Diffusion, and Outcome,” *Journal of Cleaner Production* 262 (April 5, 2020): 121456, <https://doi.org/10.1016/j.jclepro.2020.121456>; Hadengue, Marine, Nathalie De Marcellis-Warin, Max von Zedtwitz, and Thierry Warin. “Avoiding the Pitfalls of Reverse Innovation: Lessons Learned from Essilor: One Company’s Experiences Suggest How the Specific Challenges of Reverse Innovation May Be Anticipated and Overcome.” *Research-Technology Management* 60, no. 3 (4 May 2017): 40–47. <https://doi.org/10.1080/08956308.2017.1301002>.

<sup>347</sup> Draghi, Mario. *The future of European Competitiveness*. Brussels: European Commission, September 2024. Accessed November 7, 2024. [https://commission.europa.eu/topics/strengthening-european-competitiveness/eu-competitiveness-looking-ahead\\_en#paragraph\\_47059](https://commission.europa.eu/topics/strengthening-european-competitiveness/eu-competitiveness-looking-ahead_en#paragraph_47059).

<sup>348</sup> Kusumawardhany, Prita Ayu, Imam Baihaqi, and Putu Dana Karningsih. “How Frugal Innovation Is Applied by MSMEs for Sustainability”. In *2022 IEEE Technology & Engineering Management Conference - Asia Pacific (TEMSCON-ASPAC)*, 054–058. Bangkok, Thailand: IEEE, 2022. <https://doi.org/10.1109/TEMSCON-ASPAC52831.2022.9916557>.

<sup>349</sup> Termex. “Termex -Eriste Oy – Finnish insulation expertise.” Accessed February 13, 2025. <https://termex.fi/yritys>.

<sup>350</sup> Kuidas.Works. “Works.” Accessed February 13, 2025. <https://kuidas.works/>.

<sup>351</sup> Zinsstag, Jakob, Kristina Pelikan, Tanja Hammel, Julia Tischler, Antoine Flahault, Jürg Utzinger, and Nicole Probst-Hensch. “Reverse Innovation in Global Health”. *Journal of Public Health and Emergency* 3 (January 2019): 2–2. <https://doi.org/10.21037/jphe.2018.12.05>.

**delay or limit the scaling and recognition of frugal innovations.**<sup>352,353</sup> These issues can be compounded by lengthy and complex processes of navigating strict regulatory environments. This was highlighted in the Life Nieblas case, where strict environmental protection regulations hindered implementation. In the example of Qarnot, presented in Box 17, barriers were encountered because its frugal business model did not fit into the established regulatory frameworks, hindering its development and limiting its access to public support. In the health sector, complex licensing requirements further exacerbate these challenges. Moreover, as shown in the case studies, **unclear or diverging regulations across countries** for medical device certification also added complexities to the implementation and scaling of frugal innovations internationally (e.g. e-NABLE). Some cases mitigated these challenges by leveraging local knowledge, partnerships or connections such as support from public servants.

### Box 17. The case of Qarnot Computing

Qarnot Computing<sup>354</sup> (Qarnot) is an SME based in France and also operating in Greece and Finland, with plans to expand to other European countries.<sup>355</sup> Qarnot specialises in sustainable cloud computing but also acts as a provider of energy-efficient heat by recovering and reselling the heat generated by its IT equipment.<sup>356</sup> Qarnot is an example of a frugal business model innovation because by using simple technology the company valorises heat, a byproduct of its cloud computing services, to reduce costs, conserve resources, and promote sustainability.<sup>357</sup> The company was founded in 2010, and after 3 years of R&D, began providing heat in 2013.<sup>358</sup>

Traditional data centres are embedded with cooling systems which prevent the overheating of IT equipment, ensuring the reliability and availability of services.<sup>359</sup> Cooling systems account for 30-50% of a data centre's total energy consumption.<sup>360</sup> By recovering and repurposing 96% of the heat released from its IT equipment, Qarnot significantly reduces this consumption and its carbon footprint.<sup>361</sup> By leveraging the revenue generated from heat sales Qarnot is able to offer competitive pricing,<sup>362</sup> keeping it competitive as an SME in the cloud computing market that is dominated by large companies such as Amazon, Microsoft and Google.<sup>363</sup>

The company's innovative business model, though key to its success and frugality, also posed various regulatory challenges as its model is not compatible with the frameworks set in existing regulations on data centres and heat distribution.<sup>364</sup> For example, until recently, data centres in France had to meet certain cooling requirements for IT equipment,<sup>365</sup> and because Qarnot's model eliminates the need for a cooling system, initially the regulations prevented Qarnot from being categorised as a data centre.<sup>366</sup> Similarly, the heat provided by Qarnot is often mistaken for waste heat, an incorrect assumption because the Qarnot's business model relies on the intentional reuse

<sup>352</sup> Sheikh, Fayaz Ahmad, Rhiannon Pugh, Xiaobo Wu, and Soumodip Sarkar. "Regional Studies and Frugal Innovation: A Missing Link?" *Regional Studies* 58, no. 4 (2 April 2024): 893–905. <https://doi.org/10.1080/00343404.2023.2222136>.

<sup>353</sup> Harris, Matthew, Emily Weisberger, Diana Silver, Viva Dadwal, and James Macinko. "That's Not How the Learning Works – the Paradox of Reverse Innovation: A Qualitative Study". *Globalization and Health* 12, no. 1 (December 2016): 36. <https://doi.org/10.1186/s12992-016-0175-7>.

<sup>354</sup> Qarnot. "Qarnot." Accessed August 7, 2024. <https://qarnot.com/en>.

<sup>355</sup> Interview with employee, June 4, 2024.

<sup>356</sup> *Ibid.*

<sup>357</sup> Interview with employee. June 4, 2024.

<sup>358</sup> Qarnot. "History." Accessed August 7, 2024. <https://qarnot.com/en/history>.

<sup>359</sup> Zhang, Hainan, Shuangquan Shao, Hongbo Xu, Huiming Zou, and Changqing Tian. "Free cooling of data centers: A review." *Renewable and sustainable energy reviews* 35 (2014): 171-182.

<sup>360</sup> *Ibid.*

<sup>361</sup> Qarnot. "Cloud Computing, HPC & IT Infrastructures Low Carbon by Qarnot." Accessed August 7, 2024. <https://qarnot.com/en>.

<sup>362</sup> Felix Richter. "Amazon Maintains Cloud Lead as Microsoft Edges Closer," *Statista Daily Data*. 2024. Accessed November 22, 2024. <https://www.statista.com/chart/18819/worldwide-market-share-of-leading-cloud-infrastructure-service-providers/>.

<sup>363</sup> Mary Zhang, "Top 10 Cloud Service Providers Globally in 2024." *Dgtl Infra*. 2024. Accessed November 22, 2024. <https://dgtlinfra.com/top-cloud-service-providers/>.

<sup>364</sup> Interview with employee. July 19, 2024.

<sup>365</sup> Maria Avgerinou, Paolo Bertoldi, and Luca Castellazzi, "Trends in Data Centre Energy Consumption Under the European Code of Conduct for Data Centre Energy Efficiency," *Energies* 10, no. 10 (September 22, 2017): 1470, <https://doi.org/10.3390/en10101470>;

<sup>366</sup> Interview with employee July 19, 2024.

of the heat from IT equipment, ensuring that the heat is never otherwise wasted.<sup>367</sup> With waste heat gaining increasing public support through subsidies and grants, Qarnot is excluded from these support instruments because it does not meet the technical criteria.<sup>368</sup>

Despite these regulatory challenges, recent policy developments suggest a growing recognition of Qarnot's innovative approach and its potential to align with broader sustainability goals. In 2022 France introduced a reduced rate of Contribution au Service Public de l'Electricité (CSPE), a tax levied in France on electricity consumption, for data centres that have an annual energy consumption exceeding 1 GWh and implement heat recovery systems.<sup>369</sup> Though these policy developments benefit Qarnot, because the company has data centres with varying energy capacities, the company's smaller data centres do not qualify for the tax reduction.<sup>370</sup> Nevertheless, with the introduction of the European Energy Efficiency Directive (Directive (EU) 2023/1791),<sup>371</sup> which requires data centres with an energy capacity exceeding 1 MW to recover the waste heat, provided it is technically and economically feasible, signals a broader alignment with sustainable data centre models like Qarnot's, further validating its innovative approach.

Qarnot is an important example of frugal innovation, demonstrating how a frugal mindset can redefine business models in traditionally resource-intensive industries. This frugal approach enables the company to thrive as an SME in a sector dominated by large corporations, showing that simplicity and resource optimisation can be disruptive forces.

## Obstacles related to market conditions

Well-established markets are usually dominated by large players, making it **challenging for frugal innovation ventures to compete against conventional products which benefit from mature supply chains and are trusted options for end-users**. This can limit market entry and scalability, especially in more developed markets with entrenched distribution channels and market preferences. This makes it difficult for reverse innovators without local (i.e., advanced European market) presence to enter these business systems effectively.<sup>372,373</sup> Moreover, frugal innovations, often designed for localised and specific markets,<sup>374</sup> can face adaptability issues when expanding. As highlighted in the case studies, **a lack of infrastructure (e.g. digital infrastructure), limited technology availability, niche target markets and users or context-dependency can all limit scalabilities**. For example, in the Handicap International case study, it was found that scaling was impacted due to limited smartphone, internet and connectivity access in lower-middle-income countries. Adapting frugal innovations for different markets or sectors can drive up costs and make innovations less viable as frugal solutions.<sup>375</sup> However, some exceptions were identified in the case studies of frugal innovations which were successfully scaled internationally. The findings from the e-NABLE case study demonstrated how they were successfully able to scale their innovation (assistive devices) internationally while maintaining their adaptability, utilising the accessibility of 3D printing technology which enabled a decentralised production of their innovation. This scaling was also supported by

<sup>367</sup> *Ibid.*

<sup>368</sup> *Ibid.*

<sup>369</sup> SDIA. "France Offers Reduced Energy Tax for Data Centers That Meet Efficiency Criteria," Accessed October 30, 2024, <https://knowledge.sdialliance.org/policies/france-offers-reduced-energy-tax-for-data-centers-that-meet-efficiency-criteria>.

<sup>370</sup> Interview with employee, July 19, 2024.

<sup>371</sup> European Parliament and Council. *Directive (EU) 2023/1791 of the European Parliament and of the Council of 13 September 2023 on Energy Efficiency and Amending Regulation (EU) 2023/955 (Recast)*. Official Journal of the European Union, L 230/1, September 20, 2023. <http://data.europa.eu/eli/dir/2023/1791/oj>

<sup>372</sup> Hyypiä, Mirva, and Rakhshanda Khan. "Overcoming Barriers to Frugal Innovation: Emerging Opportunities for Finnish SMEs in Brazilian Markets". *Technology Innovation Management Review* 8, no. 4 (24 April 2018): 38–48. <https://doi.org/10.22215/timreview/1151>.

<sup>373</sup> McCausland, Tammy. "Reverse Innovation, Frugal Innovation, and Jugaad". *Research-Technology Management* 66, no. 1 (2 January 2023): 68–70. <https://doi.org/10.1080/08956308.2023.2142444>.

<sup>374</sup> Hossain, Mokter, Nivedita Agarwal, Yasser Bhatti, and Jarkko Levänen. "Frugal Innovation: Antecedents, Mediators, and Consequences". *Creativity and Innovation Management* 31, no. 3 (September 2022): 521–40. <https://doi.org/10.1111/caim.12511>.

<sup>375</sup> Van Oorschot, Wieneke, Noël L W Keijsers, René F Van Ee, and Mark Van Houdenhoven. "Reverse Innovation in Western Healthcare: A Randomised Crossover Trial Comparing the ReMotion Prosthetic Knee with the Current Standard of Care". *BMJ Innovations* 9, no. 2 (April 2023): 65–72. <https://doi.org/10.1136/bmjinnov-2021-000908>.

the intrinsic motivation of individuals within the community initiative, which was also seen in the RepRap case study and facilitated its development and international uptake.

However, as some evidence demonstrates, many firms **may be hesitant to create low-cost alternatives for their products or introduce reverse innovation into their European markets because of the fear of cannibalisation of the higher-priced products**.<sup>376</sup> For example, Essilor,<sup>377</sup> an eyeglasses manufacturer headquartered in France, created a range of low-cost lenses to access lower-income consumers in emerging markets. Nevertheless, the company has been hesitant to introduce the lenses to Europe as it could take sales away from the high-end models. Furthermore, it risks brand dilution whereby the company's image may not be as highly esteemed.<sup>378</sup>

**Established companies have more opportunities for large-scale, strategic development of frugal innovations.** For example, in the case of Termex, the company leveraged surplus resources to scale production. In contrast, smaller or less established companies have fewer capabilities to mobilise resources in this way and can face challenges stabilising production and assessing growth due to limited implementation. This disparity stems largely from the lack of high-tech and other strategic assets in SMEs compared to large companies. Innovation activities within SMEs often target the low-income segment, where price sensitivity is a critical factor, necessitating a focus on affordable solutions rather than high-tech advancements.<sup>379</sup> Additionally, new ventures from emerging economies face challenges when entering global markets, due to a lack of operational history or established brands, which can lead to negative country-of-origin perceptions regarding product quality and reliability.<sup>380</sup>

Additionally, **ventures entering unfamiliar markets face steep learning curves** in developing new operational strategies and networks. An interviewed expert similarly highlighted that there are no established consultancy networks to support frugal innovation.<sup>381</sup> Networks and partnerships are important tools for both SMEs and large companies in leveraging market opportunities and mitigating obstacles. Case studies showed that smaller entities often use networks to support development, strengthen market access and diversify revenue streams. For example, for socially orientated ventures, collaborations with NGOs or private sector organisations seeking to fulfil social corporate responsibilities can help to secure funding or create new commercial and distribution opportunities.

## Obstacles related to investment and funding

The case studies found that frugal innovations face significant funding obstacles, particularly in SMEs, start-ups, and NGOs. A lack of financial resources, especially in competitive markets, limits smaller companies' capacity to develop and scale innovations.<sup>382</sup> Helioz is one such example demonstrating how a lack of investment and support frameworks can limit, if not completely obstruct, SMEs and start-ups in their frugal ventures (Helioz is presented as a mini-case in Box 18). The case studies indicated they **received**

<sup>376</sup> Krohn, Malte, Finn Petersen, Dustin Hochmuth, and Cornelius Herstatt. *The deliberative frugal mindset: A model of managerial opportunity recognition for frugal innovation*. No. 109. Working Paper, 2020.

<sup>377</sup> Essilor. "About us." Accessed February 13, 2025. <https://www.essilor.com/us-en/about-us/>.

<sup>378</sup> Hadengue, Marine, Nathalie De Marcellis-Warin, Max von Zedtwitz, and Thierry Warin. "Avoiding the Pitfalls of Reverse Innovation: Lessons Learned from Essilor: One Company's Experiences Suggest How the Specific Challenges of Reverse Innovation May Be Anticipated and Overcome." *Research-Technology Management* 60, no. 3 (4 May 2017): 40–47. <https://doi.org/10.1080/08956308.2017.1301002>.

<sup>379</sup> Kusumawardhany, Prita Ayu, Imam Baihaqi, and Putu Dana Karningsih. "Frugal Innovation in SMEs: Challenges and Opportunities of Doing More With Less Strategy". In *2022 IEEE Technology & Engineering Management Conference - Asia Pacific (TEMSCON-ASPAC)*, 048–053. Bangkok, Thailand: IEEE, 2022. <https://doi.org/10.1109/TEMSCON-ASPAC52831.2022.9916558>.

<sup>380</sup> Khavul, Susanna, Mark Peterson, Drake Mullens, and Abdul A. Rasheed. "Going Global with Innovations from Emerging Economies: Investment in Customer Support Capabilities Pays Off". *Journal of International Marketing* 18, no. 4 (December 2010): 22–42. <https://doi.org/10.1509/jimk.18.4.22>.

<sup>381</sup> InnoFrugal network. Interview with expert. August 14, 2024.

<sup>382</sup> Chipanje, Bridget, Dong Ying, and Lv Haiping. "Performance Analysis of Reverse and Frugal Innovations in Nigeria A Case Study of IVM Automobile Company". *Technium Social Sciences Journal* 23 (2021): 591–625.

**limited national public funding**, such as R&D grants, subsidies, and commercialisation support, with little to no funding being received from the EU funding instruments. More commonly, these **ventures sought private sector funding** from companies, foundations or individual donors as these sources were more easily accessible, and carried less administrative burden than national funding schemes. SMEs, start-ups, and socially focused NGOs often relied on targeted smaller-scale grants or public initiatives (e.g. scaling subsidies, awareness raising, prizes etc.) or private support from incubators and institutions (e.g. the UN or UNICEF). Better Shelter exemplifies a socially focused start-up sustained through funding and partnerships with larger socially aligned agencies (see Box 5).

The cases suggest that frugal innovations, due to their niche market segments, are **more likely to acquire funding from investors with shared values**. One interviewee highlighted that venture capitalists in particular anticipate returns on investments in a shorter time frame when compared to angel investors who are more likely to nurture the investment of their personal funds.<sup>383</sup> This was demonstrated in the case study on the frugal modular construction, ISIBRIX, which received funding from an individual investor, and presented an opportunity to diversify their portfolio with more sustainable investments.<sup>384</sup> Relatedly, corporate social responsibility funds could be a growing area where frugal innovations might be well supported as private companies seek to align their business interests with social impact. This dynamic becomes particularly relevant as the boundaries between frugal innovation and social innovation are increasingly blurred, with both addressing pressing societal needs and adding value to society.<sup>385</sup> Conversely, it is essential to ensure that their long-term sustainable, meaningful goals are not overshadowed by immediate market needs.<sup>386</sup>

Attracting risk-averse investors into niche markets was a challenge identified across the case studies. Investors can be reluctant to fund frugal innovations,<sup>387</sup> especially in the early stages when they might struggle to provide proof of concept. Thin profit margins and difficulties in accessing R&D funding limit the research, marketing and distribution potential of innovations.<sup>388</sup> Additionally, when expanding into developed markets, the **incongruity between low-cost frugal innovation and the cost-intensive requirements of developed markets creates financial burdens for investors**.<sup>389</sup> This highlights additional challenges faced by companies attempting to reverse their innovation. This instability, in particular, extends to humanitarian-focused entities reliant on donations which can be unpredictable and lead to uncertainties in the sustainability of the venture. MNCs and larger companies face specific challenges compared to smaller companies when developing frugal innovations. For example, the case studies demonstrate that even **large organisations can struggle to establish reliable funding frameworks for frugal innovations**. In the case of Handicap International, fiscal donations were unpredictable and directed to the most urgent projects. The case of Philips and its frugal spin-off companies showed that the requirement of meeting given profit margins in large corporations and MNCs is not well aligned with the low profitability associated with socially-orientated frugal solutions.

<sup>383</sup> Beta-i. Interview with social partner. September 15, 2024.

<sup>384</sup> ISINNOVA. Interview with employee. September 23, 2024.

<sup>385</sup> Khan, Rakhshanda, and Helinä Melkas. "The Social Dimension of Frugal Innovation". *International Journal of Technology Management* 83, no. 1/2/3 (2020): 160. <https://doi.org/10.1504/IJTM.2020.109234>.

<sup>386</sup> Richey, Lisa Ann. "Conceptualizing "everyday humanitarianism": Ethics, affects, and practices of contemporary global helping." *New Political Science* 40, no. 4 (2018): 625-639.

<sup>387</sup> Čučković, Nevenka, and Valentina Vučković. "EU R&D Funding as a Way of Incentivizing Innovation of SMEs: A Review of Impacts". *Croatian Economic Survey* 20, no. 2 (2019): 97-127. <https://doi.org/10.15179/ces.20.2.4>.

<sup>388</sup> Sheikh, Fayaz Ahmad, Rhiannon Pugh, Xiaobo Wu, and Soumodip Sarkar. "Regional Studies and Frugal Innovation: A Missing Link?" *Regional Studies* 58, no. 4 (2 April 2024): 893-905. <https://doi.org/10.1080/00343404.2023.2222136>.

<sup>389</sup> Ahuja, Himanshu, and Deep Shree. "New Product Development in 'Emerging Markets'—The Growing Scope of Reverse Innovation in the Post-pandemic World." In *Pandemic, New Normal and Implications on Business: 12th Annual International Research Conference of Symbiosis Institute of Management Studies (SIMSARC21)*, pp. 165-181. Singapore: Springer Nature Singapore, 2022. [https://doi.org/10.1007/978-981-19-4892-3\\_11](https://doi.org/10.1007/978-981-19-4892-3_11).

**Box 18. The case of Helioz**

Helioz, a small Austrian social enterprise founded in 2010,<sup>390</sup> developed the **WADI, a simple solar water disinfection device**<sup>391</sup> introduced in India in 2017<sup>392</sup> and later in other lower-middle-income countries, such as Uganda and Bangladesh. Helioz's main stakeholders included households, local NGOs, and entities in the voluntary carbon market (VCM).<sup>393</sup> The WADI measures UV exposure in water-filled PET or glass bottles, displaying a smiley face signalling when the water is safe for drinking.<sup>394</sup> By using solar energy instead of boiling water for purification, it reduces household CO2 emissions, an estimated 2 tons per household per year.<sup>395</sup> Helioz entered the VCM by monetising these reductions, selling Gold Standard certified carbon credits at around EUR 8.60 per credit.<sup>396</sup>

Despite its positive impact,<sup>397</sup> Helioz terminated operations in 2023, largely due to a lack of investment.<sup>398</sup> However, its innovation continues through projects managed by other organisations. According to the company's former CEO Niclas Schmiedmaier, **insufficient national level support, intense competition, and flaws in the Gold Standard certification**<sup>399</sup> contributed to its closure. Austria's limited participation in green bonds and impact investment markets, place it behind other EU countries. Despite established frameworks for voluntary international cooperation to trade carbon credits and collaborate on climate actions, outlined in Article 6 of the Paris Agreement, Austria has yet to engage in the VCM or implement direct supporting measures. Helioz's reliance on the VCM and the lack of direct government support posed a significant challenge to the firm.

Intense competition in the VCM was faced as large firms often bulk purchase carbon credits at lower costs, influencing carbon credit price<sup>400</sup> and **disadvantaging SMEs who may struggle to generate credits at a comparable scale or reduce prices competitively**. Moreover, flaws in Gold Standard certification create additional challenges in the VCM market. While the certification ensures CO2 reductions, it does not always require projects to deliver practical solutions or meaningful change, despite its aims. Schmiedmaier highlighted cases where many companies in the VCM received Gold Standard certification for installing clean water pipes under the Jal Jeevan Mission,<sup>401</sup> despite water not being drinkable, taking advantage of insufficient regulation. These methodological flaws allow companies to gain market value and carbon credits without delivering impact, highlighting the need for **stricter regulation to ensure validated impacts and credibility of the Gold Standard certification**.

The case highlights the **significant barriers that SMEs in the VCM face, particularly in Member States that lack robust support measures in the intensely competitive market**. Underregulation in the sector creates opportunities for greenwashing, which has gained attention at the policy level, with concerns expressed at COP28, recommending preventative measures to restore integrity in the VCM.<sup>402</sup> While the VCM has the potential to play a significant role in meeting EU and Member States' climate goals, a more robust regulatory framework is needed to support projects that make positive impacts.

## Obstacles related to technology and skills

**Balancing cost-to-efficiency ratios** was highlighted in case studies to be an obstacle in the development of technologies or in adapting technology to low-resource settings. In addition, frugal innovations developed for specific markets can be hindered by a lack of skilled labour and geographical remoteness.<sup>403</sup> The case studies further demonstrated this with specific costs associated with **the need for skilled professionals or having to invest in training local populations**.

Obstacles can also exist when developing advanced solutions within low-resource settings, despite innovations being frugal compared to market alternatives. The case studies highlighted that **limited end-user access to technology can hinder implementation**, even when technology is simplified. For example, not all target users of the TeReFa prosthetics have access to the smartphones required to use the innovation, limiting its scope.

Adopting reverse innovations in high-cost European target markets often necessitates similarly high-cost operations in the supporting business value chain, even if the product itself is frugal in nature, simple in design and application, and low-cost in production.<sup>404</sup> **The indirect costs of selling a frugal product in a high-cost country undermine the otherwise low-cost value proposition of the frugal product itself.** These indirect costs are imposed by local salary standards, the cost of local support services, the cost of warehousing and rent, compliance with local regulations, etc. The cost reduction gained from replacing the more expensive non-frugal product with the less expensive frugal product in the entire value chain becomes negligible compared to the fixed costs of selling a product in the first place. For instance, even if the cost of a frugal product is only EUR 5 compared to a conventional product at EUR 50, the costs of storage, shelf space, and sales of the product may cost EUR 500, irrespective of the frugality of the product itself, leading the frugal product's cost of sales to be EUR 505 compared to the original product's cost to be EUR 550. Given that the frugal product often has simplified features and reduced functionality, the only slightly cheaper price often does not compensate for the potential loss in customer utility.

## Obstacles related to cultural acceptance

Another significant obstacle is the **perception bias around frugal innovation** as something that is viewed as inferior or a second-tier alternative in high-income markets.<sup>405</sup> This poses a challenge to branding as innovators may struggle to convince customers that their frugal products can meet or exceed their needs,<sup>406</sup> particularly due to biases of more affluent consumers that do not always align with frugal characteristics.<sup>407</sup> Adoption of frugal innovations is even lower for reverse innovations, which carry the additionally stigmatising association with low quality coming from a developing country. The effects of low-quality perception of reverse innovations are present not only in the marketplace (as in biased customer preferences) but also within multinational companies when managers decide on introducing low-cost products or technologies from their subsidiaries in developing

<sup>403</sup> Hossain, Mokter, Nivedita Agarwal, Yasser Bhatti, and Jarkko Levänen. "Frugal Innovation: Antecedents, Mediators, and Consequences". *Creativity and Innovation Management* 31, no. 3 (September 2022): 521–40. <https://doi.org/10.1111/caim.12511>.

<sup>404</sup> Hadengue, Marine, Nathalie De Marcellis-Warin, Max von Zedtwitz, and Thierry Warin. "Avoiding the Pitfalls of Reverse Innovation: Lessons Learned from Essilor: One Company's Experiences Suggest How the Specific Challenges of Reverse Innovation May Be Anticipated and Overcome." *Research-Technology Management* 60, no. 3 (4 May 2017): 40–47. <https://doi.org/10.1080/08956308.2017.1301002>.

<sup>405</sup> McCausland, Tammy. "Reverse Innovation, Frugal Innovation, and Jugaad". *Research-Technology Management* 66, no. 1 (2 January 2023): 68–70. <https://doi.org/10.1080/08956308.2023.2142444>.

<sup>406</sup> Malodia, Suresh, Shaphali Gupta, and Anand Kumar Jaiswal. "Reverse Innovation: A Conceptual Framework". *Journal of the Academy of Marketing Science* 48, no. 5 (September 2020): 1009–29. <https://doi.org/10.1007/s11747-019-00703-4>.

<sup>407</sup> Ahuja, Himanshu, and Deep Shree. "New Product Development in 'Emerging Markets'—The Growing Scope of Reverse Innovation in the Post-pandemic World." In *Pandemic, New Normal and Implications on Business: 12th Annual International Research Conference of Symbiosis Institute of Management Studies (SIMSARC21)*, pp. 165-181. Singapore: Springer Nature Singapore, 2022. [https://doi.org/10.1007/978-981-19-4892-3\\_11](https://doi.org/10.1007/978-981-19-4892-3_11).

countries. This is supported by the case studies which also found that **cultural acceptance within established market sectors made it difficult to gain market entry** because end-users prefer traditional options. Multinational companies can temper these effects somewhat either by guaranteeing quality with their brand reputation or by emphasising that part of the innovation has taken place outside developing countries. For instance, Apple has labelled some of its products with “Designed by Apple in California”, thus deemphasising the fact that many of its products are developed by Foxconn and manufactured and assembled in China. General Electric’s Lullaby baby warmer<sup>408</sup> and Philips’s Lumify<sup>409</sup> (presented in the case studies in Annex 6) benefitted from the global brand reputation of their parent companies. Moreover, for reverse innovation, cultural variations across marketplaces<sup>410</sup> pose challenges for larger organisations, which can face managerial and organisational resistance<sup>411</sup> to adopt a more frugal and conscious approach that is tailored to local market needs.<sup>412,413</sup>

### 5.3. Opportunities of frugal and reverse innovation

This section first discusses the opportunities that frugal and reverse innovation present for the EU and HEAC followed by the relevance of such innovations to the wider EU agenda, such as the EU Green Deal,<sup>414</sup> NEIA<sup>415</sup> and social innovation. There are three principal benefits that frugal and reverse innovation offers:

1. Due to their low-cost nature, frugal innovations can contribute to the lowering of price levels and reduce costs of living and affordability in high-price countries such as the European Union.
2. Organisations that are able to develop and introduce frugal innovations, either based on internal competencies or in the form of reverse innovations from abroad, are expected to gain market share and thus contribute to improved overall competitiveness of the European industry.
3. Simplicity in design and lowered ecological footprint of frugal innovations will indirectly benefit European society in general through more limited reliance on natural resources.

### Unlocking the potential of frugal and reverse innovation in the EU

The case studies and desk research highlight that frugal and reverse innovations leverage particular factors to address societal or humanitarian challenges and to support their long-term viability. These include local skills and workforces, community-driven efforts, and accessible, and in some cases open-source, technologies. These highlighted practices

<sup>408</sup> GE Healthcare. “Lullaby warmer.” Accessed February 13, 2025. <https://www.gehealthcare.co.uk/products/perinatal-care/warmers/lullaby-warmer>.

<sup>409</sup> Philips. “Lumify Home.” Accessed February 13, 2025. <https://www.philips.co.uk/healthcare/sites/lumify>.

<sup>410</sup> Hyypiä, Mirva, and Rakhshanda Khan. “Overcoming Barriers to Frugal Innovation: Emerging Opportunities for Finnish SMEs in Brazilian Markets”. *Technology Innovation Management Review* 8, no. 4 (24 April 2018): 38–48. <https://doi.org/10.22215/timreview/1151>.

<sup>411</sup> Amnaganti, Srikant, and Prageetha G. Raju. “Reverse innovation: Create far from home, win everywhere.” *Competitiveness Review: An International Business Journal* 23, no. 3 (2013): 299–302; Hadengue, Marine, Nathalie De Marcellis-Warin, Max von Zedtwitz, and Thierry Warin. “Avoiding the Pitfalls of Reverse Innovation: Lessons Learned from Essilor: One Company’s Experiences Suggest How the Specific Challenges of Reverse Innovation May Be Anticipated and Overcome.” *Research-Technology Management* 60, no. 3 (4 May 2017): 40–47. <https://doi.org/10.1080/08956308.2017.1301002>.

<sup>412</sup> Borini, Felipe Mendes, Sidney Costa, and Moacir De Miranda Oliveira Junior. “Reverse Innovation Antecedents”. Edited by William Newbury, John R. McIntyre And Wlamir Xavier. *International Journal of Emerging Markets* 11, no. 2 (18 April 2016): 175–89. <https://doi.org/10.1108/IJoEM-11-2013-0194>.

<sup>413</sup> Malodia, Suresh, Shaphali Gupta, and Anand Kumar Jaiswal. “Reverse Innovation: A Conceptual Framework”. *Journal of the Academy of Marketing Science* 48, no. 5 (September 2020): 1009–29. <https://doi.org/10.1007/s11747-019-00703-4>.

<sup>414</sup> European Commission. *The European Green Deal*. Accessed October 17, 2024. [https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal\\_en](https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en).

<sup>415</sup> European Commission. “The New European Innovation Agenda.” Accessed January 2, 2025. [https://research-and-innovation.ec.europa.eu/strategy/support-policy-making/shaping-eu-research-and-innovation-policy/new-european-innovation-agenda\\_en](https://research-and-innovation.ec.europa.eu/strategy/support-policy-making/shaping-eu-research-and-innovation-policy/new-european-innovation-agenda_en).

point to ways the EU could both capitalise on and support frugal and reverse innovation to strengthen its economic and social resilience, as discussed below.

The longevity of frugal business ventures can be sustained by local workforces, whereby **centralised implementation can reduce dependencies on external factors**. The case studies highlighted this and some pointed to the importance of establishing skills and technology early on to increase the viability of the venture and to attract continued support for long-term growth.<sup>416</sup> Additionally, some ventures successfully utilised open-source technologies to foster innovation by attracting volunteer engineers and local entrepreneurs to establish businesses.<sup>417</sup>

Relatedly, the increasing availability of technology within low-resource settings could also create future **opportunities for the EU to support and expand frugal ventures into new markets**. Moreover, the case studies demonstrated that technological advancements in unrelated fields can enhance frugal innovations, developments which can be harnessed by the EU and developed for broader applications. Together with improved digital infrastructure in low-resource settings, this provides an opportunity to reach a wider group of end-users, driving social and economic impact in these regions. An interviewed policy maker in Morocco noted the importance of leveraging innovations from outside of the country, rather than aiming to be at the frontier of innovation.<sup>418</sup> For lower innovator regions, harnessing reverse innovation and technological advancements provides a valuable opportunity to meet their needs.

The potential for frugal and reverse innovation could also be harnessed through technological developments undertaken in research institutions and academia, if given the opportunity to, for example, develop partnerships and commercialise. In one example, an interviewed policy maker in Ukraine noted that some frugal initiatives supporting Ukrainian exports include military exports of drone technology and cybersecurity, originally developed in an academic context, and now commercialised and applied in conflict settings, and which are gaining traction in Western markets.<sup>419</sup>

Importantly, **open-source projects, in particular, can play a key role in supporting an innovative ecosystem**, which is particularly relevant for resource-constrained innovations.<sup>420</sup> Significantly, several examples in the case studies relied on accessible and open-source 3D printing (hardware and software) for their R&D and manufacturing. Advancements in this area could further enhance EU-led frugal innovations across diverse sectors, creating new opportunities for growth and competitiveness.

These factors highlight that frugal ventures can provide opportunities for the bottom-up economy within the EU, enabling locally or community-driven workforces that are supported through open-source technologies. Both the case studies and literature suggest that grassroots and community-level innovative ventures have the potential to support more inclusive innovation, sustainable manufacturing and supply chains as well as employment. This has already been well demonstrated within the Maker Movement (see Box 19), which has been found to support the democratisation of innovation, supporting education, skill and community development<sup>421</sup> as well as promoting open innovative ecosystems via open-

<sup>416</sup> von Zedtwitz, Maximilian. "International R&D strategies of TNCs from developing countries: the case of China." In *Globalization of R&D and developing countries*, vol. 24. New York, NY: Unctad, 2005.

<sup>417</sup> RepRap. Interview with Employee. August 2nd, 2024.

<sup>418</sup> Interview with policy maker. August 22, 2024.

<sup>419</sup> Ukrainian Ministry of Education and Science. Interview with policy maker. September 6, 2024.

<sup>420</sup> European Commission: Directorate-General for Research and Innovation, Fraunhofer ISI and Nesta. *Study on Frugal Innovation and Reengineering of Traditional Techniques*. Publications Office: Brussels, 2017. <https://data.europa.eu/doi/10.2777/94587>; Hadengue, Marine, Nathalie de Marcellis-Warin, and Thierry Warin. "Reverse Innovation: A Systematic Literature Review". *International Journal of Emerging Markets* 12, no. 2 (1 January 2017): 142–82. <https://doi.org/10.1108/IJoEM-12-2015-0272>; Hussler, Caroline, and Thierry Burger-Helmchen. "Opening the reverse innovation black box to pinpoint its drivers and challenges in Western MNCs." *European Journal of International Management* 14, no. 5 (2020): 941-954.

<sup>421</sup> Mersand, Shannon. "The state of makerspace research: A review of the literature." *TechTrends* 65, no. 2 (2021): 174-186.

source and collaborative practices<sup>422</sup> and can enhance problem-solving and entrepreneurial ecosystems.<sup>423</sup> Interviewed policy makers also highlighted projects with frugal elements often have strong community engagement and are better deployed at a small scale before being replicated in other contexts.<sup>424</sup> This points to how grassroots solutions at a local level could be promoted to provide solutions to other similarly affected regions.

### Box 19. The Maker Movement

Maker Movement refers to the growing community of makers, individuals who, through formal or informal training, embrace the do-it-yourself (DIY) culture of making, often leveraging open peer-to-peer resources and digital fabrication technologies to realise their creations.<sup>425</sup> The origins of the movement are traced back to 2005 with the launch of Dale Dougherty's Make Magazine,<sup>426</sup> a publication that offers readers tutorials on various DIY projects, which can be completed at home using readily available materials.<sup>427</sup>

Since the magazine's launch, the movement has evolved globally, a growth which can be attributed to advancements in robotics, programming languages and digital fabrication technologies, such as 3D printers, as well as the expansion of the internet which has enabled online communities to share resources, collaborate on tools, and promote their designs across distributed networks.<sup>428</sup> The growth of the movement has also led to the proliferation of fabrication spaces, such as FabLabs, makerspaces, and hackerspaces, which afford individuals public access to various tools, including 3D printers, enabling them to bring their creations to life.<sup>429</sup>

Research indicates that many makers are socially motivated to create,<sup>430</sup> a finding supported by their active contributions and support during times of crisis. For example, during the COVID-19 pandemic Maker communities mobilised to produce face masks, face shields and ventilators. The communities, through the flexibility of their design and production processes, were able to fill critical gaps in supply chains much faster than governmental actors.<sup>431</sup> In this crisis the Maker movement acted as a critical supplier of aid, underscoring its capacity for and commitment to social innovation.

By focusing on core functionality, emphasising resourcefulness and fostering social innovation, the Maker Movement aligns well with the principles of frugal innovation. For these reasons, many Maker Movement initiatives, including e-NABLE and RepRap (see the case studies in Annex 6), have resulted in both frugal and reverse innovations.

Moreover, **strategic partnerships are often utilised by frugal and reverse ventures.** The literature provides substantial evidence that reverse innovations, in particular, can foster increased partnerships between companies from high-income and low and middle-

<sup>422</sup> Saari, Hanna, Maria Åkerman, Barbara Kieslinger, Jouko Myllyoja, and Regina Sipos. "How open is the maker movement? Integrative literature review of the openness practices in the global maker movement." *Sustainability* 13, no. 24 (2021): 13559.

<sup>423</sup> Saavedra Munar, Leonardo, and Marc Alier Forment. "The Maker Movement in Engineering Education: A Partial Literature Review of the Research Opportunities on Competency Development." In *International conference on technological ecosystems for enhancing multiculturalism*, pp. 1311-1319. Singapore: Springer Nature Singapore, 2022.

<sup>424</sup> Group interview with two policy makers. October 1110, 2024.

<sup>425</sup> Massimo Menichinelli and Alessandra Gerson Saltiel Schmidt, "First Exploratory Geographical and Social Maps of the Maker Movement," *DOAJ (DOAJ: Directory of Open Access Journals)*, June 1, 2020, <https://doi.org/10.6092/issn.2612-0496/9640>; Lucia Corsini, Valeria Dammico, and James Moultrie, "Frugal Innovation in a Crisis: The Digital Fabrication Maker Response to COVID-19," *R and D Management* 51, no. 2 (December 3, 2020): 195–210, <https://doi.org/10.1111/radm.12446>.

<sup>426</sup> See: Make. Accessed November 22, 2024. <https://makezine.com/>.

<sup>427</sup> Massimo Menichinelli and Alessandra Gerson Saltiel Schmidt, "First Exploratory Geographical and Social Maps of the Maker Movement," *DOAJ (DOAJ: Directory of Open Access Journals)*, June 1, 2020, <https://doi.org/10.6092/issn.2612-0496/9640>.

<sup>428</sup> Sofia Papavlasopoulou, Michail N. Giannakos, and Letizia Jaccheri, "Empirical Studies on the Maker Movement, a Promising Approach to Learning: A Literature Review," *Entertainment Computing* 18 (September 9, 2016): 57–78, <https://doi.org/10.1016/j.entcom.2016.09.002>.

<sup>429</sup> Lucia Corsini, Valeria Dammico, and James Moultrie, "Frugal Innovation in a Crisis: The Digital Fabrication Maker Response to COVID-19," *R and D Management* 51, no. 2 (December 3, 2020): 195–210, <https://doi.org/10.1111/radm.12446>.

<sup>430</sup> Massimo Menichinelli and Alessandra Gerson Saltiel Schmidt, "First Exploratory Geographical and Social Maps of the Maker Movement," *DOAJ (DOAJ: Directory of Open Access Journals)*, June 1, 2020, <https://doi.org/10.6092/issn.2612-0496/9640>.

<sup>431</sup> Corsini, Lucia, Valeria Dammico, Lin Bowker-Lonnecker, and Robbie Blythe. "The Maker Movement and Its Impact in the Fight against COVID-19". 2020. <https://doi.org/10.17863/CAM.60248>.

income countries, which in turn mitigates the challenges associated with operating in foreign markets.<sup>432</sup> Such partnerships present opportunities for the EU to leverage collaborations to gain access to new markets, enhance knowledge transfer, increase competitiveness,<sup>433</sup> and drive socially orientated innovation within the EU and HEAC. The study finds relatively few examples of intra-EU reverse innovation, particularly when compared to the many examples of reverse innovations developed outside of the EU. Importantly, reverse innovation within the EU could provide opportunities to capitalise on partnerships, drive innovation and competitiveness, and more comprehensively and equitably address EU-wide challenges. This aligns with the Draghi report findings that collaboration networks across the EU are underused by innovators and researchers.<sup>434</sup> A collaboration network could help to improve the potential of the EU and contribute to a coordinated approach for a better R&I landscape.

Furthermore, previous research finds that frugal and reverse innovations arise in response to humanitarian challenges, and can serve as timely and effective tools for crisis management.<sup>435</sup> Similarly, the findings from the case studies suggest that **frugal innovations offer unique potential to provide low-cost and sustainable products or services in conflict regions where resources are constrained.** For instance, following Russian aggression in Ukraine, there is a potential gap in the market to provide services needed in the reconstruction of Ukrainian infrastructure or meet increasing health demands. Not only could this serve a demand for affordable products, but it could ensure reconstruction efforts are aligned with sustainable practices.

<sup>432</sup> Dubiel, Anna, and Holger Ernst. "Success factors of new product development for emerging markets." *The PDMA handbook of new product development* 3 (2013): 100-114; Corsi, Simone, Alberto Di Minin, and Andrea Piccaluga. "Reverse Innovation at Speres: A Case Study in China". *Research-Technology Management* 57, no. 4 (1 July 2014): 28–34. <https://doi.org/10.5437/08956308X5704215>; Crisp, Nigel. "Mutual Learning and Reverse Innovation—Where Next?" *Globalization and Health* 10, no. 1 (28 March 2014): 14. <https://doi.org/10.1186/1744-8603-10-14>; Hadengue, Marine, Nathalie de Marcellis-Warin, and Thierry Warin. "Reverse Innovation: A Systematic Literature Review". *International Journal of Emerging Markets* 12, no. 2 (1 January 2017): 142–82. <https://doi.org/10.1108/IJoEM-12-2015-0272>.

<sup>433</sup> Kusumawardhany, Prita Ayu, Imam Baihaqi, and Putu Dana Karningsih. "How Frugal Innovation Is Applied by MSMEs for Sustainability". In *2022 IEEE Technology & Engineering Management Conference - Asia Pacific (TEMSCON-ASPAC)*, 054–058. Bangkok, Thailand: IEEE, 2022. <https://doi.org/10.1109/TEMSCON-ASPAC52831.2022.9916557>; Velananda, Yashoda L., D. M. R. Dissanayake, and C. N. Wickramasinghe. "Application of Frugal Innovations in a Global Context." *Asian Basic and Applied Research Journal* (2022): 327-338.

<sup>434</sup> Draghi, Mario. *The future of European Competitiveness*. Brussels: European Commission, September 2024. Accessed November 7, 2024. [https://commission.europa.eu/topics/strengthening-european-competitiveness/eu-competitiveness-looking-ahead\\_en#paragraph\\_47059](https://commission.europa.eu/topics/strengthening-european-competitiveness/eu-competitiveness-looking-ahead_en#paragraph_47059).

<sup>435</sup> Miesler, Tobias, Christine Wimschneider, Alexander Brem, and Lorenz Meinel. "Frugal Innovation for Point-of-Care Diagnostics Controlling Outbreaks and Epidemics". *ACS Biomaterials Science & Engineering* 6, no. 5 (11 May 2020): 2709–25. <https://doi.org/10.1021/acsbiomaterials.9b01712>; Santos, Leandro Lima, Felipe Mendes Borini, Moacir De Miranda Oliveira, Dennys Eduardo Rossetto, and Roberto Carlos Bernardes. "Bricolage as Capability for Frugal Innovation in Emerging Markets in Times of Crisis". *European Journal of Innovation Management* 25, no. 2 (16 February 2022): 413–32. <https://doi.org/10.1108/EJIM-06-2020-0225>; Lucia Corsini, Valeria Dammico, and James Moultrie, "Frugal Innovation in a Crisis: The Digital Fabrication Maker Response to COVID-19," *R and D Management* 51, no. 2 (December 3, 2020): 195–210, <https://doi.org/10.1111/radm.12446>; Park, Hyunkyoo, Miyoung Lee, and Joon Mo Ahn. "Bottom-up Solutions in a Time of Crisis: The Case of Covid-19 in South Korea". *R&D Management* 51, no. 2 (March 2021): 211–22. <https://doi.org/10.1111/radm.12449>; Sedita, Silvia Rita, Silvia Blasi, and Andrea Ganzaroli. "Exaptive Innovation in Constraint-Based Environments: Lessons from COVID-19 Crisis". *European Journal of Innovation Management* 25, no. 6 (19 December 2022): 549–66. <https://doi.org/10.1108/EJIM-07-2021-0348>; Sheikh, Fayaz Ahmad, Rhiannon Pugh, Xiaobo Wu, and Soumodip Sarkar. "Regional Studies and Frugal Innovation: A Missing Link?" *Regional Studies* 58, no. 4 (2 April 2024): 893–905. <https://doi.org/10.1080/00343404.2023.2222136>.

## Relevance to wider policy developments and the EU agenda

The contributions of frugal and reverse innovations to sustainability are well-documented in the academic literature and **a growing emphasis in policy and regulation at the EU level on sustainability and circular economy can raise awareness, cultural acceptance and wider opportunities for growth for frugal ventures.**<sup>436</sup> As demonstrated in the case studies, this can increase the relevance and scope of frugal innovations. In some cases, national policy and regulations did not align with EU policy shifts, potentially undermining these efforts. On the other hand, in the case of Termex insulation, it was noted that a strong national prioritisation of recycling infrastructure enabled their venture to succeed but scaling was not viable within the EU due to a lack of similar infrastructure. **In both cases, better national and EU alignment would present significant market expansion and scaling opportunities which would be mutually beneficial for the EU economy and society and the frugal and reverse innovation ecosystem.**

Moreover, case studies and literature highlight that frugal and reverse innovations are well placed to **address the future needs of the EU and global challenges**, including EU burning issues, in particular reducing the reliance on fossil fuels, and wider environmental, health, and security challenges. Research finds that frugal and reverse innovations can bolster energy efficiency,<sup>437</sup> improve care for critically ill patients,<sup>438</sup> and offer a more robust defence of critical infrastructure.<sup>439</sup> The case studies contribute to the existing research by demonstrating the utility of these innovation types in Europe. For the Life Nieblas project, for example, it was expressed that their fog water collector could meet the needs of the growing issue of drought and limited water sources. This is of particular concern to Southern European countries and presents affordable and accessible solutions. The Desolenator innovative desalination system is another example demonstrating the potential for frugal solutions to address growing social challenges (see Box 1).

For frugal solutions meeting defence needs, the recent 14<sup>th</sup> NATO Innovation Challenge<sup>440</sup> provides a good example. The competition judged innovative solutions for remote search and neutralisation of explosive mines and encouraged high-efficiency and low-cost solutions to meet operational challenges faced, for example, in Ukraine. While not specific to frugal innovation, the competition resulted in the showcasing of high-tech yet frugal-aligned solutions to meet the needs of the war in Ukraine, which included AI, drone technology, and virtual reality.<sup>441</sup> This example not only demonstrates how frugal innovation can contribute to EU priority areas of deep tech and digital innovation as well as addressing defence needs but also how high-profile competitions could be leveraged to raise awareness of frugal innovations and innovators.

Within the health sector, access to affordable health technology or services is a growing need, particularly in response to global challenges, such as conflict. Frugal solutions in health care are often implemented in low-resource settings outside of the EU,<sup>442</sup> however,

<sup>436</sup> Mokter Hossain, "Frugal Innovation: Conception, Development, Diffusion, and Outcome," *Journal of Cleaner Production* 262 (April 5, 2020): 121456, <https://doi.org/10.1016/j.jclepro.2020.121456>; Alexander Brem and Björn Ivens, "Do Frugal and Reverse Innovation Foster Sustainability? Introduction of a Conceptual Framework," *Journal of Technology Management for Growing Economies* 4, no. 2 (October 1, 2013): 31–50, <https://doi.org/10.15415/jtmge.2013.42006>.

<sup>437</sup> De Marchi, Valentina, Maria A. Pineda-Escobar, Rachel Howell, Michelle Verheij, and Peter Knorringa. "Frugal Innovation and Sustainability Outcomes: Findings from a Systematic Literature Review". *European Journal of Innovation Management* 25, no. 6 (2022): 984–1007. <https://doi.org/10.1108/EJIM-02-2022-0083>.

<sup>438</sup> Mekontso Dessap, Armand. "Frugal Innovation for Critical Care". *Intensive Care Medicine* 45, no. 2 (February 2019): 252–54. <https://doi.org/10.1007/s00134-018-5391-6>.

<sup>439</sup> Andromachi Papagianni, Konstantinos Ioannidis, Theodora Tsikrika, Stefanos Vrochidis, and Ioannis Kompatsiaris. "Frugal and Robust AI for Defence Advanced Intelligence." In *Paradigms on Technology Development for Security Practitioners*, pp. 427–437. Cham: Springer Nature Switzerland, 2024.

<sup>440</sup> InnovationHub. "Innovation Challenges". Accessed October 29, 2024. <https://innovationhub-act.org/innovation-challenges/>.

<sup>441</sup> NATO ACT. "Winner of the 14<sup>th</sup> NATO Innovation Challenge Selected for Landmine Clearance Solution". Accessed October 29, 2024. <https://www.act.nato.int/article/15th-nato-innovation-challenge-winner/>

<sup>442</sup> Mekontso Dessap, Armand. "Frugal Innovation for Critical Care". *Intensive Care Medicine* 45, no. 2 (February 2019): 252–54. <https://doi.org/10.1007/s00134-018-5391-6>; Papagianni, Andromachi, Konstantinos Ioannidis, Theodora Tsikrika,

as evidenced by frugal innovative efforts during the COVID-19 crisis, there is a clear potential for these innovations in the EU.<sup>443</sup> Having said this, case studies highlighted that the divergence of needs in the health sector in less developed and more developed nations introduced challenges in the adaptability or acceptance of these solutions. The example of the GOAL3 health monitoring systems further demonstrates this, as shown in Box 4. Nevertheless, frugal innovations within the health sector show that **circular and low-resource approaches to health care are possible** and present an opportunity to transform currently established systems if market access is facilitated.

Frugal innovations within the construction sector provide opportunities to **facilitate sustainable industry practices, lower carbon emissions, introduce more circular practices** and support the Renovation Wave of the EU Green Deal<sup>444</sup> and the Circular Economy Action Plan.<sup>445</sup> However, the resource-intensive sector is typically a conservative and well-established market, making it difficult to scale frugal solutions. One interviewed policy maker emphasised that the European Commission would be well placed to organise fairs to encourage the exchange of ideas which support its circularity and sustainability goals.<sup>446</sup>

**Open-source technology was also highlighted to increase EU security and reduce dependencies on external markets.** For example, findings from both the case studies and academic literature demonstrate that 3D printing technology can reduce dependencies on external supply chains and digital infrastructure (as open-source 3D printers can be made and operated off-grid and be modified independently).<sup>447</sup> The literature finds that the localisation of supply chains through 3D printing makes for more sustainable frugal innovations, and the case study data builds on this by suggesting that this too can enhance security in sensitive R&D projects.<sup>448</sup> Moreover, open-source 3D printing technology has unique applications in conflict zones. Wider access to this technology in lower innovator regions also promotes an open and innovative ecosystem, reducing the innovation divide

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Stefanos Vrochidis, and Ioannis Kompatsiaris. "Frugal and Robust AI for Defence Advanced Intelligence." In *Paradigms on Technology Development for Security Practitioners*, pp. 427-437. Cham: Springer Nature Switzerland, 2024; Park, Sukyung, Eugenia Rosca, and Nivedita Agarwal. "Driving Social Impact at the Bottom of the Pyramid through the Internet-of-Things Enabled Frugal Innovations". *Technovation* 118 (December 2022): 102381. <https://doi.org/10.1016/j.technovation.2021.102381>.

<sup>443</sup> Mekontso Dessap, Armand. "Frugal Innovation for Critical Care". *Intensive Care Medicine* 45, no. 2 (February 2019): 252–54. <https://doi.org/10.1007/s00134-018-5391-6>; Hossain, Mokter, Nivedita Agarwal, Yasser Bhatti, and Jarkko Levänen. "Frugal Innovation: Antecedents, Mediators, and Consequences". *Creativity and Innovation Management* 31, no. 3 (September 2022): 521–40. <https://doi.org/10.1111/caim.12511>; Park, Sukyung, Eugenia Rosca, and Nivedita Agarwal. "Driving Social Impact at the Bottom of the Pyramid through the Internet-of-Things Enabled Frugal Innovations". *Technovation* 118 (December 2022): 102381. <https://doi.org/10.1016/j.technovation.2021.102381>; Lucia Corsini, Valeria Dammicco, and James Moultrie, "Frugal Innovation in a Crisis: The Digital Fabrication Maker Response to COVID-19," *R and D Management* 51, no. 2 (December 3, 2020): 195–210, <https://doi.org/10.1111/radm.12446>; Sedita, Silvia Rita, Silvia Blasi, and Andrea Ganzaroli. "Exaptive Innovation in Constraint-Based Environments: Lessons from COVID-19 Crisis". *European Journal of Innovation Management* 25, no. 6 (19 December 2022): 549–66. <https://doi.org/10.1108/EJIM-07-2021-0348>.

<sup>444</sup> European Commission. *A Renovation Wave for Europe: Greening Our Buildings, Creating Jobs, Improving Lives*. Brussels: European Commission, 2020. [https://energy.ec.europa.eu/system/files/2020-10/eu\\_renovation\\_wave\\_strategy\\_0.pdf](https://energy.ec.europa.eu/system/files/2020-10/eu_renovation_wave_strategy_0.pdf)

<sup>445</sup> European Commission. *A New Circular Economy Action Plan for a Cleaner and More Competitive Europe*. Brussels: European Commission, 2020. <https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1583933814386&uri=COM:2020:98:FIN>.

<sup>446</sup> European Parliament. Interview with policy maker. September 11, 2024.

<sup>447</sup> Lucia Corsini, Valeria Dammicco, and James Moultrie, "Frugal Innovation in a Crisis: The Digital Fabrication Maker Response to COVID-19," *R and D Management* 51, no. 2 (December 3, 2020): 195–210, <https://doi.org/10.1111/radm.12446>; Gibson, Ian, and Abhijeet Shukla. "Sustainable Frugal Design Using 3D Printing". In *Handbook of Sustainability in Additive Manufacturing*, edited by Subramanian Senthilkannan Muthu and Monica Mahesh Savalani, 85–100. Environmental Footprints and Eco-Design of Products and Processes. Singapore: Springer Singapore, 2016. [https://doi.org/10.1007/978-981-10-0606-7\\_4](https://doi.org/10.1007/978-981-10-0606-7_4).

<sup>448</sup> *Ibid.*

(Flagship 3 of the NEIA<sup>449</sup>) and closing the innovation gap (Draghi report,<sup>450</sup> Competitiveness Compass<sup>451</sup>).

## 6. Conclusions and recommendations

This chapter provides conclusions of the study and recommendations, structured by research objectives and responding to their associated research questions, ensuring that all research questions are addressed.

### 6.1. Conclusions

#### Common definitions of frugal and reverse innovation

To meet the objective and address the research question<sup>452</sup> to provide orientations for the development of common definitions which can be applied in an EU context to support a more comprehensive approach to future policy measures, suggested definitions have been developed. Currently, the key concepts, frugal and reverse innovation, are marked by a level of ambiguity and vary by context. Frugal and reverse innovations can share similar interpretations which results in reverse innovations sharing the resource-constrained characteristics of frugal innovations. This study adopts the following tailored definitions which align with their applicability in the European and resource-constrained innovation context:

***Frugal innovations** are products in the wider sense that appeal through their simplicity compared to more complex solutions but with sufficiently similar context-specific utility and robustness. Frugal innovations are further characterised by significant gains in affordability, reduced use of resources in manufacturing and application, lowered cost of ownership and use, and greater ecological compatibility.*

To operationalise this definition of frugal innovation, four core mutually exclusive characteristics were considered to account for the dimensions of frugality:

- **Simple** = reduced functionality, defeatured, focus on core functionality, easy-to-use.
- **Economical** = developed and manufactured under resource-constraints.
- **Cheap** = offered at a significantly lower price than comparable reference products, lower cost of ownership for the customer.
- **Sustainable** = reduced total product lifecycle costs, lowered ecological footprint.

<sup>449</sup> European Commission. "Flagship 3: Accelerating and Strengthening Innovation in European Innovation Ecosystems Across the EU and Addressing the Innovation Divide. New European Innovation Agenda Roadmap." Accessed October 17, 2024. [https://research-and-innovation.ec.europa.eu/strategy/support-policy-making/shaping-eu-research-and-innovation-policy/new-european-innovation-agenda/new-european-innovation-agenda-roadmap/flagship-3-accelerating-and-strengthening-innovation-european-innovation-ecosystems-across-eu-and\\_en](https://research-and-innovation.ec.europa.eu/strategy/support-policy-making/shaping-eu-research-and-innovation-policy/new-european-innovation-agenda/new-european-innovation-agenda-roadmap/flagship-3-accelerating-and-strengthening-innovation-european-innovation-ecosystems-across-eu-and_en).

<sup>450</sup> Draghi, Mario. *The future of European Competitiveness*. Brussels: European Commission, September 2024. Accessed 7 November, 2024. [https://commission.europa.eu/topics/strengthening-european-competitiveness/eu-competitiveness-looking-ahead\\_en#paragraph\\_47059](https://commission.europa.eu/topics/strengthening-european-competitiveness/eu-competitiveness-looking-ahead_en#paragraph_47059).

<sup>451</sup> European Commission. *COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE EUROPEAN COUNCIL, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS - A Competitiveness Compass for the EU*. Brussels: European Commission, 2025. Brussels. [https://commission.europa.eu/document/download/10017eb1-4722-4333-add2-e0ed18105a34\\_en](https://commission.europa.eu/document/download/10017eb1-4722-4333-add2-e0ed18105a34_en).

<sup>452</sup> This specific research objective relates to the following research questions: *What are the key concepts and terminology related to frugal and reverse innovation? How could they be defined? What are the main differences in conceptual and linguistic understanding of frugal and reverse innovation in EU / HEAC countries? What mechanisms related to common definitions / terminology for frugal and reverse innovation can bridge conceptual gaps across different EU/ HEAC countries?*

**Reverse innovation** is a frugal innovation that is either developed by a low innovator country in Europe or targeted at low innovator countries in Europe, and that has demonstrated marketability and scalability in other high innovator markets in Europe.

The study findings suggest that there is **limited awareness at the policy and investment level of these specific innovation concepts**. While in the few examples of specific EU and national projects which use the term frugal innovation, the descriptions align with the core characteristics of simplicity, cost-effectiveness, resource-constraints, and sustainability, the findings from stakeholder consultations suggest that many policy makers and innovators are unaware of the concepts. In particular, the applicability of such terms in the context of innovation and within the EU are not well understood and requires attention to create a cohesive understanding of the terms.

## Landscape of frugal and reverse innovation in the EU and HEAC

A mapping and scoping of frugal and reverse innovation in the EU and Horizon Europe Associated countries, of both innovative ventures and policy support, has provided a broad picture answering the research questions related to the landscape of implementation and support and market and business diversity of frugal and reverse innovation.<sup>453</sup> Importantly, the limitations of the innovation and policy mapping mean that the resulting databases are non-exhaustive, as comprehensive data for the niche yet heterogeneous innovation types for the EU and HEAC was not found. Therefore, the results below present a landscape of frugal and reverse innovation in the EU and HEAC.

The findings of the innovation mapping suggest that despite the characteristics of frugal innovation which make them adaptive to low-resource settings **the majority of frugal innovation examples come from high innovator regions<sup>454</sup> within the EU (France, Germany and the Netherlands)**, with fewer examples from lower innovator regions or HEAC. This is consistent with the findings that 'spill-back' innovations were the most commonly identified type of reverse innovation, although in general fewer examples of reverse innovation were identified. Given that high innovator regions are typically more resource-rich, this suggests there is potential for innovations that were designed and developed in advanced EU/HEAC countries for developing non-EU/HEAC markets to be re-introduced (commercialised) to advanced EU/HEAC countries to meet the growing need for solutions to burning challenges in the EU and HEAC. At the regional level, the majority of mapped examples were developed in Innovation Leader and Strong Innovator regions and cities. Building a stronger frugal innovation ecosystem could support the EU's cohesion policy to continue to drive innovation across the whole of the EU, as recommended in the Draghi report,<sup>455</sup> and to facilitate participation in the Single Market, a concept stressed in the Letta report, to ensure a prosperous EU.<sup>456</sup>

The innovation mapping reflects that **smaller entities, such as SMEs, start-ups and local NGOs, lead the way** due to their small teams with a dedicated focus on singular, socially oriented innovations. MNCs and large companies were found to be less inclined to adopt or introduce frugal innovations due to internal reluctance. Large companies face difficulties in supporting frugal innovations due to lower profitability and internal competition which enforce traditional market expectations. This can result in companies prioritising more

<sup>453</sup> This specific research objective relates to the following research questions: *What frugal and reverse innovation can be identified in EU and HEAC? What is the volume of implementation of these innovations? What policies support frugal and reverse innovation in EU and HEAC? What is the volume (total funding designated) of these policies? How diverse in terms of market sector and business model are frugal and reverse innovations? What obstacles (market failures, political or institutional constraints, etc.) prevent the European ecosystem from pursuing frugal and reverse innovation?*

<sup>454</sup> Classifications for 'low' and 'high' innovator countries in this study are based on the European Innovation Scoreboard (EIS) and the Global Innovation Index (GII). Further details on country classification can be found in Section 2.2.

<sup>455</sup> Draghi, Mario. *The future of European Competitiveness*. Brussels: European Commission, September 2024. Accessed November 7, 2024. [https://commission.europa.eu/topics/strengthening-european-competitiveness/eu-competitiveness-looking-ahead\\_en#paragraph\\_47059](https://commission.europa.eu/topics/strengthening-european-competitiveness/eu-competitiveness-looking-ahead_en#paragraph_47059).

<sup>456</sup> Letta, Enrico. *Much More Than a Market – Speed, Security, Solidarity. Empowering the Single Market to deliver a sustainable future and prosperity for all EU Citizens*. April 2024. Accessed December 9, 2024. <https://www.consilium.europa.eu/media/ny3j24sm/much-more-than-a-market-report-by-enrico-letta.pdf>.

profitable innovations over frugal ones, which might have lower profitability projections. In larger companies, **frugal innovations should be quickly adapted into business cases**. The economic viability of frugal innovations being developed in this context can be supported by redefining the expectations of profitability, for example by creating spin-offs, expectations of scalability,<sup>457</sup> and engaging in strategic partnerships with large-scale buyers. Moreover, frugal innovations would be well placed to receive support from social corporate responsibility funds (or similar) and help the private sector to contribute and align their interests with social impact. It was found that frugal and reverse innovations are socially orientated within the EU and HEAC, even when developed by profit-seeking firms. **Addressing social challenges is an appropriate niche within the EU** that would allow frugal and reverse innovations to flourish without having to compete in traditional profit-driven markets. This idea was also supported by interview findings from policy makers who suggested that support could be aimed at projects addressing societal problems as opposed to preconceived technological solutions.<sup>458</sup> This aligns with the Draghi report which notes that EU productivity and innovation growth should strive to preserve social inclusion.<sup>459</sup> Frugal innovations present a means to harness low-cost local innovation which also targets pressing social issues.

The study highlights that despite their similarities, **frugal and reverse innovations can stem from distinct contexts to meet specific market needs and present sector-specific opportunities**. Frugal innovations were most prominent in the health, food and consumer goods and services sectors, as well as automotive and green technology sectors within the EU, and addressing diverse social and environmental challenges. The case studies support that health (such as e-NABLE, Good Vision and Handicap International case studies available in Annex 6, Primary Care Panels in Box 3, and the GOAL3 IMPALA system in Box 4) and green construction (such as Termex, Kuidas.Works, LITUA and ISIBRIX case studies) are key sectors for frugal innovation, especially in crisis responses (notably, e-NABLE, Handicap International, and LITUA case studies). Frugal innovations also have potential in security, where local manufacturing can reduce external dependencies and **strengthen EU resilience and strategic autonomy**. This aligns well with the goals of the Competitiveness Compass, to reduce dependencies and improve security of the EU.<sup>460</sup> A strengthened EU frugal innovation ecosystem could harness resource-efficient solutions which target social and sustainable solutions and bolster EU-wide security and, as recommended in the Draghi report, capture opportunities across key sectors, including green and health technologies.<sup>461</sup> In addition, the Letta report highlights the need for integration across the healthcare sector and sustainable access to healthcare,<sup>462</sup> an area in which frugal innovation could act to support accessibility and low-cost solutions which are easily implemented across the EU. Notably, sustainability as a characteristic of frugal innovations was less prominent in the mapping, suggesting that sustainability could be a byproduct of frugality, rather than a motivation, despite literature suggesting otherwise.

The policy mapping found that **frugal and reverse innovations are not policy priorities at the EU or national level**, with a limited number of targeted policies which directly support or promote them. Due to the limited number of examples found, it was not possible to

<sup>457</sup> KTH Royal Institute of Technology. Interview with expert. August 26, 2024.

<sup>458</sup> Group interview with two policy makers. October 11, 2024.

<sup>459</sup> Draghi, Mario. *The future of European Competitiveness*. Brussels: European Commission, September 2024. Accessed November 7, 2024. [https://commission.europa.eu/topics/strengthening-european-competitiveness/eu-competitiveness-looking-ahead\\_en#paragraph\\_47059](https://commission.europa.eu/topics/strengthening-european-competitiveness/eu-competitiveness-looking-ahead_en#paragraph_47059).

<sup>460</sup> European Commission. *COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE EUROPEAN COUNCIL, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS - A Competitiveness Compass for the EU*. Brussels: European Commission, 2025. Brussels. [https://commission.europa.eu/document/download/10017eb1-4722-4333-add2-e0ed18105a34\\_en](https://commission.europa.eu/document/download/10017eb1-4722-4333-add2-e0ed18105a34_en).

<sup>461</sup> Draghi, Mario. *The future of European Competitiveness*. Brussels: European Commission, September 2024. Accessed November 7, 2024. [https://commission.europa.eu/topics/strengthening-european-competitiveness/eu-competitiveness-looking-ahead\\_en#paragraph\\_47059](https://commission.europa.eu/topics/strengthening-european-competitiveness/eu-competitiveness-looking-ahead_en#paragraph_47059).

<sup>462</sup> Letta, Enrico. *Much More Than a Market – Speed, Security, Solidarity. Empowering the Single Market to deliver a sustainable future and prosperity for all EU Citizens*. April 2024. Accessed December 9, 2024. <https://www.consilium.europa.eu/media/ny3j24sm/much-more-than-a-market-report-by-enrico-letta.pdf>.

establish the volume (total funding designated) of these policies. More frequently, initiatives and projects were found at both EU and national levels which indirectly supported innovation with the characteristics of frugal innovation, such as those promoting sustainability and circular principles. Moreover, as shown in several frugal innovation examples throughout the report, they can arise in response to crises, often at a local level to respond to social challenges (e.g. e-NABLE, LITUA, and ISIBRIX case studies). As outlined in the recommendations of the Draghi report, policies should promote EU resilience and preparedness to address current and future EU wide challenges.<sup>463</sup> Similarly, the Niinistö report calls for more comprehensive preparedness to ensure that all of the EU can withstand threats, including by centring citizen participation to build social cohesion.<sup>464</sup> The inclusion of frugal innovation within policy could be one means of meeting this need.

The identified initiatives in the policy mapping, often involving public-private partnerships (e.g. Box 13. Smart Open Lisboa (SOL) and Box 14. UK-Ukraine Twinning Initiative), provide opportunities for knowledge sharing and community-driven solutions and create valuable spaces for SMEs and start-ups to develop or market innovations in competitive green and digital sectors. Relatively few examples were found of policies and actions supporting reverse innovation, most of which are focused on development policy and targeted at partnerships between high and low innovator countries. Selected examples show that EU-wide networking and marketing support to SMEs and start-ups in low innovator countries has the potential to bridge the innovation divide by supporting innovation in low innovator or resource-constrained regions and innovation flow throughout the EU and HEAC. The inclusion of frugal concepts within existing policies and initiatives could act as a means to bolster frugal innovation successes while making innovative activities more accessible to lower-resource regions through frugal innovations' cost-effective and grassroots characteristics.

## Opportunities and challenges of frugal and reverse innovation

Findings from the desk research and case studies consider the opportunities and challenges faced by frugal and reverse innovative ventures to answer the research questions<sup>465</sup> related to the enabling factors and barriers faced by frugal and reverse innovations, and the opportunities they present for EU economic and social development.

Key enabling factors demonstrated in the case studies and literature review highlight how successful frugal or frugal-reverse ventures unlocked their potential. The evidence points to the importance of **leveraging strategic partnerships, filling market gaps and the developing need for affordable and sustainable solutions**. Moreover, frugal innovation ventures are often able to take advantage of the simplicity of frugal products to more easily manufacture and mobilise local workforces to support a sustainable venture, an enabling factor which is unique to frugal innovations. **Future developments in technology and promoting open-source innovation** have the potential to promote a circular innovation ecosystem further and drive entrepreneurship and new opportunities for frugal solutions. As

<sup>463</sup> Draghi, Mario. *The future of European Competitiveness*. Brussels: European Commission, September 2024. Accessed November 7, 2024. [https://commission.europa.eu/topics/strengthening-european-competitiveness/eu-competitiveness-looking-ahead\\_en#paragraph\\_47059](https://commission.europa.eu/topics/strengthening-european-competitiveness/eu-competitiveness-looking-ahead_en#paragraph_47059).

<sup>464</sup> Niinistö, Sauli. *Safer Together: Strengthening Europe's Civil and Military Preparedness and Readiness*. Brussels: European Commission, October 30. Accessed February 13, 2025. [https://commission.europa.eu/document/download/5bb2881f-9e29-42f2-8b77-8739b19d047c\\_en?filename=2024\\_Niinisto-report\\_Book\\_VF.pdf](https://commission.europa.eu/document/download/5bb2881f-9e29-42f2-8b77-8739b19d047c_en?filename=2024_Niinisto-report_Book_VF.pdf).

<sup>465</sup> This specific research objective relates to the following research questions: *How did the case studies unlock potential for frugal and reverse innovation? Which obstacles prevented the cases from pursuing frugal/reverse innovation? What specific challenges had the cases to address when pursuing frugal and reverse innovations? Were there any solutions to these challenges (i.e., risk mitigation measures applied)? What new opportunities pursuing frugal and reverse innovation were created? How have frugal and reverse innovation of the cases contributed to EU initiatives, such as European Green Deal and New European Innovation Agenda? Can we identify any specific actions, examples per sector (e.g. energy, food security, circularity, digital, health)? How has frugal and reverse innovation of the cases complemented to social innovation, social enterprises or other social projects in EU and HEAC? Is it possible to observe patterns across the case studies in their internal capacities and external conditions conducive to initiating and implementing frugal and reverse innovation?*

stressed in the Draghi report<sup>466</sup> and the Letta report,<sup>467</sup> and reflected in the 2024 Mission Letters to Commissioners-designate by European Commission President Ursula von der Leyen,<sup>468</sup> a circular economy is integral to meeting climate challenges and the challenges of current manufacturing chains, both of which frugal innovation could be well placed to facilitate. Moreover, as several case study examples highlighted the importance of open-access technologies and innovations, frugal innovations are often characteristically accessible to promote adoption and further innovation and benefit from collaborative approaches and this way can contribute to the inclusiveness and accessibility of the Union, as recommended in the Draghi report.<sup>469</sup>

The majority of challenges illustrated in the study are not unique to frugal and reverse ventures and are **representative of the more general barriers faced by SMEs and start-ups developing or implementing innovative ventures**. However, frugal and reverse innovation ventures do face some specific barriers to their development. These include bias favouring established markets, including in regulation and funding which is designed for conventional or 'high-tech' innovation priorities, investment opportunities and consumer preferences, balancing cost-efficiency ratios, high up-front R&D investments, and cultural perceptions. Despite this, the findings suggest that within the right context, frugal and reverse innovations can leverage a competitive advantage to meet specific needs, such as affordability and accessibility. In addition, if given the opportunity, the often socially driven nature of frugal innovations could contribute well to the recommendations of the Letta report, which emphasises the need for the Single Market to include a *genuine* social dimension which promotes inclusiveness, fair opportunities and reducing inequalities.<sup>470</sup>

Moreover, frugal and reverse innovations are uniquely placed to contribute to the EU sustainability goals, including the EU Green Deal<sup>471</sup> and the Circular Economy Action Plan<sup>472</sup> and addressing rising global challenges, including reducing the reliance on fossil fuels, making health more accessible and potentially, increasing EU security and autonomy by promoting local solutions. In addition, frugal solutions can support a fair green and digital transition (twin transition), which, as highlighted in the Letta report, is crucial to boosting EU global competitiveness and supporting greater social standards within Europe.<sup>473</sup> Frugal and reverse innovative ventures can also contribute well to bridging the innovation divide, Flagship 3 of the NEIA,<sup>474</sup> by fostering inclusive and accessible innovation ecosystems, as

<sup>466</sup> Draghi, Mario. *The future of European Competitiveness*. Brussels: European Commission, September 2024. Accessed November 7, 2024. [https://commission.europa.eu/topics/strengthening-european-competitiveness/eu-competitiveness-looking-ahead\\_en#paragraph\\_47059](https://commission.europa.eu/topics/strengthening-european-competitiveness/eu-competitiveness-looking-ahead_en#paragraph_47059).

<sup>467</sup> Letta, Enrico. *Much More Than a Market – Speed, Security, Solidarity. Empowering the Single Market to deliver a sustainable future and prosperity for all EU Citizens*. April 2024. Accessed December 9, 2024. <https://www.consilium.europa.eu/media/ny3j24sm/much-more-than-a-market-report-by-enrico-letta.pdf>.

<sup>468</sup> European Commission. "Commissioners-designate (2024-2029)." Accessed December 9, 2024.

[https://commission.europa.eu/about/commission-2024-2029/commissioners-designate-2024-2029\\_en](https://commission.europa.eu/about/commission-2024-2029/commissioners-designate-2024-2029_en).

<sup>469</sup> Draghi, Mario. *The future of European Competitiveness*. Brussels: European Commission, September 2024. Accessed November 7, 2024. [https://commission.europa.eu/topics/strengthening-european-competitiveness/eu-competitiveness-looking-ahead\\_en#paragraph\\_47059](https://commission.europa.eu/topics/strengthening-european-competitiveness/eu-competitiveness-looking-ahead_en#paragraph_47059).

<sup>470</sup> Letta, Enrico. *Much More Than a Market – Speed, Security, Solidarity. Empowering the Single Market to deliver a sustainable future and prosperity for all EU Citizens*. April 2024. Accessed December 9, 2024. <https://www.consilium.europa.eu/media/ny3j24sm/much-more-than-a-market-report-by-enrico-letta.pdf>.

<sup>471</sup> European Commission. *The European Green Deal*. Accessed October 17, 2024. [https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal\\_en](https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en).

<sup>472</sup> European Commission. *A New Circular Economy Action Plan for a Cleaner and More Competitive Europe*. Brussels: European Commission, 2020. <https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1583933814386&uri=COM:2020:98:FIN>.

<sup>473</sup> *Ibid.*

<sup>474</sup> European Commission. "Flagship 3: Accelerating and Strengthening Innovation in European Innovation Ecosystems Across the EU and Addressing the Innovation Divide. New European Innovation Agenda Roadmap." Accessed October 17, 2024. [https://research-and-innovation.ec.europa.eu/strategy/support-policy-making/shaping-eu-research-and-innovation-policy/new-european-innovation-agenda/new-european-innovation-agenda-roadmap/flagship-3-accelerating-and-strengthening-innovation-european-innovation-ecosystems-across-eu-and\\_en](https://research-and-innovation.ec.europa.eu/strategy/support-policy-making/shaping-eu-research-and-innovation-policy/new-european-innovation-agenda/new-european-innovation-agenda-roadmap/flagship-3-accelerating-and-strengthening-innovation-european-innovation-ecosystems-across-eu-and_en).

well as the recommendations to close the innovation gap by improving pathways from innovation to commercialisation in the Draghi report<sup>475</sup> and Competitiveness Compass.<sup>476</sup>

Moreover, an established frugal and reverse innovation ecosystem within the EU can strengthen sustainable supply chains and present an **opportunity for the EU to increase its competitiveness against growing competition from emerging external markets**. Frugal and reverse innovation which is fostered within the EU can **drive a bottom-up frugal economy and enhance EU-wide resilience**, improving the capacity to more readily address social challenges and shocks through affordable, accessible and more easily mobilised, manufactured and distributed solutions. Sustainable, resource-constrained and cost-effective solutions characterised by frugal solutions also present an opportunity to reduce the reliance on fossil fuels and secure the advantages of low-cost solutions for European consumers. In this way, they can contribute to the Competitiveness Compass goals of decarbonisation<sup>477</sup> and, as also highlighted in the Draghi report, increase the EU's competitiveness against, for example, Chinese competition in key industries of clean technology, providing cost-effective solutions to mitigate the EU's lack of natural resources and reliance on (potentially cheaper) external markets.<sup>478</sup>

## 6.2. Recommendations

This study presents three main sets of recommendations on the key actionable areas relating to the research objective, proposing future policy developments which will enable European companies to take advantage of frugal and reverse innovation in Europe. The recommendations address the research questions<sup>479</sup> (see Table 1) by providing suggestions for strategic measures and policy actions in the various policy areas (e.g. access to finance, informational, educational) which could be implemented in current or future framework programmes. The recommendations and their justification are presented below, with specific actionable points for EU, national, and regional level policy makers presented in Table 4. The recommendations focus on frugal innovation and those types of reverse innovation that are frugal and developed in the European context. As frugal innovation has a straightforward alignment with European market needs, it is a relevant and actionable concept, whereas reverse innovation often originates outside of Europe and is therefore outside of the reach of European policy in the early and maturing stages of innovation. Some of our recommendations highlight the need for more dissemination of best practices around frugal innovations within Europe, but also greater facilitation of frugal innovations to be recognised early and adopted by European innovators.

The proposed recommendations provide an opportunity for the EU to take a proactive lead in promoting and supporting a more inclusive frugal innovation ecosystem within future framework programmes. The recommendations reflect the study conclusions that highlight the compatibility of frugal innovation with priorities outlined in the Draghi<sup>480</sup> and Letta

<sup>475</sup> Draghi, Mario. *The future of European Competitiveness*. Brussels: European Commission, September 2024. Accessed November 7, 2024. [https://commission.europa.eu/topics/strengthening-european-competitiveness/eu-competitiveness-looking-ahead\\_en#paragraph\\_47059](https://commission.europa.eu/topics/strengthening-european-competitiveness/eu-competitiveness-looking-ahead_en#paragraph_47059).

<sup>476</sup> European Commission. *COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE EUROPEAN COUNCIL, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS - A Competitiveness Compass for the EU*. Brussels: European Commission, 2025. Brussels. [https://commission.europa.eu/document/download/10017eb1-4722-4333-add2-e0ed18105a34\\_en](https://commission.europa.eu/document/download/10017eb1-4722-4333-add2-e0ed18105a34_en).

<sup>477</sup> *Ibid.*

<sup>478</sup> Draghi, Mario. *The future of European Competitiveness*. Brussels: European Commission, September 2024. Accessed November 7, 2024. [https://commission.europa.eu/topics/strengthening-european-competitiveness/eu-competitiveness-looking-ahead\\_en#paragraph\\_47059](https://commission.europa.eu/topics/strengthening-european-competitiveness/eu-competitiveness-looking-ahead_en#paragraph_47059).

<sup>479</sup> This objective relates to the research questions: *How can the Commission include the frugal/reverse innovation in the policy design of the current framework Work Programmes? How can the Commission develop relevant policy angles in relation to frugal and reverse innovation and the upcoming new European Commission (and Framework Programme 10)? What are the key opportunities and challenges of frugal/reverse innovation in the European Union and Horizon Europe HEAC? How European Commission could promote frugal and reverse innovation projects across different policy fields? What strategies and supporting measures the European Commission could undertake?*

<sup>480</sup> Draghi, Mario. *The future of European Competitiveness*. Brussels: European Commission, September 2024. Accessed November 7, 2024. [https://commission.europa.eu/topics/strengthening-european-competitiveness/eu-competitiveness-looking-ahead\\_en#paragraph\\_47059](https://commission.europa.eu/topics/strengthening-european-competitiveness/eu-competitiveness-looking-ahead_en#paragraph_47059).

reports,<sup>481</sup> the Budapest Declaration,<sup>482</sup> and 2024 Mission Letters to Commissioners-designate by European Commission President Ursula von der Leyen.<sup>483</sup> A strong frugal innovation ecosystem has the potential to contribute to EU sustainability and circular economy goals, reduce the cost of living, build more secure and localised supply chains in the face of geopolitical challenges, strengthen inclusion and accessibility of health and technology, and increase the competitiveness of the Single Market. These recommendations can be considered within the broader context of the Union's priorities on future and current challenges and provide actionable steps towards these goals.

First, **awareness raising** at EU, national and regional level is a primary step in developing a supportive ecosystem for frugal and reverse innovation and should be targeted at policy makers. A lack of specific policy support for frugal and reverse innovation and poor understanding or knowledge of these concepts by policy makers indicates that improving awareness and knowledge should be prioritised. Moreover, as is highlighted in the Draghi report, a lack of collaboration on innovation hinders EU innovation and economic competitiveness and could be strengthened through better coordination of public R&I across Member States.<sup>484</sup> This also aligns with the Mission Letter statement that increased investment and cooperation are needed to bring a focus to innovations needed to meet wider competitive, security and importantly, sustainability goals.<sup>485</sup> Building awareness can facilitate a more cohesive environment, supporting the integration of frugal solutions across the EU, encouraging partnerships and facilitating stakeholder connections. Specific actions should be considered to raise awareness and are presented in Table 4.

Second, it is recommended to **ensure frugal and reverse innovations are recognised and incentivised within policy frameworks**. Future policy instruments, funding, and investments should be inclusive of frugal and reverse innovations to create a more level playing field. Frugal innovations risk being excluded from the market or funding opportunities because they fail to meet requirements set for conventional innovations (e.g. high-tech or high-profit) or face bureaucratic challenges due to unclear or non-specific regulations in their sector. These innovations face similar challenges to non-frugal start-ups and SMEs which suggests that instead of developing specific instruments to target frugal or reverse ventures, they could benefit from likewise innovation policy instruments if given equal conditions to participate or even additional incentives. Specific measures which could be taken to achieve this are presented in Table 4. This recommendation is also well aligned with the Budapest Declaration's competitive drivers, for example, to reduce the burden on SMEs by simplifying regulatory frameworks,<sup>486</sup> and thus, as emphasised in the Letta report, enable greater participation of SMEs in the Single Market.<sup>487</sup> Moreover, as highlighted in the 2024 Mission Letters to Commissioners-designate by European Commission President Ursula von der Leyen, effective competition should be aligned with shared goals of, for example, decarbonisation and a just transition, including ensuring a level playing field for both large and small firms, protection from rising consumer prices and addressing the threats to supply chains.<sup>488</sup> The inclusion of frugal and reverse innovation within policy

<sup>481</sup> Letta, Enrico. *Much More Than a Market – Speed, Security, Solidarity. Empowering the Single Market to deliver a sustainable future and prosperity for all EU Citizens*. April 2024. Accessed December 9, 2024.

<https://www.consilium.europa.eu/media/ny3j24sm/much-more-than-a-market-report-by-enrico-letta.pdf>.

<sup>482</sup> European Council. "Budapest Declaration on the New European Competitiveness Deal." 2024. Accessed November 15, 2024. <https://www.consilium.europa.eu/en/press/press-releases/2024/11/08/the-budapest-declaration/>.

<sup>483</sup> European Commission. "Commissioners-designate (2024-2029)." Accessed December 9, 2024.

[https://commission.europa.eu/about/commission-2024-2029/commissioners-designate-2024-2029\\_en](https://commission.europa.eu/about/commission-2024-2029/commissioners-designate-2024-2029_en).

<sup>484</sup> Draghi, Mario. *The future of European Competitiveness*. Brussels: European Commission, September 2024. Accessed November 7, 2024. [https://commission.europa.eu/topics/strengthening-european-competitiveness/eu-competitiveness-looking-ahead\\_en#paragraph\\_47059](https://commission.europa.eu/topics/strengthening-european-competitiveness/eu-competitiveness-looking-ahead_en#paragraph_47059).

<sup>485</sup> Ursula von der Leyen. *Mission Letter*. European Commission. September 2024.

[https://commission.europa.eu/document/download/130e9159-8616-4c29-9f61-04592557cf4c\\_en?filename=Mission%20letter%20-%20ZAHARIEVA.pdf](https://commission.europa.eu/document/download/130e9159-8616-4c29-9f61-04592557cf4c_en?filename=Mission%20letter%20-%20ZAHARIEVA.pdf).

<sup>486</sup> European Council. "Budapest Declaration on the New European Competitiveness Deal." 2024. Accessed November 15, 2024. <https://www.consilium.europa.eu/en/press/press-releases/2024/11/08/the-budapest-declaration/>.

<sup>487</sup> Letta, Enrico. *Much More Than a Market – Speed, Security, Solidarity. Empowering the Single Market to deliver a sustainable future and prosperity for all EU Citizens*. April 2024. Accessed December 9, 2024.

<https://www.consilium.europa.eu/media/ny3j24sm/much-more-than-a-market-report-by-enrico-letta.pdf>.

<sup>488</sup> European Commission. "Commissioners-designate (2024-2029)." Accessed December 9, 2024.

[https://commission.europa.eu/about/commission-2024-2029/commissioners-designate-2024-2029\\_en](https://commission.europa.eu/about/commission-2024-2029/commissioners-designate-2024-2029_en).

frameworks can facilitate these goals, addressing common challenges while also contributing to wider objectives, as highlighted in the Mission Letters, of competitiveness and sustainability, social fairness and security.<sup>489</sup>

Finally, the above **recommendations would benefit from additional insights from other innovation ecosystems**. While this study focuses on the EU and HEAC context, insights from other innovation ecosystems could give guidance on strategy, implementation and opportunities. Countries such as India and China, or from continents such as Latin America and Africa, have a long history of low-resource low-cost innovation and potentially much to offer in terms of culture and context of making such innovations happen. Furthermore, many frugal innovations local to these countries may be identified as suitable for application in Europe but require an international adopter to introduce them to Europe. The recommendation to explore best practices in frugal innovation, combined with our recommendation for institutional know-how about frugal innovation at the EU level, may turn these solutions into reverse innovations for Europe.

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<sup>489</sup> Ursula von der Leyen. *Mission Letter*. European Commission. September 2024. [https://commission.europa.eu/document/download/5b1aee5-681f-470b-9fd5-ae14e106196\\_en?filename=Mission%20letter%20-%20RIBERA.pdf](https://commission.europa.eu/document/download/5b1aee5-681f-470b-9fd5-ae14e106196_en?filename=Mission%20letter%20-%20RIBERA.pdf).

**Table 4 – Recommendations for policy makers and investors**

	Context/challenge	Recommendation	Intended recipient
<b>Awareness raising targeted at EU, national, and regional level policy makers</b>			
1	There is a lack of specific policy support for frugal and reverse innovation and poor understanding or knowledge of these concepts by policy makers and other stakeholders.	<p><b>Consider establishing a dedicated group, centre or office for frugal innovation</b> at the European Commission. This group/centre/office would be responsible for overseeing initiatives related to frugal innovation at the European Commission. It could collect and highlight best practices and other intelligence about frugal and reverse innovation, spread information across the European Commission and Member States, offer resources, showcase available policy and financial instruments, and curate a knowledge base of best practices around frugal and reverse innovation in Europe. It could also steer and support cooperation between research organisations currently working with frugal and reverse innovation (e.g., International Centre for Frugal Innovation (in the Netherlands), Center for Frugal Innovation at the Technical University Hamburg, Delft University of Technology, University of Naples Parthenope, Bern University of Applied Sciences, Fraunhofer ISI, Judge Business School) as well as inclined industrial firms, community innovation projects, and individual social innovation startups. Establishing such a network or cluster would connect stakeholders and almost automatically raise the profile of frugal innovations.</p> <p>The implementation of this recommendation would significantly enhance the likelihood of succeeding with the other recommendations, as there is a need for an organisation to coordinate these efforts. An additional study to explore best practices outside Europe (in alignment with recommendation 9) could generate additional ideas on how this group/centre/office could be arranged.</p>	RTD, EISMEA
2		<p><b>Consider launching targeted awareness raising campaigns</b> about frugal and reverse innovation, promoting social innovation at community (and municipal) levels and a broader understanding of frugal concepts and their relevance to policy and innovation. These could highlight key benefits such as cost-effective innovation solutions, and the competitive and cohesive advantages presented by frugal and reverse innovation. Sector specific campaigns could build credibility for frugal and reverse innovations within areas which are most likely to benefit, such as health, green tech, and construction sectors, and promote a roadmap to support frugal or reverse innovation within these areas. Educational campaigns targeted at the key EU institutions would also be relevant and help policy makers in the Commission to get familiar with the term and its benefits.</p>	Group/centre/office for frugal innovation (if created)
3		<p><b>Explore the possibility to offer prizes or awards</b> for outstanding frugal or reverse innovations to increase the visibility and credibility of ventures and showcase their value to increase investor and consumer confidence. These could be incorporated as a category within existing relevant contests.</p>	Group/centre/office for frugal innovation (if created)
4		<p><b>Explore the possibility of developing a model and guidelines for integrating frugal innovation into educational programmes (e.g. for engineering and business trainings).</b> This would ensure the awareness of frugal innovation and its principles among a new generation of innovators, ventures, and investors, increasing</p>	Group/centre/office for frugal innovation (if created)

	Context/challenge	Recommendation	Intended recipient
		the adherence to frugal principles among them. DG RTD and/or EISMEA could initiate a call/project to develop the measures suggested above under the Erasmus+ or other EU support programmes. An additional study to explore best practices outside Europe (recommendation 9) could generate some ideas on how this could be arranged.	
<b>Ensure frugal and reverse innovations are recognised and incentivised within policy frameworks</b>			
5	Frugal and reverse innovations are not policy priorities at the EU or national level, with a limited number of targeted policies which directly support or promote them.	<b>Put efforts in ensuring that policies and regulations are technology/material neutral.</b> This would support diverse innovation types and allow frugal innovators to participate without being disadvantaged by biased regulations which favour established markets or high-tech solutions.	RTD, EISMEA, group/centre/office for frugal innovation (if created)
6	Regulation and funding opportunities tend to favour conventional or 'high-tech' innovations.	<b>Consider incorporating a 'frugal principle' into existing policy frameworks</b> (especially social and sustainability policy frameworks). Similar to the 'innovation principle', the adoption of frugal criteria could be promoted when there is potential to achieve objectives through cost-effective, resource-efficient methods. A 'frugal principle' could support this and be reflected within EU funding instruments, promoting the value of frugal innovations. Moreover, mainstreaming frugality within existing policies and policy instruments could avoid over-engineering and increased spending in response to social challenges and increase awareness of frugal principles. In addition, inspiration could also be drawn from the open innovation concept, which was successfully mainstreamed in academic, policy and private sectors. A similar approach to frugal innovation would raise the profile of frugal innovation and support its adoption at the early stages of innovation, embedding it within the mainstream innovation narrative. An additional study to explore best practices outside Europe (recommendation 9) could generate additional ideas on how this could be done.	RTD, EISMEA, group/centre/office for frugal innovation (if created)
7		<b>Consider incentivising frugal innovation by rewarding frugality criteria</b> (simple, economic, cheap, sustainable) with additional points in the current innovation support funding instruments targeting social issues or responses to crises. Sustainability criteria should be a necessary condition to make sure that only ideas with positive externalities for ecology/social sustainability are rewarded. Incentives for targeting social issues and responses to crises are suggested as the study showed that addressing social challenges could be an appropriate niche within the EU for frugal innovation. Inspiration could be taken from Innowide <sup>490</sup> instrument and further developed.	RTD, EISMEA, group/centre/office for frugal innovation (if created)
8		<b>Public procurement could prioritise social and environmentally-orientated solutions.</b> This could be done by encouraging public procurers to add frugality criteria (simple, economic, cheap, sustainable) in their procurements and give higher scores for covering them. Sustainability criteria should be a necessary condition to make sure that only ideas with positive externalities for ecology/social sustainability are rewarded. By	RTD, EISMEA, group/centre/office for frugal innovation (if created)

<sup>490</sup> Eureka. "Innowide." Accessed November 7, 2024. <https://eurekanetwork.org/programmes/innowide/>.

## Study on Mapping and Scoping of Frugal and Reverse Innovation

	Context/challenge	Recommendation	Intended recipient
		<p>encouraging public sector adoption, piloting and partnerships, cost-effective innovations are given market access and R&amp;D and scaling opportunities, while introducing a low-cost product or service in the public sector. This could also be particularly relevant for Ukraine and allow the country to benefit from public sector investments that address post-crisis social challenges. An additional study to explore best practices outside Europe (recommendation 9) could generate some ideas on how it could be arranged.</p>	
<b>Explore international best practices</b>			
9	<p>This study focused on the EU and HEAC context. Additional insights from other innovation ecosystems could give guidance on strategy, implementation and opportunities for frugal innovation.</p>	<p><b>Extract best practices</b> of coordinating and supporting frugal innovation as well as relevant and enabling factors in countries successful in frugal and reverse innovation, such as India, China, Japan, Brazil, and Mexico, which could be transposed to the EU. This could provide insights into alternative policy approaches to support frugal and reverse innovation ecosystems and support the EU’s innovation and strategic autonomy goals. Implementing this recommendation could provide ideas on implementing other recommendations (especially recommendations 1, 4, 6, 8).</p>	RTD, EISMEA

Source: Visionary Analytics, 2024.

## Annex 1. Detailed study methodology

This annex presents the detailed methodology of all methods used during the implementation of the study.

### Desk research and literature review

Desk research and literature review have been undertaken as part of Task 1 (Sub-task 1.2), as described in the proposal. The objective of scoping was to better define the boundaries of the study and inform the **refinement of the research questions, provide information for concept definition, and define the parameters for the data collection by establishing clear inclusion and exclusion criteria** for innovation and policy mapping. In addition, the literature review provided **insights on entity and sectoral characteristics, the landscape of policy support at EU and national level, the broader understanding of the terms at a policy level, as well as opportunities, challenges, and impacts of frugal and reverse innovation**. The following activities were undertaken as part of this task:

1. Exploratory desk research to conduct a preliminary review of the data to identify key concepts and better acquire an understanding of the available data and identify any gaps.
2. Initial inclusion and exclusion criteria for the subsequent (sub) tasks (mapping, case studies) have been further determined based on the reviewed literature, considering the relevance, data, geographical coverage, and thematic focus.
3. Based on the initially collected data, the research questions were reviewed, and amendments were made to ensure appropriate coverage of the topic, and to meet the established research objectives.
4. Based on the list of sources (see Annex 5) the relevant literature was analysed and its findings were integrated into Chapters 3, 4 and 5.

The project team performed exploratory desk research (in English) on the concept of frugal and reverse innovation, as well as the general thematic area. Using relevant keywords (see Box 20), digital databases were explored (e.g. Publications Office of the European Union<sup>40</sup> and Google Scholar<sup>41</sup>) and relevant sources were selected if they fit into the pre-defined inclusion and exclusion criteria of language and quality. The collection of data was thematically sorted to ensure coverage of the study topic and the identification of gaps in the available data. The scoping contributed to the fine-tuning of the study methodology and refinement of research questions.

#### Box 20. Keywords used in desk research

Keywords for Frugal Innovation: 'Frugal innovation', 'Affordable innovation', 'Resource-constrained innovation', 'Cost-effective solutions', 'Bottom of the pyramid innovation', 'Grassroots innovation', 'Jugaad innovation', 'Simple technology', 'Low-cost solutions', 'Constraint-based innovation', 'Inclusive innovation', 'Minimalist design', 'Basic needs innovation', 'Rural innovation', 'Lean innovation', 'Value for money products', 'Accessible technology', 'Localised innovation', 'Context-specific innovation', 'Scalable solutions', 'User-centred design'.

Keywords for Reverse Innovation: 'Global-to-local innovation', 'Emerging markets innovation', 'Market-back innovation', 'Local adaptation', 'Global innovation', 'Multinational adaptation', 'Home market adaptation', 'Local innovation transfer', 'Diaspora innovation', 'Emerging market solutions',

'Reverse flow of innovation', 'In-sourcing of innovation', 'Cross-border innovation', 'Localisation of products', 'Emerging market opportunities', 'Market-specific innovation', 'Local market customisation', 'Multi-market innovation', 'Indigenous innovation', 'Global-local synergy'.

Source: Visionary Analytics, 2024.

Following the identification of the sources, a literature review has been carried out based on approaches recommended by Arksey and Malley (2005)<sup>47</sup> and Petticrew and Roberts (2008),<sup>48</sup> to ensure that no crucial information was omitted. The literature review involved the following key steps:

1. **Charting the data** – descriptively charting selected studies in a MS Excel form. The charting provides a comprehensive, but concise and clear, overview of all key elements from each study including key information by relevant research question.
2. **Collating, summarising, and reporting the results** – the analysis of the charted literature has been initiated by the project team, with results to be reported as they relate to the research questions. These results were further used while analysing research questions.

## Mapping of frugal and reverse innovations

The methodology for mapping innovations is detailed at the beginning of Chapter 3, while the methodology for mapping policies is outlined at the start of Chapter 4. Including these methodologies at the beginning of their respective chapters, rather than in the annex, ensures a smoother flow of the text and provides readers with a clear understanding of the mapping process before they delve into the results.

## Case studies

The case study method focuses on an intensive study of selected frugal and reverse innovation in the EU and HEAC. Our approach to their implementation is detailed below and will be conducted in four main parts, illustrated in Figure 4.

To ensure consistency across the case studies, detailed templates and guidelines were provided to the study team. An internal team meeting was held to outline the process and establish a shared understanding of the case study aims and objectives. A comprehensive case study briefing note was shared with the study team, including the key aims and objectives of the cases, a library of relevant information, and a breakdown of tasks. Additionally, shared files such as an interview tracker and data mapping documents were created to facilitate a transparent and uniform approach across the cases.

Figure 4: Case study implementation steps



Source: Visionary Analytics, 2024.

## Step 1: Case study selection

During the mapping of innovations, examples were gathered according to four criteria for frugal innovation: **Sustainable, Economical, Cheap, and Simple**. Based on this, 45 innovations within the database were ranked as being moderately or strongly frugal, having at least three frugality criteria, and made up the long list of potential case studies. Following this, a total of 135 invitations to interview were sent to stakeholders from organisations from the long list and 19 pre-case interviews were conducted (see Annex 7 for a list of interviewed stakeholders).

The outreach and scoping interviews aimed to clarify the relevance of selected examples by gaining additional details on the innovation (such as organisational and temporal elements on innovation development and implementation) and establishing organisations' willingness to participate in case studies. Building on the pre-case interviews and the case study selection criteria, a short list of 10 case studies and 8 back-up cases were selected to represent suitable sectoral and geographic coverage (see Figure 5). In addition, the pre-case interviews identified interesting examples of frugal innovations, which while not suitable for full case studies, will be included as mini-cases in the final report.

**Figure 5: Representation criteria for selected 10 case studies**

Only frugal 7	Product / service 9	Firm-led 4 (1 large, 3 SMEs)	'Old' EU 6	High innovator country 6	Socially-oriented 9	Green 4
	Business model 1	NGO-/social enterprise-led 5 (1 large, 4 SMEs)	'New' EU 2			Digital 2
Frugal and reverse 3				Process 1*	Community-led 1**	HEAC 2
	Health 4					
						Security 2

Note: \*Some product/service innovation can also be considered a process innovation. \*\* Community-led innovations are often small-scale and will be covered in mini cases.

Source: Visionary Analytics, 2024.

Table 5 presents the list of selected cases and their corresponding criteria. Importantly, all of the cases selected are examples of frugal innovation and three are both frugal and reverse innovation.

**Table 5 – Criteria of selected case studies**

#	Country	Organisation	Innovation	Frugal/Reverse	Innovation type	Entity and intent	Sector	Social innovation
1	Finland	Termex	Insulation	Frugal	Product/service	Firm-led profit-driven	Green	No
2	Lithuania	LITUA-Kartu	Quick assemble furniture	Frugal/Reverse	Product/service and Business model	NGO- & social enterprise-led societal challenges-driven	Security, furniture	Yes

#	Country	Organisation	Innovation	Frugal/Reverse	Innovation type	Entity and intent	Sector	Social innovation
3	Spain/Portugal	Life Nieblas	Fog net	Frugal	Product/service	NGO- & social enterprise-led societal challenges-driven	Green	Yes
4	France	Handicap International	TeReFa	Frugal/Reverse	Product/service	Director of innovation, impact and information	Health	Yes
5	Italy	BRIX	Modular Home Construction	Frugal	Product/service	Firm-led profit-driven	Green, construction, housing	Yes
6	Netherlands	Philips	ChARM	Frugal/Reverse	Product/service	Firm-led profit-driven	Health, digital	Yes
7	Germany	Good Vision	Glasses	Frugal	Product/service	Firm-led profit-driven	Health	Yes
8	Türkiye	Robotel	Prosthetics	Frugal	Product/service	NGO- & social enterprise-led societal challenges-driven	Health, security (crisis response)	Yes
9	Estonia	Kuidas.Works	Construction materials	Frugal	Process	NGO- & social enterprise-led societal challenges-driven	Green, construction, furniture	Yes
10	United Kingdom	RepRap	3D printer	Frugal	Product/service	Community-led local constraints-driven	Digital	Yes

Source: Visionary Analytics, 2024.

## Step 2: Desk research

The desk research under this task aimed to gather information to support the development of the case studies by ensuring the identification of relevant stakeholders for interviews and detailed and specific coverage of the cases selected. In particular, this step contributed to:

- Stakeholder mapping to ensure appropriate types of actors are identified and can be selected for interviews.
- Collection and analysis of information relating to each organisation selected for study. Desk research allowed to collect the already available information on each organisation. Additional information, such as that not publicly available (e.g. internal company reports), will be collected during the interview phase of the task.

## Step 3: Interviews

To fill in the data gaps remaining after the desk research and collect additional data, interviews per each selected case study were implemented. The interviews, combined with

desk research, provided critical insights which go beyond the available documentation. Case study interviews explored the internal and external factors influencing the pursuit of frugal and reverse innovation in each selected organisation, providing in-depth knowledge at ground level.

We carried out semi-structured interviews, allowing the questionnaire to guide interviewers, but provide interviewees with the opportunity to provide additional insights. The interview questionnaires followed the same structure but were tailored per the type of respondent and the type of organisation. In total, 69 interviews were implemented during case studies. The list of implemented interviews are provided in Annex 7. The interview structure and suggested questions are provided in Annex 8.

Tender specifications initially set a target of 20 interviews per case study. However, as agreed during the second project progress meeting, it was recognised that some case studies have fewer relevant stakeholders to interview before reaching saturation of information. Qualitative research does not mandate a fixed number of interviews, as the robustness of findings hinges on collecting all relevant information rather than meeting a numerical threshold.<sup>491</sup> For organisational case studies, the focus is on the depth, context, and relevance of information gathered, often achievable through fewer interviews. Hence, on average we implemented 7 interviews per case study, ranging from 3 to 11 interviews per case. The number of interviews implemented per case study is provided in Table 6. To compensate for the lower number of interviews we implemented additional case study interviews (see the section on interviews outside case studies below). In addition, a focus group (see section on focus group below) with experts in the field of frugal and reverse innovation that was not foreseen in Tender Specifications, was implemented in the project.

**Table 6 – Number of interviews per case study**

Case study	Employee	Policy maker	Researcher	Investors/public procurers	End-users	Other	Total
Case study 1 - Termex	3	-	-	-	-	-	<b>3</b>
Case study 2 - LITUA	4	1	1	1	1	-	<b>8</b>
Case study 3 - Life Nieblas	5	-	1	2	1	-	<b>9</b>
Case study 4 - Handicap International	5	-	1	-	-	-	<b>6</b>
Case study 5 - BRIX	3	-	-	-	2	-	<b>5</b>
Case study 6 - Philips	9	-	-	-	-	-	<b>9</b>
Case study 7 – Good Vision	7	-	-	-	-	-	<b>7</b>
Case study 8 – e-NABLE	8	-	-	-	-	3	<b>11</b>
Case study 9 - Kuidas.Works	4	-	-	-	-	-	<b>4</b>
Case study 10 - RepRap	2	-	1	-	2	2	<b>7</b>

<sup>491</sup> Guest, Greg, Arwen Bunce, and Laura Johnson. "How many interviews are enough? An experiment with data saturation and variability." *Field methods* 18, no. 1 (2006): 59-82; Marshall, Bryan, Peter Cardon, Amit Poddar, and Renee Fontenot. "Does sample size matter in qualitative research?: A review of qualitative interviews in IS research." *Journal of computer information systems* 54, no. 1 (2013): 11-22; Charmaz, Kathy. *Constructing grounded theory: A practical guide through qualitative analysis*. sage, 2006; Creswell, John W., and Cheryl N. Poth. *Qualitative inquiry and research design: Choosing among five approaches*. Sage publications, 2016.

Case study	Employee	Policy maker	Researcher	Investors/public procurers	End-users	Other	Total
<b>Total</b>	<b>50</b>	<b>1</b>	<b>4</b>	<b>3</b>	<b>6</b>	<b>5</b>	<b>69</b>

Source: Visionary Analytics, 2024.

#### Step 4: Development of 10 case studies

In this step information collected during desk research and interviews was analysed. A separate report for each case study was drafted. These reports are available in Annex 6. Findings from these case studies are integrated across the report.

### Cross-case analysis

Following the development of individual case studies, a cross-case analysis was implemented to systematically analyse the results. A cross-case analysis matrix was developed and included all the relevant case criteria (such as innovation type, entity, company size etc.) and the different thematic elements based on the research questions (Table 7 illustrates the core categories included in the matrix with some examples). This ensured that all of the relevant information from each chapter of the case studies was analysed. The following steps were taken using the matrix:

1. **Categorisation** – data from individual case studies was input into the matrix according to the relevant theme of the case study chapters (e.g. policy context, success factors, obstacles, future relevance) and sub-theme (e.g. motivation, role of technology, business viability). The data in each (sub) theme was then further categorised into refined codes.
2. **Pattern recognition** – using the matrix, the coded data was further analysed for any recurring themes or characteristics, as well as to identify any potential outlying characteristics. The matrix could be filtered by case type (e.g. innovation type, company size) to establish commonalities or differences by type, as well as trends across topics.
3. **Comparative analysis** – data from the matrix and any identified patterns were critically compared and analysed.
4. **Synthesis** – the synthesis of data collected in the matrix allowed for conclusions to be drawn on the overarching findings of the collected cases.

**Table 7 – Cross-case analysis matrix**

Case	Case selection criteria	Case description			Policy and investment context				Success conditions				Obstacles					Future relevance		
Case #	e.g. innovation and organisation type	Motivation	Timeline	Business model	Policy support	Funding and investment	Contribution to EU agenda	Contribution to social agenda	Market conditions	Technology	Skill	Other	Policy/regulations	Business and market conditions	Technology and skills	Socio-economic	Other	Future relevance	Business model viability	Policy
Case 1	Frugal, SME	Crisis response	1 yr	a-typical	None	Private investment, public donations	N/A	N/A	Market gap	Basic tech, University R&D support	Low-skill production	Networks	High-tech bias	a-typical model, lack of resources	N/A	N/A	N/A	Other applications, scalable	Reverse potential	N/A
Case 2	Frugal-reverse, large company	Affordable health-tech	Unknown	Public/private partnership, bottom of pyramid	None	Company, foundation, NGO funding, prizes	Accessible healthcare	Spin-offs	Bottom of pyramid, low profit-margin	Access to available tech for R&D	Socially driven employees	Corporate incubation	Certification barriers, bureaucracy	Entering established markets, low priority	Heavy R&D resources	Market acceptance	Distribution channels	Applications elsewhere, reversible	Low-profit margins, risk of deprioritising	Medical device regulations
Case 3	Frugal, start-up	Intellectual	3 yrs	Open-source non-commercial	None	Grant, university funding	Democratising tech (NEIA)	Open-innovation enabling open innovation	Market gap, limited competition	Access to 3D printers	Specialised volunteers	Uptake by businesses	Brexit, IP	Chinese mass manufacturing, loss of revenue	Medium/high skill entry	N/A	N/A	Research, open innovation	Uptake by private/public orgs, hobbyists	Open-source hardware/software
Case N																				

Source: Visionary Analytics, 2024.

## Interviews outside case studies

In addition to interviews under case studies, we implemented interviews with the following groups:

- Organisations implementing frugal and reverse innovations to prepare mini exemplary cases of innovations not covered under case studies
- Organisations implementing frugal and reverse innovation to prepare mini cases of failed innovations providing more insights into opportunities and challenges of frugal and reverse innovation implementation
- Policy makers to have mini cases of policies supporting frugal or reverse innovation and to get additional insights about policies (or lack of) supporting frugal or reverse innovation
- Academics, experts, innovation labs, and investors to get insights on the landscape of frugal and reverse innovation and suggestions on streamlining them

In total, we have implemented 38 interviews outside of case studies. The breakdown of these interviews per stakeholder group is presented in Table 8. The list of implemented interviews is provided in Annex 7.

**Table 8 – Interviews outside case studies**

Stakeholder group	Number of interviews implemented
Organisations implementing frugal and reverse innovations	15
Policy makers	16
Academics, experts, innovation labs, investors	7

Source: Visionary Analytics, 2024.

## Focus group

A Focus group with experts in the field of frugal and reverse innovation was organised on February 13th, 2024. The aim of this focus group was to establish a broad understanding of the key concepts and validate preliminary concept definitions within the field of frugal and reverse innovation. In addition, the focus group aimed to discuss potential means of mapping frugal and reverse innovation and estimating the volume of such innovation within the EU and HEAC. Five experts and three European Commission representatives participated in the focus group (excluding the project team experts who also participated in discussions). The full list of participants is provided Table 9. The agenda of the focus group is presented in Table 10.

**Table 9 – Focus group participants**

Participant	Institution
Cees van Beers	Delft University of Technology
Rishiksha T Krishnan	India Institute of Management Bangalore
Venkata Gandikota	Centre for India and Global Business/InnoFrugal
Lorenza Claudio	University of Naples Parthenope
Bastian Widenmayer	Bern University of Applied Sciences
Eva Rückert	EISMEA
Tiit Jurimae	DG RTD
Magdalena Cymerys	DG RTD
Max von Zedtwitz	Copenhagen Business School (Project team member)
Jaideep Prabhu	University of Cambridge Judge Business School (Project team member)
Fatima Irfan	Open University of the Netherlands (Project team member)
Jonas Antanavičius	Visionary Analytics (Project team member)
Marius Kalanta	Visionary Analytics (Project team member)
Rebecca Davies	Visionary Analytics (Project team member)
Clara Doyle	Visionary Analytics (Project team member)
Moritz Dyczek	Visionary Analytics (Project team member)

Source: Visionary Analytics, 2024.

**Table 10 – Focus group agenda**

Time	Session
09:00 – 09:10	<b>Welcome and introduction:</b> a brief presentation of the study and focus group aims, agenda, and procedural information.
09:10 – 09:20	<b>Presentation of definitions and their context:</b> a brief presentation of our understanding of the current landscape of concepts of frugal and reverse innovation and proposed definition of concepts.
09:20 – 10:05	<p><b>Discussion covering first group of questions:</b></p> <ul style="list-style-type: none"> <li>• Do you think the suggested definitions suit the context of the study and are in line with the definitions provided in academic literature?</li> <li>• Do you agree to narrowing scope of reverse innovation to cover only reverse frugal innovation?</li> <li>• Do you think it is worth considering innovation flows between Central Eastern Europe and Western Europe as reverse?</li> <li>• Do you think considering the following two types of innovation adds value to the study: <ul style="list-style-type: none"> <li>○ Frugal or resource/cost-constrained innovations developed in Europe by subsidiaries from developing country firms.</li> </ul> </li> </ul> <p>Innovations developed by European subsidiaries in developing countries and eventually marketed also in Europe.</p>
10:05 – 10:15	<b>Wrap up of the first discussion:</b> Moderators will present key takeaways. All participants will have a chance to react to this.

Time	Session
10:15 – 10:45	<p><b>Discussion covering second group of questions:</b></p> <ul style="list-style-type: none"> <li>Any practical suggestions on how to map frugal and reverse innovation in Europe?</li> </ul> <p>Any practical suggestions on how to estimate volume of frugal and reverse innovation in Europe?</p>
10:45 – 11:00	<p><b>Wrap up of the second breakout room discussion and next steps:</b> Moderators will present key takeaways. All participants will have a chance to react to this. The study team will then present the next steps of the study.</p>

Source: Visionary Analytics, 2024.

For the first part of the focus group, two breakout room sessions were created to foster discussion in smaller groups on the first four questions (see the table above) related to the proposed definitions of frugal and reverse innovation. The breakout groups were then brought together to discuss their findings. This was followed by a larger group brainstorming and discussion on the last two questions (see the table above) related to mapping frugal and reverse innovations. This section summarises the main key takeaways of those discussions.

## Summary of discussion on the proposed definitions

Participants were divided into two breakout rooms and considered the following questions:

- Do you think the suggested definitions suit the context of the study and are in line with the definitions provided in academic literature?
- Do you agree to narrowing scope of reverse innovation to cover only reverse frugal innovation?
- Do you think it is worth considering innovation flows between Central Eastern Europe and Western Europe as reverse?
- Do you think considering the following two types of innovation adds value to the study:
  - Frugal or resource/cost-constrained innovations developed in Europe by subsidiaries from developing country firms.
  - Innovations developed by European subsidiaries in developing countries and eventually marketed also in Europe.

### General feedback

- The definition of reverse innovation is **overly complicated and can be simplified**.
- It is appropriate to **consider only reverse frugal innovations**. It would also be of interest to know the volume of reverse vs frugal and reverse innovations.

### Geography vs market segment

- Resource-constraints are not linked to the wealth of a country.
- In defining reverse innovation, the geographic dimension is not as relevant as the market-based dimension. Instead of considering countries it would be better to **consider the market segments**.

- The definition of reverse innovation might be **sensitive** in the way it describes less or more developed or innovative countries. Using predefined economic indicators to classify countries, basing definitions on market segments, or focusing on regions would mitigate this. **Defining reverse innovation by flow from lower to upper market segments** is more appropriate and relevant to the nature of reverse innovation.
  - It should be noted that if the value proposition changes, the value and how the value is created differs when it moves from one segment to another.
- **Defining by market segment might not support the best interest of the EU study.** In this sense, some large organisations also operate by taking from low segments to high segments (e.g. manufacturing in China and distributing products in the EU). We should consider whether this definition would lend support to these profit-driven imports and whether this is in the interest of the EU.

### Inclusivity

- Consider a more inclusive definition of frugal and reverse innovation which includes innovations by firms, non-profits, civilians etc. As well as frugal innovators not just innovations, and consumers not just companies.
- Consider how frugal innovation can be integrated into the EU's broader (innovation) agenda. For example, given its relevancy in the Commission and ongoing research projects, consider exploring the connection between open science and frugal innovation.
- Regarding the scope of reverse innovation, it is advised not to completely exclude high-tech innovations because many frugal innovations depend on high-tech.
- Frugal innovation aims to reduce overengineering, consider how policies can also be frugal.
- The sustainability component of frugal innovation is not inherent to all cases. In particular, not all cases of frugal innovations are ecologically sustainable. It should be considered if this is an element which needs to be supported.

### Production process

- Consider that frugal innovation is not just about the consumer price but also the **production process and cost of manufacturing**. Additionally, consider expanding the scope of frugal innovation beyond innovations on the market, in order to capture innovations that operate within the internal production processes of companies.

## Summary of discussion on suggestions for mapping frugal and reverse innovation

Participants were asked to consider the following questions:

- Any practical suggestions on how to map frugal and reverse innovation in Europe?
- Any practical suggestions on how to estimate volume of frugal and reverse innovation in Europe?

## Suggested approaches to mapping/estimating the volume of frugal and reverse innovations

- Break down **innovations by sector** – use price points as a marker within specific geographies.
  - This may not be appropriate as the pricing will be distorted and market signals are not clear in a European context.
- Run a **survey** to collect data on self-reported frugal innovations or, an **open survey** which invites stakeholders to share examples with reasoning and use the data to identify relevant market segments.
  - May not have the resources, time or response rate needed.
  - The terms frugal and reverse innovation are mostly used in academia or may not be adopted by many industries (who also may not want to market innovations as such).
- If we consider market segments in the definition of frugal innovation, we will have to decide on how many product markets and segments to select and include.
  - This could be done by choosing well-known examples and searching the literature for well-identified markets. This would open the approach to looking at secondary sources (e.g. price points as mentioned above) and then a survey.
  - A useful starting point could be **hardware-based products** which substitute hardware for software to achieve frugality.
- Filter by **characteristics** of frugal and reverse innovation, such as where it was produced, circumstances, and intentions.
- Important to consider that frugal innovation is a relative definition, **frugality is relative to the existing market segment**.
- Utilise a **market research company** (e.g. Euromonitor) to provide data on innovation products across categories.

## Policy recommendation validation workshop

A policy recommendation validation workshop with policy makers and experts in the field of frugal and reverse innovation was held online on November 13, 2024. The aim of the workshop was to discuss the preliminary recommendations and gather feedback on the appropriateness and validity of the suggested recommendations. 17 stakeholders and 3 European Commission representatives participated in the workshop (excluding the project team, who also participated in discussions). One additional expert was not able to attend the workshop and instead provided written inputs. The full list of participants is provided in Table 11. The agenda of the workshop is presented in Table 12.

**Table 11 – Workshop participants**

Participant	Institution
Antal Nikodemus	Hungarian Innovation Agency
Bastian Widenmayer	Bern University of Applied Sciences
Buse Hidirođlu	Technology Development Foundation of Turkey
Cankut Kaan Bolat	Technology Development Foundation of Turkey
Cees van Beers	Delft University of Technology
Esra Boran	Technology Development Foundation of Turkey
Florence Hennart	Public Service of Wallonia – Economy, Employment and Research
Hilde Vermeulen	Vlaanderen Department of Economy, Science & Innovation
Anonymous	Anonymous
Laura Doyle	Frugal Innovation Hub
Lucia Corsini	University of Oxford
Neno Rakić	Croatian Agency for SMEs Innovations and Investments
Ravi Ramamurti	Northeastern University
Sara Lindeman	Aalto University
Sigurđur Óli Sigurđsson	Rannis – The Iceland Centre for Research
Simone Corsi	Lancaster University
Susanne Nilsson (Written responses)	KTH Royal Institute of Technology
Vasileios Gongolidis	General Secretariat for Research and Innovation Greece
Daniel Gassmann	EISMEA
Eva Rückert	EISMEA
Magdalena Cymerys	DG RTD
Max von Zedtwitz	Copenhagen Business School (Project team member)
Jaideep Prabhu	University of Cambridge Judge Business School (Project team member)
Fatima Irfan	Open University of the Netherlands (Project team member)
Kimmo Halme	4Front (Project team member)
Heidi Utto	4Front (Project team member)
Jamie de Valle Ortiz	4Front (Project team member)
Jonas Antanavičius	Visionary Analytics (Project team member)
Rebecca Davies	Visionary Analytics (Project team member)

Clara Doyle	Visionary Analytics (Project team member)
Irina Şerban	Visionary Analytics (Project team member)

Source: Visionary Analytics, 2024.

**Table 12 – Workshop agenda**

Time	Session
13:00 – 13:10	<b>Welcome and introductory:</b> opening words said by the moderator. Presenting the study aims and objectives.
13:10 – 13:30	<b>Presentation of key findings and draft recommendations:</b> the study team will present the findings of the study and the draft policy recommendations.
13:30 – 13:45	<b>Q&amp;A session:</b> participants will have the opportunity to ask questions and clarifications on the study findings and policy recommendations presented.
13:45 – 14:50	<b>Parallel discussions on draft recommendations:</b> in breakout rooms. Discussion questions and context behind them are provided below.
14:50 – 15:00	<b>Break</b>
15:00 – 15:45	<b>Plenary session:</b> The moderator of each breakout room will present a summary of discussions and invite the participants to discuss the findings of each group.
15:45 – 16:00	<b>Wrap up and next steps:</b> The study team will present a main summary of what has been discussed, providing an opportunity for participants to offer final thoughts and reactions. The study team will then present the next steps of the study.

Source: Visionary Analytics, 2024.

Following the presentation of the key findings and draft recommendations and a short Q&A, participants were divided between three breakout rooms to discuss specific recommendations and respond to pre-determined questions (see below) in smaller groups. After the smaller breakout session the group was brought back together to discuss their findings and open the floor to a wider discussion about the recommendations. Table 13 presents the draft recommendations and discussion questions assigned to each breakout room. This section summarises the key takeaways from the workshop discussions.

**Table 13 – Discussion questions by recommendation**

Breakout room	Recommendation and discussion questions
1	<p><b>Recommendation 1:</b> Awareness raising should be targeted at policy makers to address the lack of specific policy support for frugal and reverse innovation and poor understanding or knowledge of these concepts at this level.</p> <p><b>Discussion questions:</b></p> <ol style="list-style-type: none"> <li>1. Is there a need for awareness raising about frugal and reverse innovation and who should be the target group of awareness raising activities?</li> <li>2. Do you find the list of suggested awareness raising activities appropriate and do you have any suggestions for additional awareness raising activities?</li> <li>3. Are there existing platforms, contests, or fairs that you are aware of where these innovations could gain visibility?</li> </ol> <p><b>Recommendation 4:</b> Explore international best practices and monitor global innovations to enhance frugal and reverse innovation within the EU.</p> <p><b>Discussion questions:</b></p> <ol style="list-style-type: none"> <li>1. Is there a need for an additional study on international best practices in frugal and reverse innovation, and what should be covered in this study?</li> <li>2. Do you think there is a need for a reverse innovation observatory and what role should it play in engaging policy makers and investors?</li> <li>3. Is there a need for the EU to adopt a collaborative or protective approach toward frugal and reverse innovation in relation to emerging markets?</li> </ol>

Breakout room	Recommendation and discussion questions
2	<p><b>Recommendation 2:</b> Ensure frugal and reverse innovations are recognised within policy frameworks. Future policy instruments, funding, and investments should be inclusive of frugal and reverse innovations to create fair competition.</p> <p><b>Discussion questions:</b></p> <ol style="list-style-type: none"> <li>1. Do you agree that there is an issue with the recognition of frugal and reverse innovation within the current policy support frameworks and are the suggested measures to level the playing field appropriate?</li> <li>2. What additional or current policies or pathways could help integrate (new and existing) frugal and reverse innovations at the EU level, particularly to address current and expected crisis situations (e.g. climate change or geopolitical tensions from food, drugs, and energy shortages)?</li> </ol>
3	<p><b>Recommendation 3:</b> Develop financial incentives to promote investment in frugal innovation. This would help to overcome the challenges of attracting investors to low-profit and socially orientated ventures.</p> <p><b>Discussion questions</b></p> <ol style="list-style-type: none"> <li>1. Is there a need for financial incentives to promote investment in frugal innovation and what specific measures would be most effective? Is this needed for reverse innovation?</li> <li>2. How can these financial incentives be integrated into the current European, regional, and national innovation support policies and funding instruments, particularly to drive public/private partnerships and attract private sector contribution?</li> </ol>

## Summary of discussion on recommendations 1 & 4

**Regarding recommendation 1**, the group agreed that frugal and reverse innovation are not well-known concepts amongst policy makers, and therefore awareness raising is an important policy measure and an effective first step. However, group members felt that frugal innovation needs to be embedded in the mainstream innovation narrative earlier, before it reached policymakers, in, for instance, foundational education.

Group members discussed that the issue of awareness is coupled with that of credibility, because there is an assumption (by key stakeholders) that frugal products/processes are lower quality or inferior, they are thought to be inapplicable in context of Europe/the Global North. The team felt this credibility could be built through the suggested prizes, competitions, celebrations during which frugal and reverse innovations would be championed.

The group also felt that inspiration could be taken from open innovation, as this is an innovation concept which has been successfully mainstreamed in the academic, policy and private sector. It was suggested that this could be done by formulating frugality as a more universal concept, in the same way that open innovation has been formulated as a universal concept. In the case of open innovation, the framing suggested that all innovations were created through the support of some form of open innovation, the same approach could be applied to frugal innovation, wherein all innovations have some elements of frugality.

Referring to the example of Dr Matthew Harris and his work promoting frugal/reverse solutions in the NHS, the team felt that the recommendations should target credibility building in defined/targetable populations and structures. This could be done by highlighting a key (EU) institution/sector that would benefit from frugal/reverse mainstreaming. This approach would help counter the current vagueness of recommendation 1.

It was discussed that by avoiding overengineering and overspending, a frugal mindset can be embedded in the policy recommendations. There needs to be a shift in policymaking wherein the answer to socio-economic challenges is not always increased spending, but

rather than policies/policy instruments can be crafted using 'minimal resources.' The group felt that mainstreaming frugal and reverse innovation principles in existing policy/regulatory structures would increase awareness.

**Regarding recommendation 4**, it was discussed that a frugal/reverse observatory would be a good tool to promote, support and import best practices (e.g. in healthcare).

The group noted that it would firstly be important to narrow down the scope, identifying which sectors and at which levels are these frugal/reverse solutions most in demand in the European ecosystem.

The group mentioned that it could be interesting to track cases of frugal/reverse innovations/practices that were implemented unsuccessfully. The group also felt that the observatory could serve as a platform on which the various existing frugal/reverse innovation institutions could collaborate in direct connection with Brussels. Furthermore, it was suggested that the observatory could incorporate a funding instrument that could serve to support low-and middle-income countries.

Additionally, it was stated that the observatory could also serve as the basis for identifying indicators of frugal and reverse innovations. These indicators could somehow be integrated into existing publications such as the Global Innovation Index, or European Innovation Scoreboard. In the mapping of frugal/reverse innovations it was felt that financial indicators (e.g. financial model) could be included.

In reference to the scope of the observatory, it was expressed that a global observatory may be too ambitious and taxing, and therefore the mapping should, at least initially be contained within the EU and HEAC and be targeted towards, for example, specific sectors or mission approach.

## **Summary of discussion on recommendation 2**

The group expressed concern over the recommendation's dependence on the existing policy framework. This is because it was felt that the existing policy framework may not be able to effectively adapt to and address modern challenges, which are arising and evolving rapidly. Instead, it was suggested to focus on pathways which enable the faster distribution of solution, by supporting smaller-scale initiatives. In this context, the importance of alternative decision-making, as this approach would foster greater local engagement through a distributed democratic process, was also discussed.

The group agreed that it is important to formulate a clear definition of both frugal and reverse innovation. This could be strengthened by better aligning both concepts to the EU innovation agenda and relying on existing language/terminology. For example, reference could be made to the Budapest Declaration on the New European Competitiveness Deal, the Draghi/Letta reports, the mission letters from Ursula VdL to new commissioners.

Additionally, it was mentioned that the integration of frugal/reverse innovation into public procurement is a beneficial approach, in part because it could help demonstrate the relevance of frugal and reverse innovation in broader political objectives. This contrasts with the startup or venture capital policy or financing ecosystems, though some initiatives in Finland and the European Institute of Innovation and Technology (EIT) prove as successful approaches.

The question was raised whether alternative, more easily understood and accessible concepts should be used (e.g. resource-constrained innovation, social innovation). In general, the group felt that the terminology is not well understood, and when understood the terminology has a negative connotation, and therefore overall awareness around the terminology needs to be raised.

The group discussed that there is a need to identify which sectors are most likely to benefit from frugal and reverse innovations. Once identified, there is also a need to create a frugal/reverse innovation 'roadmap' of the relevant sectors, by identifying the potential regulatory challenges that these sectors may pose to these innovation types.

Similarly, it was discussed that more attention should be brought to the relevance of frugal and reverse innovation in social challenges. In this context, for frugal and reverse innovations to receive policy support in this context more value should be placed on social dimensions within market constraints in general. At a policy level, social innovations should be better supported in the market, either through state intervention certain or through alternative tools such as systemic investing.

There was a brief discussion on 'leapfrogging' and the utility of using AI to search patent databases in order to scout potentially relevant reverse innovations. It was also noted that stringent EU regulatory standards serve as barriers to reverse innovation.

### **Summary of discussion on recommendation 3**

The group discussed that separate funding instrument for frugal and reverse innovations are not needed at this stage. Instead, frugal and reverse innovations could be incentivised by rewarding frugality criteria (simple, economic, cheap, sustainable) with additional points in the current innovation support funding instruments. In addition, looking at demand-side innovation policies, frugal and reverse innovations could be incentivised by encouraging public procurers to add frugality criteria in their procurements and give higher scores for covering them. Sustainability criteria was especially highlighted multiple times, as this is in line with EU policies (e.g. Green Deal).

It was discussed that definitions of frugal and reverse innovation are not universally understood. Thus, while creating financial incentives, frugal and reverse innovation must be very clearly defined.

It was briefly discussed that there might be more needs for support not to develop innovations, but to scale, market, and sell innovation.

An idea for financial incentives at education level to teach students (especially students in engineering and business) about frugal innovation was shared.

Even though the breakout room did not focus on that, the issue of limited awareness about frugal and reverse innovation was mentioned multiple times. It was concluded that before thinking about funding instruments, we should focus on raising awareness first.

Similar to discussions held on the second recommendation, there were also discussions in this group about connotations of term frugal across different countries. It was noted that 'frugal' in some people eyes has a negative connotation due to being cheap, coming from developing countries and thus being associated with low quality.

Awareness and knowledge about frugal innovation across different countries (participants from the following countries participated in discussion: Croatia, Germany, Greece, Lithuania, USA) were discussed. It was concluded that the term is not well known among policy makers and businesses.

### **Summary of plenary discussion:**

The group discussed that systemic funding could be used as a tool to stimulate frugal innovation on a local level, as this funding is used to support projects which address local challenges through the efficient use of local resources.

Frugal innovation sandboxes or contextual testbeds were also suggested as an additional policy tool with the potential to incentivise frugal innovation activity. One relevant policy avenue that frugal solutions/approaches could use as a point of entry are the 'Local Green Deals', city funded sustainability projects (e.g. in CO2 reduction).

It was also noted that crisis should not be the only lens through which recommendations are made, to gain momentum there should be a focus on solutions that are relevant outside of crisis, particularly ones which can foster community building. It was noted that the Maker movement, which includes a network of Fablabs is a good example of this.

## Annex 2. Country categories and innovation scores for mapping reverse innovation

Region	Country	European Innovation Scoreboard (EIS) 2023		Global Innovation Index (GII) 2023			Proposal for EISMEA FRI study
		Score	Category	Score	Rank	Quartile	Category
HEAC	Switzerland	151.39	Innovation leader	67.6	1	1	1 - Hight innovator
EU	Denmark	149.243	Innovation leader	58.7	9	1	1 - Hight innovator
EU	Sweden	145.921	Innovation leader	64.2	2	1	1 - Hight innovator
EU	Finland	145.631	Innovation leader	61.2	6	1	1 - Hight innovator
EU	Netherlands	139.555	Innovation leader	60.4	7	1	1 - Hight innovator
EU	Belgium	136.438	Innovation leader	49.9	23	1	1 - Hight innovator
EU	Austria	129.999	Strong Innovator	53.2	18	1	1 - Hight innovator
HEAC	Norway	129.547	Strong Innovator	50.7	19	1	1 - Hight innovator
EU	Germany	127.789	Strong Innovator	58.8	8	1	1 - Hight innovator
EU	Luxembourg	127.145	Strong Innovator	50.6	21	1	1 - Hight innovator
EU	Ireland	125.605	Strong Innovator	50.4	22	1	1 - Hight innovator
HEAC	United Kingdom	124.531	Strong Innovator	62.4	4	1	1 - Hight innovator
EU	France	114.206	Strong Innovator	56	11	1	1 - Hight innovator
HEAC	Iceland	111.2	Strong Innovator	50.7	20	1	1 - Hight innovator
HEAC	Israel	-	-	54.3	14	1	1 - Hight innovator
EU	Estonia	106.997	Moderate innovator	53.4	16	1	1 - Hight innovator
EU	Cyprus	114.29	Strong Innovator	46.3	28	1	2 - low innovator
EU	Slovenia	103.104	Moderate innovator	42.2	33	1	2 - low innovator
EU	Czech Republic	102.731	Moderate innovator	44.8	31	1	2 - low innovator
EU	Italy	97.99	Moderate innovator	46.6	26	1	2 - low innovator
EU	Spain	96.795	Moderate innovator	45.9	29	1	2 - low innovator
EU	Malta	93.113	Moderate innovator	49.1	25	1	2 - low innovator
EU	Portugal	92.884	Moderate innovator	44.9	30	1	2 - low innovator
EU	Lithuania	90.924	Moderate innovator	42	34	2	2 - low innovator
EU	Greece	86.218	Moderate innovator	37.5	42	2	2 - low innovator
EU	Hungary	76.309	Moderate innovator	41.3	35	2	2 - low innovator
EU	Croatia	75.443	Emerging innovator	37.1	44	2	2 - low innovator
EU	Slovakia	71.18	Emerging innovator	36.2	45	2	2 - low innovator
HEAC	Serbia	68.565	Emerging innovator	33.1	53	2	2 - low innovator
EU	Poland	68.092	Emerging innovator	37.7	41	2	2 - low innovator
EU	Latvia	56.967	Emerging innovator	37.7	37	2	2 - low innovator
HEAC	Turkey	51.582	Emerging innovator	38.6	39	2	2 - low innovator
HEAC	Montenegro	51.015	Emerging innovator	27.8	75	3	2 - low innovator
EU	Bulgaria	50.634	Emerging innovator	39	38	2	2 - low innovator
HEAC	North Macedonia	50.248	Emerging innovator	33	54	2	2 - low innovator
HEAC	Albania	44.594	Emerging innovator	25.4	83	3	2 - low innovator
HEAC	Bosnia and Herzegovina	39.245	Emerging innovator	27.1	77	3	2 - low innovator
EU	Romania	35.852	Emerging innovator	34.7	47	2	2 - low innovator
HEAC	Ukraine	33.669	Emerging innovator	32.8	55	2	2 - low innovator
HEAC	Armenia	-	-	28	72	3	2 - low innovator
HEAC	Faroe Islands	-	-	-	-	-	2 - low innovator

Region	Country	European Innovation Scoreboard (EIS) 2023		Global Innovation Index (GII) 2023			Proposal for EISMEA FRI study
		Score	Category	Score	Rank	Quartile	Category
HEAC	Georgia	-	-	29.9	65	2	2 - low innovator
HEAC	Kosovo	-	-	-	-	-	2 - low innovator
HEAC	Moldova	-	-	30.3	60	2	2 - low innovator
HEAC	Morocco	-	-	28.4	70	3	2 - low innovator
HEAC	Tunisia	-	-	26.9	79	3	2 - low innovator

Sources: European Innovation Scoreboard 2023 and Global Innovation Index 2023.

## Annex 3. Database of the frugal and reverse innovations mapped

This annex presents the raw data of the frugal and reverse innovation mapping. It is available in a separate Excel file for a more convenient use of the information.

## Annex 4. Database of the policies supporting frugal and reverse innovation mapped

This annex presents the raw data of the policy mapping. It is available in a separate Excel file for a more convenient use of the information.

## Annex 5. A reference list of literature

This annex presents the literature sources used for this study.

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## Annex 6. Case study reports

This annex presents eight case studies. They are presented as a separate .zip file. The Final report will include the delivery of ten case studies.

## Annex 7. List of interviewed stakeholders

#	Country	Organisation	Innovation	Stakeholder type	Role	Details
1	Türkiye	Deprem.io	Deprem.io	Employee	Founder	May 16, 2024
2	France	Handicap International	TeReFa	Employee	Director of innovation, impact and information	May 16, 2024
3	Lithuania	Kalvis	Stove from wheel rims / Potbelly stoves in old gas cylinders	Employee	Production Manager	May 21, 2024
4	Portugal	LifeNieblas	Fog net	Employee	Project Manager	May 21, 2024
5	Anonymous	Anonymous	Anonymous	Employee	Anonymous	May 24, 2024
6	Lithuania	LITUA-Kartu	Modular Furniture	Employee	Owner, developer	May 27, 2024
7	Netherlands	Desolenator	The SP40	Employee	CSO	May 28, 2024
8	Netherlands	Inuka	Friendship bench	Employee	Co-CEO and co-founder	May 28, 2024
9	Italy	BRIX	Modular Home Construction	Employee	Marketing and communication	May 29, 2024
10	United Kingdom	Frugalpac	Paper-based packaging	Employee	Press/PR Manager	May 30, 2024
11	Anonymous	Anonymous	Anonymous	Employee	Anonymous	June 4, 2024
12	Germany	Good Vision	One Dollar Glasses	Employee	Founder	June 12, 2024,
13	Netherlands	GOAL3	IMPALA monitor	Employee	Marketing	June 13, 2024
14	Anonymous	Anonymous	Anonymous	Employee	Anonymous	June 14, 2024
15	Finland	Termex	Insulation	Employee	Development and marketing manager	June 16, 2024
16	Estonia	kuidas.works	Infrastructure	Employee	Co-founder	June 25, 2024
17	United Kingdom	RepRap	Low-Cost 3D Printer	Employee	Founder	June 27, 2024
18	Türkiye	Robotel	3D printed prosthetics	Employee	General	June 28, 2024
19	Germany	ECOFARIO	Microplastic Filtration	Employee	CEO and co-founder	July 1, 2024
20	Lithuania	LITUA-Kartu	Modular Furniture	Employee	Founder and CEO	July 4, 2024,
21	Lithuania	UAB "DUV"	Modular Furniture	Employee	Founder and CEO	July 4, 2024,

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22	The Netherlands	Philips	chARM	Employee	CEO	July 15, 2024
23	Croatia	Croatian Health Insurance Fund	Primary care panels	Policy maker	Managing director	July 15, 2024
24	Germany	Good Vision	One Dollar Glasses	Employee	Innovator/ Chairman and founder of Good Vision	July 19, 2024
25	Anonymous	Anonymous	Anonymous	Employee	Anonymous	July 19, 2024
26	Türkiye	Deprem.io	Deprem.io	Employee	Founder	July 22, 2024
27	Austria	Helioz	WADI	Employee	CEO	July 23, 2024
28	Anonymous	Anonymous	Anonymous	Employee	Anonymous	July 25, 2024
29	The Netherlands	Inuka	Friendship bench	Employee	Co-CEO and Co-founder	July 25, 2024
30	France	Handicap International	3D printed prosthetics	Employee	Director of innovation, impact and information	July 26, 2024
31	Anonymous	Anonymous	Anonymous	Employee	Anonymous	July 26, 2024
32	Lithuania	Vilnius Tech University	Modular furniture	Researcher	Researcher	July 29, 2024
33	Lithuania	UAB "DUV"	Modular furniture	Employee	Head of exports	July 29, 2024
34	Germany	Good Vision	One Dollar Glasses	Employee	Coordinator South America and program manager Bolivia	July 31, 2024
35	United Kingdom	RepRap Ltd.	Low-cost 3D printer	Employee	Founder and CEO	August 2, 2024
36	Germany	ECOFARIO	Microplastic Filtration	Employee	CEO and co-founder	August 2, 2024
37	Finland	Termex	Insulation	Employee	R&D director	August 5, 2024
38	United States	3D Printing World	Low-cost 3D printer	Employee/end-user	Founder	August 6, 2024
39	France	Handicap International	3D printed prosthetics	Employee	Specialist in re-adaptation	August 6, 2024
40	Anonymous	Anonymous	Anonymous	Policy maker	Anonymous	August 6, 2024
41	United Kingdom	Cormack Consultancy Group	UK-Ukraine Twinning Initiative	Employee	Founder/Chairman	August 7, 2024
42	Finland	Termex	Insulation	Employee	CEO	August 10, 2024
43	Germany	Good Vision	One Dollar Glasses	Employee	Global network and coordinator India	August 13, 2024
44	Anonymous	Anonymous	Anonymous	Policy maker	Anonymous	August 13, 2024

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45	Anonymous	Anonymous	Anonymous	Employee	Anonymous	August 14, 2024
46	Sweden	Better Shelter	Temporary shelter/ relief units	Employee	Head of communications	August 14, 2024
47	Finland/United States	InnoFrugal network	InnoFrugal network	Researcher	Co-founder	August 14, 2024
48	Estonia	kuidas.works	Infrastructure	Employee	Co-founder	August 15, 2024
49	Estonia	kuidas.works	Infrastructure	Employee	Co-founder	August 15, 2024
50	Estonia	kuidas.works	Infrastructure	Employee	Co-founder	August 15, 2024
51	Ukraine	Mariupol State University	UK-Ukraine Twinning Initiative	Policy maker	Associate professor	August 16, 2024
52	Portugal	CIM Viseu Dão Lafões	Life Nieblas fog collector	Employee	Environmental technician	August 19, 2024
53	Türkiye	Robotel	3D printed assistive devices	Employee	Director	August 21, 2024
54	Anonymous	Anonymous	Anonymous	Employee	Anonymous	August 21, 2024
55	Anonymous	Anonymous	Anonymous	Policy maker	Anonymous	August 22, 2024
56	Spain	GESPLAN	Life Nieblas fog collector	Employee	Environmental technician	August 23, 2024
57	Anonymous	Anonymous	Anonymous	Investor	Anonymous	August 23, 2024
58	Greece	e-NABLE Greece	3D printed assistive devices	Employee	Chapter leader/Fundraising manager	August 26, 2024
59	Greece	e-NABLE Greece	3D printed assistive devices	Employee	Chapter leader	August 26, 2024
60	Sweden	KTH Royal Institute of Technology	3D printed prosthetics	Researcher	Researcher at integrated product development and design	August 26, 2024
61	The Netherlands	e-NABLE Nederland	3D printed assistive devices	Employee	Chapter leader	August 28, 2024
62	France	Handicap International	3D printed prosthetics	Employee	Director of the rehabilitation division	August 29, 2024
63	Italy	e-NABLE Italia	3D printed assistive devices	Employee	Chapter leader	August 30, 2024
64	Anonymous	Anonymous	Anonymous	Policy maker	Anonymous	September 03, 2024
65	France	Handicap International	3D printed prosthetics	Employee	Rehabilitation and innovation policy and development officer	September 5, 2024
66	Portugal	Beta-i	SOL	Social partner	Co-founder and head of global	September 5, 2024

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					growth and partnerships	
67	Spain	CREAF	Life Nieblas fog collector	Researcher	Researcher	September 6, 2024
68	United Kingdom	Nottingham University	UK-Ukraine Twinning Initiative	Researcher	Director of global engagement	September 6, 2024
69	Ukraine	Ministry of Education and Science Ukraine	UK-Ukraine Twinning Initiative	Policy maker	Deputy minister of education and science	September 6, 2024
70	United Kingdom	Individual	Low-cost 3D printer	Contributor	Contributor	September 9, 2024
71	Bosnia and Herzegovina	FabLab BA	3D printed assistive devices	Employee	Director	September 10, 2024
72	Finland	Termex	Insulation	Employee	Marketing director, Poland & Ukraine	September 10, 2024
73	Anonymous	Anonymous	Anonymous	Policy maker	Anonymous	September 10, 2024
74	Lithuania	European Parliament	Modular furniture	Policy maker	Political support	September 11, 2024
75	The Netherlands	DEKNA	3D printed assistive devices	Partner organisation	Chairman	September 11, 2024
76	Germany	Munich Re Foundation	Life Nieblas fog collector	Investor	Investor/ Project manager	September 13, 2024
77	Spain	Instituto Tecnológico de Canarias (ITC)	Life Nieblas fog collector	Employee	Coordinating technician	September 13, 2024
78	Spain	Instituto Tecnológico de Canarias (ITC)	Life Nieblas fog collector	Employee	Technician and environmental specialist	September 13, 2024
79	The Netherlands	Freedom for Ukraine	3D printed medical braces	Partner organisation	Founder	September 13, 2024
80	Lithuania	UAB "Likmeré"	Modular furniture	Social partner/Investor	Supplier/Funder	September 16, 2024
81	Lithuania	Ukmergė town municipality	Modular furniture	End-user	End user	September 16, 2024
82	Finland	Leapfrog projects/Aalto University	Leapfrog projects/Aalto University	Researcher	Managing partner and researcher	September 16, 2024
83	United States	VORON Design	Low-cost 3D printer	Employee/end-user	Founder	September 17, 2024
84	Portugal	e-NABLE 3D Printing Center for Health	3D printed assistive devices	Employee/Researcher	Chapter leader/researcher	September 17, 2024

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85	Portugal	e-NABLE Portugal	3D printed assistive devices	Former Employee/ Researcher	Founder/ Researcher	September 18, 2024
86	Anonymous	Anonymous	Anonymous	Policy maker	Anonymous	September 19, 2024
87	Anonymous	Anonymous	Anonymous	Policy maker	Anonymous	September 19, 2024
88	Anonymous	Anonymous	Anonymous	Policy maker	Anonymous	September 19, 2024
89	Italy	ISINNOVA	Modular Home Construction	Employee	Project Manager	September 23, 2024
90	Anonymous	Anonymous	Anonymous	Employee	Anonymous	September 24, 2024
91	Anonymous	Anonymous	Anonymous	Employee	Anonymous	September 25, 2024
92	United Kingdom	Individual	Low-cost 3D printer	Contributor	Contributor	September 26, 2024
93	United States	Individual	Low-cost 3D printer	Contributor	Contributor	September 27, 2024
94	The Netherlands	Philips	chARM	Employee	Employee	September 27, 2024
95	Anonymous	Anonymous	Anonymous	Social partner/Investor	Anonymous	October 11, 2024
96	Anonymous	Anonymous	Anonymous	Social partner/Investor	Anonymous	October 11, 2024
97	Anonymous	Anonymous	Anonymous	Policy maker	Anonymous	October 15, 2024
98	Anonymous	Anonymous	Anonymous	End-user	Anonymous	October 17, 2024
99	Anonymous	Anonymous	Anonymous	End-user	Anonymous	October 17, 2024
100	The Netherlands	Phillips	Lumify	Employee	Business development manager	October 18, 2024
101	Italy	BRIX	Modular Home Construction	Employee	Co-founder	October 30, 2024
102	Spain	Nieblagua	Life Nieblas fog collector	Employee	Technical director	October 31, 2024
103	Ireland	Enterprise Ireland	Enterprise Ireland	Policy maker	Senior executive knowledge transfer Ireland	November 8, 2024
104	Anonymous	Anonymous	Anonymous	Policy maker	Anonymous	November 13, 2024
105	Anonymous	Anonymous	Anonymous	Policy maker	Anonymous	November 19, 2024

## Study on Mapping and Scoping of Frugal and Reverse Innovation

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106	Anonymous	Anonymous	Anonymous	Policy maker	Anonymous	November 19, 2024
107	Anonymous	Anonymous	Anonymous	Policy maker	Anonymous	November 19, 2024

## Annex 8. Case study questionnaire

Introductory questions to identify the interviewee and the organisation (directed at all)

- Can you introduce yourself, the organisation you represent and your role?
- What country/region is the organisation based in and does it operate (distribute) in any other markets?
- What sector is the organisation (and the innovation) situated in?

Questions on the innovative project (directed at organisation/partner organisations/innovators)

- Can you describe the innovation and its application (including the type, if known, e.g. frugal or reverse?)
- Have you worked with or on other innovation projects in the past? If so, how does this innovation compare with those projects? Are there differences in the approach that you took?
- What was the motivation (or main drivers) for the development of this specific innovation? In what ways has this motivation evolved over time, and what factors have contributed to these changes?
- Who is the intended user or beneficiary of this innovation? How does this innovation address the needs or interests of its target market?
- To what extent can the innovation be considered a social innovation (an innovation which addresses a social need or challenge)?
- How do you anticipate its relevance and impact evolving in the future?

Questions related to the market conditions, context, and business model (directed at organisation/partner organisations/innovators)

- Can you describe the business model used for this innovation and assess its long-term viability? (E.g. the customer value proposition, the profit formula, the key resources, and the key processes)
- When did you start developing the product and how long did it take you to complete this?
- When was the product first introduced to the market? Where was it first introduced?
- What is the current market size for this sector? What effects has this had on the development and implementation of the innovation?
- Who are the main competitors, and what is the competitive landscape like? What effects has this had on the development and implementation of the innovation?
- How do you foresee the future development of this market? What impact might this have on the development/implementation of (the) innovation?
- How has the economic, organisational, social and cultural context of the innovation played a role in its development/implementation?

Questions related to the role of technology and professional skills (directed at organisation/partner organisations/innovators)

- What specific knowledge and skills are needed to develop and produce this product/technology?

- What is the current availability of talent on the market?
- What role has/does technology play in the development/implementation of the innovation?
- Is the necessary technology accessible, affordable, and appropriate to the needs of the venture? How do you foresee this developing in the near future?

Questions related to policy context (directed at organisation/partner organisations/innovators/policy makers/experts)

- What role did public support (financial and non-financial) play in the development and implementation of the innovation?
- How easy was it to secure (private) funding for the innovation? What challenges or bottlenecks did you encounter in the process?
- Was/is the innovation supported by policy (including funding/scaling/tax exemptions)?
- How do you view and evaluate the current policy actions that are in place to promote frugal and reverse innovation?
- In what ways does the current regulatory environment support or hinder the development and implementation of frugal and reverse innovation?
- What policy or regulatory actions could be taken to promote frugal/reverse innovation? How do you envision these, what specific proposals would you suggest?
- Does the innovation contribute to the sustainability agenda of the European Green Deal or other EU burning issues? If so, how? If not, does it have the potential to?
- Does the innovation contribute to the goals of the New European Innovation Agenda to drive deep tech-based solutions? If so, how? If not, does it have the potential to?
- How has this innovation influenced other innovative activities? What changes are noticeable in the community, amongst other innovators/entrepreneurs, in your network, or in the market?

Specific questions for policy makers and investors/public procurers

- What specific policy actions or incentives, if any, promote investment in frugal and reverse innovation (e.g. tax incentives/funding)?
- In your view, what policy actions could be taken to promote frugal and reverse innovation? How do you envision these, what specific proposals would you suggest?
- Can you identify areas (sectoral/geographic) which could be better supported by investment?

Specific questions for investors of a specific case

- Can you share how you were introduced to this product?
- What were your motivations for investing in the product/company? What aspects of the product/company motivated the investment?
- What concerns did you have, if any, when investing in the product? How did you address and resolve these concerns?
- What aspects of this product do you feel are most valuable?

Specific questions for end-users

- Can you share how you came to start using this innovation?

- Can you describe your overall experience using this product? What were your initial impressions, and how have they evolved over time?
- What specific features or functionalities of the product stood out to you during your usage? How did they contribute to your overall satisfaction or dissatisfaction?
- In what ways has the product enhanced or simplified tasks, activities, or processes in your life? Can you provide specific examples?
- Are there any aspects of the product that you find frustrating or difficult to use? How do you work around this? Do you have any suggestions for improving the product?
- How would you compare your experience with this product to similar products or alternatives in the market?

Specific questions for failed cases

- At which stage of development/implementation was the innovation project concluded?
- Can you identify the main reasons why the innovation did not succeed?
- In what ways, if any, did the market size, competition and/or the availability of talent in the market factor into this?
- How did the business model impact the development/implementation of the innovation? Can you identify changes which would better support the innovation implementation in the future?

Additional questions related to challenges and opportunities (directed at organisation/partner organisations/innovators)

- What were the key factors that led to the success of your innovation? Which one do you feel was the most important?
- What obstacles, if any, have you encountered in the development/implementation of the innovation? How did you overcome/mitigate these obstacles? Given any failed reverse or frugal innovations, how did these failures impact the organisation?
- Are there any additional challenges to the development/implementation of this innovation?

Closing Questions (directed at all)

- Are you able to share any relevant documents or publications related to the innovation?
- Do you know of any relevant people we might interview for this case study?

