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8 – INNOVATION

Overarching recommendations

> The European Commission should build a cross-European approach to research and innovation and should design an innovation ecosystem that prioritises sustainability.

> The European Commission and Member States should expand the role of public finance institutions in crowding in private patient capital for investment.

> The European Commission should support Member States to align national approaches to research and innovation with European sustainability goals.

Building a sustainable European economy will require investment in the industries of the future.

The COVID-19 pandemic has underlined the central role played by research and innovation in times of crisis. In the coming decades, Europe will face unprecedented climate and environmental challenges. Achieving Europe's climate targets will require a systemic transformation of its economy.[341] The deployment of existing and emerging technologies at scale and pace will be needed for the required emissions reductions, while breakthrough technologies will need to be developed for hard-to-abate sectors. Research and innovation will also be critical to addressing related challenges such as biodiversity loss and ocean acidification.

There is ample evidence that countries investing more in research and innovation outperform those that invest less.[342] In terms of the climate

[341] E3G (2020) **Building an EU Research & Innovation Strategy for Net Zero** (forthcoming)

[342] European Commission (2019) **Research and Innovation analysis in the European Semester 2019 Country Reports**

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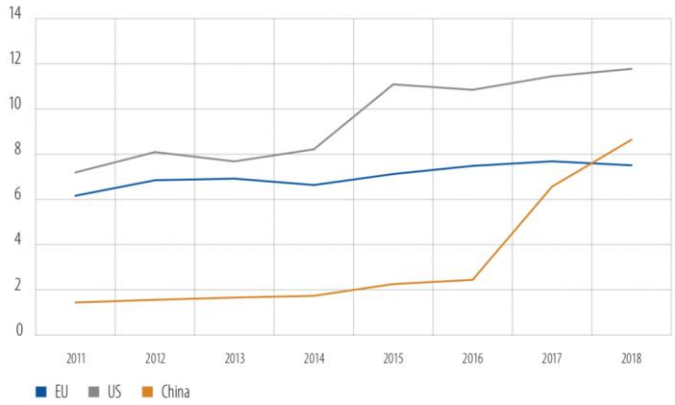
transition, an early deployment of new technologies could reduce the cost of decarbonisation through economies of scale. [343] However, while Europe maintains a competitive knowledge position it faces increased global competition in innovative technologies.[344] Research and innovation is necessary to maintain the competitiveness of European industries (including small and medium-sized enterprises) in global value chains, driving investment and exports and creating jobs for a low carbon global economy.

Europe is behind other major economies in investing in innovation, which could undermine its competitiveness. Europe set a target in 2000 to increase research and innovation investments to 3% of GDP to match other leading global regions[345] however, Member States still only spend 2.1% of GDP on R&I, or over €300 billion annually.[346] Around two thirds of investment into research and innovation is made by private sector companies, but their investment intensity of 1.3% of GDP is well below that of their competitors in China (1.6%), the US (2%), Japan (2.6%), and South Korea (3.3%).[347] Moreover, this private investment is highly concentrated within Europe, with over 90% of all investment coming from just 567 companies.[348]

Figure 8. Investment in climate-related R&D, 2011-2018 (€ billion)[349]



[343] Bruegel (2019) **Getting better all the time: The benefits of learning for decarbonisation**

[344] European Investment Bank (2019) **Investment Report 2019/2020**

[345] European Commission (2010) **Europe 2020: A European Strategy for smart, sustainable and inclusive growth**

[346] European Commission (2017) **Lab-Fab-App Investing in the European future we want**

[347] European Commission (2018) **A renewed European Agenda for Research and Innovation - Europe's chance to shape its future**

[348] Climate Strategy (2018) **Funding Innovation to Deliver EU Competitive Climate Leadership**

[349] BNEF; European Investment Bank (2019) **Investment Report 2019/2020**

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Underinvestment in climate-related research and innovation could put Europe at risk of meeting its climate targets. Europe's climate-related research and innovation intensity is very low at 0.04% of GDP,[350] and spending has only marginally increased over the past decade to €7.5 billion in 2018, remaining behind China (€8.6 billion) and the US (€12 billion) as shown in Figure 8.[351] Concentration is an issue with only 3-4% of private research and innovation investments being made by 102 companies working directly in climate-related sectors.[352] Without policy intervention the EU risks underinvesting in the necessary development and large-scale deployment of innovative climate technologies.

There is a significant East-West divide in the deployment of research and innovation across Europe. Except for Slovenia, Central and Eastern European countries lag behind other Member States (although in most cases their research and innovation intensity is increasing). Sweden, Austria, Germany and Denmark spent above 3% of GDP on research and investment in 2018, while seven Central and Eastern European countries reported spending below 1%.[353]

The climate transition represents an opportunity to level the playing field across Europe and for new leaders in clean economy research and innovation to emerge. For example, countries in Central and Eastern Europe have strong manufacturing bases integrated in Western European supply chains. This is particularly the case for the car industry, for which Central and Eastern Europe has large-scale production facilities.[354] Some countries in the region are already capitalising on the transition, for example, the Visegrad countries are ramping up efforts to upgrade car production lines towards electromobility.[355]

[350] European Investment Bank (2020) **Investment Report 2019/2020**

[351] European Investment Bank (2020) **Investment Report 2019/2020**

[352] Climate Strategy (2018) **Funding Innovation to Deliver EU Competitive Climate Leadership**

[353] Eurostat (2020) **Gross domestic expenditure on R&D (GERD)**

[354] European Investment Bank (2018) **Innovation investment in Central, Eastern and South-Eastern Europe: Building future prosperity and setting the ground for sustainable upward convergence**

[355] Euractiv (2019) **Visegrad countries fight to keep pace with e-mobility transition**

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Info: Sectoral breakdown of climate mitigation-related research and innovation needs[356]

Industry is the backbone of the European economy and generates 80% of exports.[357] It accounts for 64% of private sector research and innovation, and 49% of EU research and innovation investments. Substantial investments are needed in low cost electrolysis, energy efficiency, material efficiency, new material chemistries, and carbon capture and storage.

Europe is a global leader in the **automotive** industry, and the transport sector accounts for 5% of GDP.[358] Additional innovation investments are needed in low cost electrolysis, electric vehicles, batteries, fuel cells, the smart integration of electric vehicles and charging networks, and zero carbon planes, ships and heavy trucks.[359]

Investments in **building technologies** can stimulate the construction industry, which generates 8% of European GDP.[360] Investments are needed in smart systems, electrification, heating and cooling including district networks, building envelope materials, and construction technologies such as 3D printing and building information modelling (BIM).

Power generation is the largest emitting sector in Europe and plays a crucial role in decarbonising energy use across transport, industry and buildings.[361] The decarbonisation of the energy system will position Europe to deliver clean technologies in a €5 trillion global market.[362] A net-zero energy system requires innovation investment in renewable energy, transmission and distribution, storage and energy efficiency.

The **agriculture** sector produces only 1% of European GDP[363] but offers a disproportional level of sustainability risks and benefits. Investments are

[356] E3G (2020) **Innovation priorities to deliver climate neutrality**

[357] European Climate Foundation (2019) **Net-Zero 2050 series: Research & Innovation for EU Industry**

[358] European Commission (2019) **Transport sector economic analysis**

[359] European Climate Foundation (2019) **Net-Zero 2050 series: Research & Innovation for EU Transport**

[360] Renovate Europe (2020) **Building Renovation: A kick-starter for the EU recovery**

[361] European Environment Agency (2020) **CO2 Intensity of Electricity Generation**

[362] European Climate Foundation (2019) **Net-Zero 2050 series: Research & Innovation for EU Energy**

[363] Eurostat (2019) **Performance of the agricultural sector**

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required in smart farming systems, meat alternatives, organic fertilisers and pest management, soil carbon storage, ecosystem restoration and agroforestry. The sector can also provide a limited amount of inputs for the bio-based economy including the conversion of certain waste streams into bioproducts and the production bio-based chemicals and materials.

Integrating sustainability into national innovation planning

Europe has a more fragmented innovation system than its peers, making it harder to gain economy of scale advantages in selected sectors. National governments provide 30% of public funding into research and innovation, with just 8% of support coming through European funds.[364] It is therefore important to maximise the impact of public funding by aligning national and European research and innovation priorities. However, many Member States have still not recognised the value of investing in climate-related research and innovation. Indeed, few countries have set adequate research and innovation targets and made investment plans in their National Energy and Climate Plans which are commensurate with the level of ambition required to achieve the climate 2030 and 2050 targets.

The European Commission should support Member States in creating mission-based national R&I strategies with capital raising plans.

> National research and innovation programmes should create mission-based strategies and capital raising plans with short, medium and long-term priorities. New policies, regulatory reforms, financial instruments and fiscal incentives could then support implementation.

> National research and innovation strategies should ensure synergies with European priorities and funding instruments and should be included as part of EU level national planning processes.[365]

[364] E3G (2019) **Accelerating EU Decarbonisation with Research and Innovation Funding**

[365] E3G (2019) **Accelerating EU Decarbonisation with Research and Innovation Funding**

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> The governance structures of national research and innovation programmes should include different types of institutions (including the private sector) in order to deliver effective policy decision making together with individual project support, and to support learning.

> The European Commission should provide guidance to Member States on the development of mission-based national R&I strategies with capital raising plans. Climate-related R&I targets should be based on the advice provided by a European Panel on Climate Change.

Building a cross-European approach to climate research and innovation

The EU has yet to identify a preferred (least cost) pathway to climate neutrality; [366] such analysis would facilitate alignment and impact across Europe and could enable pan-European innovation initiatives focused around common missions to emerge.

Meanwhile, the EU is still relying on incremental and siloed approaches to research and innovation. A mission-driven policy, combined with a linked capital raising plan, would have the potential to bring more cohesion by creating a one policy approach to research and innovation for decarbonisation. [367] An example of this approach is the Canfin-Zaouati Report in France which proposed accelerating green investment by developing risk-sharing public guarantee mechanisms, together with a dedicated public investment team to develop project pipelines.[368] Within Europe these functions could be fulfilled by a new institution – the European Panel on Climate Change proposed by the European Parliament in the context of the European Climate Law.[369]

[366] E3G (2019) **EU Energy System Decarbonisation Policy: Breaking the Logjam**

[367] Pilsner, L. and Dethier, S. (2020) **Viewpoint: Legal move on climate must be backed by game plan on carbon neutrality**; E3G (2020) **Mission-based innovation for climate and energy**

[368] Finance for Tomorrow (2018) **Report Canfin-Zaouati on blended finance mechanisms**

[369] European Parliament (2020) **Draft Opinion on the European Climate Law**

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The European Commission should create an independent European Panel on Climate Change under the European Climate Law.

> Governance for zero-carbon research and innovation needs to be improved to ensure close alignment with market and industry needs, efficient allocation of resources across sectors, a consistent approach to across policies, fast learning and fair distribution of benefits across Europe.

> This function could be performed through an independent European Panel on Climate Change which would advise on sectoral deployment targets for existing and emerging technologies, processes and services, and on the development of future breakthrough technologies in the hard to abate sectors.[370]

> Through this mechanism an integrated sustainability research and innovation roadmap should be created to identify gaps and research/innovation needs for short, medium and long-term emissions reduction objectives across all economic sectors. The roadmap should be regularly updated and used as the benchmark for assessing sustainability research and innovation priorities across all relevant EU and national policies.[371]

> Rather than only reacting to sectoral demands, such an approach would maximise the impact of emissions reduction efforts because it would quickly identify barriers and gaps at a whole-economy level.

[370] Skillings and Fischer 2019, **EU Energy system decarbonisation policy: Breaking through the logjam**

[371] Such as the European Semester, National Energy and Climate Plans, National Long-Term Strategies, Just Transition Plans and Adaptation Strategies

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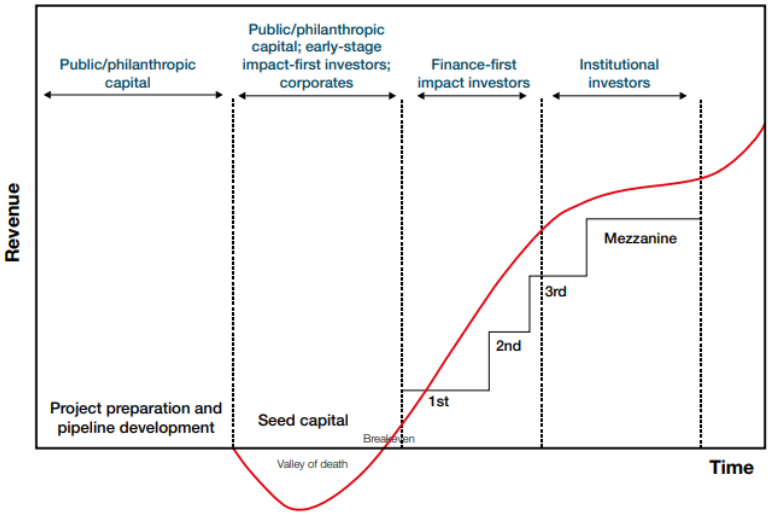
Using public finance institutions to crowd in private finance investment

Despite a tradition of excellence in both academic research and research and development, Europe is falling behind other regions in accelerating the deployment of emerging clean technologies. Clean technologies face a particular challenge in that they are associated with high capital intensity, high technology and market risks and long development lead times, which means that they require large pools of patient capital – long-term capital requiring at least 10 to 15 years to generate returns.[372] Short-termism, risk-aversion, a fragmented supply of capital and inflexible public instruments have resulted in the private sector avoiding investments in clean technologies until returns become more certain.

Figure 9. Innovation financing cycle and investor type by stage[373]



Finance gaps exist in the stage between research activities in laboratories and the scaling up of a viable technology or process. This stage is often referred to as the "valley of death" as shown in Figure 9. The first finance gap occurs in the research and demonstration phases before commercialisation. This stage is particularly risky and requires long periods of up to five years from initial research to proof of concept. The next gap occurs in the pre-commercialisation and the commercialisation phases, where finance is needed for full-scale power generation or manufacturing plants.

[372] Mazzucato, M. (2019) **Governing Missions in the European Union**

[373] Finance Watch (2020) **Nature's Return: Embedding environmental goals at the heart of economic and financial decision-making**

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Access to patient capital is thus essential for firms looking to develop and deploy innovative clean technologies. However, the wide range of activities along the innovation development chain from initial research to maturity require a range of financing instruments to suit different areas of the risk landscape. For example, grants are appropriate for early-stage research while equity can be offered to technology firms looking to scale up, and debt is more appropriate for lower risk incremental innovation such as the deployment of proven technologies.[374]

Europe has an extensive range of public instruments which can be used to support companies in accessing risk finance.[375] However, there is significant fragmentation in terms of the available instruments at EU and national level[376] and the instruments are not backed by a mission-driven approach that generates deep synergies and creates solutions developed around specific societal challenges. [377] Fragmentation means that funding may not be consistently available along the innovation development chain.[378] There are also disparities in the distribution of funding for innovation, with the majority of investments taking place in Western Europe.[379]

Increasing investments in sustainability-related research and innovation requires innovation funding tools to be focused on delivering sustainability goals including climate neutrality. The non-targeted approach of many instruments does not ensure sufficient and targeted support to technologies that will broaden the technology portfolio in specific sectors and lead to the largest sustainability benefits.[380] In addition, financial institutions working on innovation are not sufficiently focusing on increasing the sustainability of their portfolio. For example, the European Investment Fund has a climate target of just 10% for 2020, although this is expected to increase in the future.[381]

Public finance institutions can have a role in catalysing private sector investment. While the traditional functions of public finance institutions include

[374] Mazzucato, M. (2019) **Governing Missions in the European Union**

[375] E3G (2019) **Accelerating EU Decarbonisation with Research and Innovation Funding**

[376] Mazzucato, M. (2019) **Governing Missions in the European Union**

[377] E3G (2020) **Building an EU Research & Innovation Strategy for Net Zero** (forthcoming)

[378] E3G (2019) **Accelerating EU Decarbonisation with Research and Innovation Funding**

[379] European Commission (2017) **Interim evaluation of Horizon 2020**

[380] E3G (2020) **Fostering climate-neutral, energy-intensive industries in Europe: A policy vision for the EU Industrial Strategy**

[381] European Investment Fund (2019) **EIF Corporate Operational Plan 2020-2022**

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infrastructure investment and counter-cyclical lending, some institutions have gone further in driving innovation through blended finance.[382] Examples include public venture capital funds, such as the Fonds National d'Amorçage in France, to public banks like KfW in Germany. Public finance institutions provide an opportunity to redistribute finance and reduce the economic divide within Europe.

The European Commission should support Member States to expand the role of public finance institutions in crowding in private capital for investment.

> Public sector participation can provide significant patient capital covering all stages in the innovation cycle in the form of grants, blended finance, guarantees, equity and debt to attract private investment. Mission-based governance and monitoring and evaluation frameworks capturing additionality can avoid crowding out private investment.

> Patient public capital should flow to the Central, Eastern and Southern parts of Europe to ensure that the benefits of research and innovation are distributed fairly.

> The European Commission and Member States should encourage public finance institutions working on innovation such as public banks to set a mission-based R&I strategy with climate targets replicating the European Investment Bank's Energy Lending Policy and to disclose against the EU taxonomy.

> Technical assistance could be provided at EU level by putting in place a dedicated research and innovation theme under the InvestEU Advisory Hub. This would support the facilitation of technical assistance in Member States on technical, commercial and financial advice for the development of bankable projects.

Supporting access to patient venture capital for smaller firms

Small and medium-sized enterprises involved in innovation are particularly likely to have difficulty with access to finance at the demonstration stage.

[382] Mazzucato, M. and Penna, C. (2016) **Beyond market failures: the market creating and shaping roles of state investment banks**

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For innovative, small and young companies, finance at this stage is typically provided by venture capital funds. Venture capital investment in start-ups has grown four times to €23 billion in Europe in the last five years. However, the absolute level of investment is low, compared to $130 billion in the US and $92 billion in China.[383]

In the absence of venture capital, European entrepreneurs tend to find themselves relying on risk-averse bank lending. Financing remains a constraint for innovative start-ups with high investment needs who typically lack a credit history or collateral.[384] Across Europe, start-ups and small and medium-sized enterprises are twice as likely as large firms to be financially constrained.[385]

In Central and Eastern Europe, firms rely on banking as private equity and venture capital markets lag behind the rest of the EU, except for Lithuania and Latvia.[386] Private equity volumes are only a third of the EU average in these countries, and venture capital accounts only for 6% of total investment volume.[387] Most innovation activity in the region comes from the large foreign-owned manufacturing firms.

Clean technologies may face additional barriers, as venture capital funds tend to be short-term and exit-driven which makes it harder to finance disruptive innovation. Patient venture capital may be required to provide access to finance to clean start-ups. Impact venture capital firms, and corporate venture capital firms focusing on clean technologies which are more likely to offer patient capital, have appeared in the last years.[388] Examples include Engie New Ventures, a corporate venture capital firm in France, and DOEN Foundation, an impact venture capital firm in the Netherlands.

Greater access to patient venture capital across Europe would enable more companies to cross the valley of death and attract larger amounts of capital for investments in the clean economy. At EU level the European Commission and the European Investment Fund have made efforts to increase venture capital

[383] Forbes (2019) **Raising Venture Funding In Europe Vs. The U.S.**

[384] Mazzucato et al. (2018) **The role of patient finance in mission-oriented innovation: the market shaping role of state investment banks**

[385] European Investment Bank (2019) **Investment Report 2019/2020**

[386] European Commission (2020) **European Innovation Scoreboard 2020: Annex B - Performance per indicator**

[387] European Investment Bank (2018) **Innovation investment in Central, Eastern and South-Eastern Europe: Building future prosperity and setting the ground for sustainable upward convergence**

[388] EcoSummit (2019) **Smart green VCs you should know**

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through the pan-EU fund-of-funds VentureEU, which is expected to double the amount of venture capital available in Europe.[389] Public venture capital funds, and tax incentives for venture capital investors at national level, can also play an important role. However, there are concerns around the lack of alignment and coordination of measures across Europe.[390]

Provide additional services to start-ups and small and medium-sized Enterprises to help them to finance patient venture capital.

> Additional financial support should be provided to improve the access to patient venture capital for development stage innovation by small and medium-sized enterprises, notably in Central and Eastern Europe.

> The European Commission should facilitate access of start-ups and small and medium-sized enterprises to EU and national public funding tools through simplified registrations and quotas.

> Member States should encourage venture capital funds to set up ambitious climate targets and to disclose against the EU taxonomy in order to increase funding for start-ups developing clean technologies.

> Technical assistance should be provided in the form of additional financial incentives to the accelerators that provide training and networking opportunities to entrepreneurs and connection to private investors improve access to capital.

Designing the innovation ecosystem to incentivise sustainability

Banks and institutional investors currently lack awareness of sector-specific risks and opportunities and the risk management expertise that is required to invest in clean technologies, thus preventing them from adapting their products and investment strategies. In addition to providing them with de-risking instruments it is also important to improve their awareness of new innovations.

[389] European Commission (2018) **VentureEU: €2.1 billion to boost venture capital investment in Europe's innovative start-ups**

[390] Jacques Delors Institut (2017) **Public policies to promote venture capital**

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In addition, access to capital is not the only barrier to clean innovation. Indeed, the absence of a stable policy framework is another key barrier.[391] Low carbon prices will not drive investments in clean technologies unless they are combined with other instruments. Clean products also require a certain demand to reach the market, yet the proportion of innovative public procurement remains low while established companies in Europe are often hesitant to buy new products from innovative clean technology companies.[392]

There is insufficient collaboration between innovation actors from government, industries, small and medium-sized enterprises, start-ups and investors to leverage private investment and deploy emerging innovations. The European Commission has sought to foster a more transformative innovation policy through the launch of Missions and European Innovation Ecosystems under Horizon Europe and industrial alliances. However, although these include sustainability goals, they currently do not have adequate governance in place to ensure a rapid transition to climate neutrality.

Innovation clusters have emerged as useful tools to stimulate innovation and attract investment by enabling a network of companies to coexist in a geographic location and allowing them to collaborate and compete.[393] Examples include Clean Tech Delta in the Netherlands and the Green Tech Cluster in Austria. Estonia provides a best practice example of an active innovation policy relying on the use of knowledge-based innovation clusters through location-based policies.[394]

[391] Stockholm Environment Institute (2020) **Policies, not finance, are the obstacle to decarbonizing industry**

[392] World Economic Forum (2019) **Europe is no longer an innovation leader. Here's how it can get ahead**

[393] The Economist Intelligence Unit (2015) **Innovation Clusters: Understanding Life Cycles**

[394] European Bank for Reconstruction and Development (2014) **Policies supporting innovation**

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The European Commission should develop a dynamic public-private innovation ecosystem that incentivises sustainability

> The European Commission should promote collaborative partnerships through industrial alliances between the public, industrial and finance sectors to originate and finance a suitable portfolio of research and innovation projects from small scale pilots to large-scale demonstration. Public procurement can also be used as a lever for private sector investment at scale.

> The European Commission should also promote the development of mission-driven clean technology clusters in Central and Eastern Europe with a focus on connecting start-ups and small and medium-sized enterprises with investors and industry and growing a stronger innovation and collaboration culture.

> The European Commission should work with Member States to create new financial instruments and incentives to mobilise private sector investment in research and innovation that supports European policy goals and national frameworks. For example, public-private risk-sharing financial instruments and tax incentives could incentivise companies investing in taxonomy-aligned research and innovation in Member States where there are currently lower levels of investment in research and innovation.