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DELIVERING CLIMATE NEUTRALITY: ACCELERATING EU DECARBONISATION WITH RESEARCH AND INNOVATION FUNDING

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Climate and energy research and innovation has an essential role to play in the EU's deep decarbonisation as part of the long-term climate strategy and European Green Deal flagship policy. The EU has considerable financial resources at its disposal to ensure climate and energy R&I helps deliver climate neutrality, through various funding instruments. The overlapping dimensions of innovation are supported across a range of EU programmes and funds, which together hold the potential to support clean innovation. But these funds must be designed in a coherent and complementary manner to support clean innovation across the EU economy. This briefing sets out the requirements and conditions for well-designed and aligned innovation funding that delivers mid-century climate neutrality for the EU.

Key points

- > **Adopt a solution-driven approach:** innovation should be focused on delivering targeted low carbon aims and outcomes, delivered within a specific time frame
- > **Facilitate the deployment of innovative technology:** innovative low carbon technology often faces the challenge of being deployed within existing policies that do not always promote innovative or immature technology
- > **Cover all stages of the innovation process:** policy needs to ensure support is given to all stages of innovation, not just the initial research and development phase
- > **Ensure funds are socially and geographically inclusive:** to ensure innovation addresses climate change and improves the lives of EU citizens, policies should be designed to drive climate-related technological innovation while also improving social welfare for EU citizens



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Innovation as an enabler of EU climate neutrality

Europe's plan to become the first climate neutral economy is a step-change in decarbonisation ambition, but delivering this policy outcome requires a shift from target-setting to a new focus on implementation and delivery. Policies such as research and innovation will be essential in delivering this outcome in the following ways:

Deep-decarbonisation of the EU economy – while a large proportion of EU decarbonisation can be delivered using existing technologies, innovation is essential in reducing emissions across all sectors of the economy. Although the power sector continues to decarbonise, the so-called 'hard to decarbonise' industrial, transport and agriculture sectors have seen emissions remain broadly flat or increase in the last decade. In these high emitting sectors, R&I's contribution already spans the 'known' technology readiness levels, but it must also enter new areas through emergent trends such as sector coupling, digitalisation, and more efficiency in production processes. This must include the deployment of both small and large-scale technologies.

Acceleration of the clean transition – catalysing investment in low carbon technology is essential to ensure the pace of decarbonisation accelerates enough to keep the EU on the correct trajectory to achieve climate neutrality by mid-century. European public funds on their own are limited when compared to R&I investment needs for deep decarbonisation, but they are a powerful tool to align national research programmes across member states, as well as providing signals to attract for private sector finance in climate-related sectors.

Facilitate a joint societal and technological shift – decarbonising almost a whole continent is as much a social and political challenge as it is a technical one. Though new technologies will be key to deep-decarbonisation, reaching climate neutrality cannot happen unless there are changes to lifestyles, social structures, and how citizens use energy in their everyday lives. Technological innovation must go hand-in-hand with social innovation, to ensure reaching climate neutrality is done in a just manner, harnessing the potential to empower citizens with new skills, and promoting social inclusivity across all member states.

Because society will need to change how it interacts with energy to meet the Paris Agreement and climate neutrality, there must be changes across economics, political institutions, social structures and consumer behaviour.¹ This means the types of technology and infrastructure being deployed will need to evolve, as well as the way we use them and the energy services they provide. Social innovation is therefore required to ensure these system changes can happen, but in an equitable and just manner for all groups in society.

¹ European Commission (2018) 'Final Report of the High-Level Panel of the European Decarbonisation Pathways Initiative' https://ec.europa.eu/info/sites/info/files/research_and_innovation/research_by_area/documents/ec_rtd_decarbonisation-report_112018.pdf



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Aligning innovation funding with climate neutrality

The EU has substantial financial resources at its disposal to ensure there is sufficient climate-related R&I to help deliver climate neutrality. But these resources are not found within a single entity, and are instead spread across a variety of funds, programmes and policies, among which the Multiannual Financial Framework (MFF) plays a big role. However, a set of tools does not necessarily equate to a single policy. Ultimately, the ability of innovation funding to contribute to delivering clean innovation at-scale depends on how the funds are designed and how they are actually used.

It is crucial that the design of innovation funding tools and any future governance must be explicitly aligned with a target of climate neutrality. Having a solution-driven innovation approach with explicit climate mainstreaming for all EU funds – meaning dedicating a share of each fund to climate-related projects - will help deliver mid-century climate neutrality. Mainstreaming climate in funding should also include ‘climate proofing’ to exclude expenditure on fossil fuel technology and infrastructure.² Currently, climate and energy expenditure is limited to only one pillar of Horizon Europe (HEU), meaning it has just a 35% share of funds. This means that non-climate proofed funding is too high, while the share for energy and climate is insufficient to catalyse private sector investments.

This also means that different innovation funding mechanisms of the EU need to be complimentary and able to work together to deliver clean innovation across the EU economy. Achieving climate neutrality means the EU needs to encourage the development of new technologies, but it is crucial to have a cohesive structure to help target innovation support and that there are synergies between funds to ensure all stages of innovation are adequately covered.

Delivering a climate neutral economy by the mid-century will require a shift in climate policy from tools such as the Emissions Trading System (ETS) and promotion of renewable energy sources (ostensibly electricity generation), to a wider, deep decarbonisation of industry and transport, as well as fundamental social systems.³ This will have wide-ranging implications for technologies and infrastructure, as mid-century climate neutrality leaves little room for the use of currently widespread technologies, such as conventional petrol and diesel vehicles, unabated gas-fired power generation, and gas-fired heating in homes. Innovation can be either disruptive or incremental, but both forms are needed to reduce emissions reductions required for a 1.5°C warming scenario, along with the deployment of all existing technology at-scale.⁴

² E3G (2018) ‘4 priorities for a future-oriented Connecting Europe Facility’ <https://www.e3g.org/library/4-priorities-for-a-future-oriented-connecting-europe-facility>

³ See for example: Committee on Climate Change (2019) ‘Net Zero: The UK’s contribution to stopping global warming’, pp.136-146 <https://www.theccc.org.uk/wp-content/uploads/2019/05/Net-Zero-The-UKs-contribution-to-stopping-global-warming.pdf>

⁴ Wilson, C (2018) Disruptive low-carbon innovations, *Energy Research & Social Science*, 37, pp. 216-223



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The EU's clean innovation funding toolbox

EU R&I funding for climate and energy extends across a broad range of policy instruments beyond its flagship programme Horizon Europe. EU clean innovation benefits from a large toolbox of other funds of different sizes and functions, which will all assist in the clean transition and reaching climate neutrality.⁵ Funding for these instruments comes primarily from the MFF. Running from 2021-2027, the framework includes programmes like Horizon Europe and Invest EU. The MFF proposal included an innovation funding envelope 43% larger than in its predecessor, despite an overall reduction in the MFF budget. The ETS is also a key source of funding for climate and energy innovation instruments, while the European Investment Bank (EIB) may increase in importance in future. Recent changes on lending policy criteria changes could see more resources dedicated to low carbon innovation.⁶

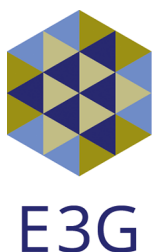
FUND	TOTAL ⁷	COVERAGE	SCOPE
Funded via the Multi-annual Financial Framework (MFF)			
Cohesion policy funds	€374bn	Regional development and convergence	Deployment
European Social Fund Plus	€101bn	Education, employment and social inclusion	Testing, evaluation and scaling-up
Horizon Europe (formerly Horizon 2020)	€100bn	Research and innovation	Research, development and deployment
InvestEU	€15bn + €650bn private funds	Leverage private funds to cover investment gaps	Innovation projects at all stages
Connecting Europe Facility	€8.7bn	Infrastructure (energy and transport)	Deployment
LIFE	€5.5bn	Environment and climate	Demonstration and scaling-up
Funded via the Emissions Trading System (ETS)			
Innovation Fund	€10bn	Clean innovation focused on industry	Demonstration
Modernisation Fund	€9.3bn	Support energy system transition in the CEE region	Deployment

Figure 1: Primary EU innovation funding mechanisms

⁵ Institut Jacques Delors (2019) 'Mainstreaming Innovation Funding in the EU Budget' [http://www.europarl.europa.eu/thinktank/en/document.html?reference=IPOL_STU\(2019\)636471](http://www.europarl.europa.eu/thinktank/en/document.html?reference=IPOL_STU(2019)636471) , p. 13

⁶ European Investment Bank (14 November 2019) *EU Bank launches ambitious new climate strategy and Energy Lending Policy* <https://www.eib.org/en/press/all/2019-313-eu-bank-launches-ambitious-new-climate-strategy-and-energy-lending-policy> [accessed 5 December 2019]

⁷ This number is the total size of the fund, not the amount allocated to research and innovation



Horizon Europe

Horizon Europe (HEU) is the EU's largest dedicated R&I funding programme, and the flagship tool for supporting clean innovation. It has a proposed budget envelope of €100bn from 2021-2027, which is €20bn higher compared to the funding under the fund Horizon 2020, which ran from 2014-2020. As well as being the largest in budget terms, Horizon Europe is significant because it covers all stages of technological development. The Commission selected *Climate, Energy and Mobility* as one of the five challenge pillars around which HEU is structured and proposed committing a 35% share of funds to climate-related projects. It also introduced the 'missions' feature of the programme, which would see a targeted and directional form of innovation funding, focused on critical challenges facing EU.

Horizon Europe is a versatile fund with high impact because it works across all stages of innovation, and can deploy a range of tools to support innovation. Beyond financing research and development, HEU's newly introduced Enhanced European Innovation Council (EIC) also act as an incubator for breakthrough technologies, facilitating their development and market-readiness.⁸ This will be supported by a new public-private partnership under the joint Breakthrough Energy Europe (BEE) initiative.⁹ Alongside these, the European Institute of Innovation and Technology InnoEnergy (EIT) aims to position the EU as front-runner on sustainable energy innovation through encouraging partnerships between business, education and research organisations.

InvestEU

Formerly known as European Fund for Strategic Investments (EFSI), InvestEU is the main instrument to leverage private investment. It is a 'fund of funds', aggregating several pots including the InnovFin instrument which co-facilitated access to finance for innovative EU businesses in conjunction with the EIB. By mobilising large private investments alongside with EU funds, InvestEU fills investment gaps and addresses market failures. Although the fund is not dedicated to innovation, one of the four InvestEU thematic windows is funding R&I and digitalisation – the latter being a key component of the energy system transformation.¹⁰

Because InvestEU leverages private finance it has the potential to substantially increase the overall size of funding and the ability of R&I projects to access it. It has a proposed envelope of €15bn from the European Commission and an estimated leveraged total of €650bn in private funds. This particularly benefits projects perceived by some lenders as higher risk, a perception that can be a hurdle to innovative development. It can also overcome the challenge that EFSI faced because of a lack of financial and political capacity on member states and a lack of scalable funding for smaller projects. For example, using innovative technology on infrastructure projects can involve higher

⁸ European Commission, 'Enhanced European Innovation Council (EIC) pilot' <https://ec.europa.eu/research/eic/index.cfm?pg=home> [accessed 5 December 2019]

⁹ For more information on the BEE see: https://europa.eu/rapid/press-release_IP-18-6125_en.htm

¹⁰ E3G (2017) 'Infrastructure For a Changing Energy System: The Next Generation of Policies For The European Union' <https://www.e3g.org/library/infrastructure-for-a-changing-energy-system-the-next-generation-of-policies>



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levels of risk compared to more mature technologies, making it difficult to deploy under a merchant financing model.¹¹ InvestEU's leveraging of private finance can therefore help with the deployment of technology, in the absence of policy and regulatory change.

Innovation Fund

The Innovation Fund is a new source of funding introduced for the post-2020 EU budget period, aimed at supporting the demonstration of innovative low carbon technologies.¹² It has a particular focus on the industrial sector, complimenting the fact that its €10bn resource is drawn from the sale of allowances from ETS. Funds will also come from unspent resources from its smaller predecessor the NER300. The Innovation Fund is a key component of the Commission's *Clean Planet for All* strategy, through financially supporting the development of clean innovation technologies and helping to bring to market new technologies for energy intensive industries and related energy sectors.

Although the fund targets more mature emissions-reducing technologies, it also aims to help the development of less mature innovation in areas such as energy storage and carbon capture and storage (CCS).¹³ The fund is expected to work in tandem with InvestEU to provide comprehensive financial backing to private sector clean innovation investment and boost overall European competitiveness.

Cohesion Policy funds

The European Regional Development Fund (ERDF) and the Cohesion Fund (referred to collectively as cohesion policy funds) are the EU's main tools for regional development, reducing economic and social disparities across the EU. With a proposed envelope of €374bn from the MFF, cohesion policy funds are one the MFF's largest spending areas, as regional transformation is a major priority for the European Commission.

The use of innovation-based economic transformation and the low-carbon transition are the two primary policy objectives for the Commission, meaning the funds can also complement Horizon Europe. The targeted use of cohesion policy funds could encourage regions to embed clean innovation at the heart of their regional development strategies, and support a smart, low carbon transition in their industrial sectors and value chains.¹⁴

¹¹ E3G (2018) 'Innovation In EU Electricity Grids: Linking Research and Innovation to Deployment Instruments' <https://www.e3g.org/library/innovation-eu-electricity-grids>

¹² European Commission (26 February 2019) *Innovation Fund Delegated Regulation – Frequently Asked Questions* https://ec.europa.eu/commission/presscorner/detail/en/MEMO_19_1416

¹³ DG CLIMA, 'Innovation Fund' https://ec.europa.eu/clima/policies/innovation-fund_en [accessed 8 December 2019]

¹⁴ Institut Jacques Delors (2019) 'Mainstreaming Innovation Funding in the EU Budget', p. 100 [http://www.europarl.europa.eu/thinktank/en/document.html?reference=IPOL_STU\(2019\)636471](http://www.europarl.europa.eu/thinktank/en/document.html?reference=IPOL_STU(2019)636471)



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Other clean innovation funding sources

The **Connecting Europe Facility** – as part of the MFF – supports European cross-border projects for the development of energy, transport and digital networks. The energy component of CEF supports Europe’s decarbonisation by deploying large-scale clean infrastructure projects such as smart grids, high-voltage interconnectors and innovative storage projects. It has a proposed budget of €8.7bn in future investment rounds, but CEF is not aligned with climate policies and to date it has primarily invested in natural gas transmission infrastructure.¹⁵

The **European Social Fund Plus** (ESF+) provides support for member states to test, evaluate and scale up innovative solutions at local and regional levels. It partially addresses the absence of dedicated funds for supporting the **social component of innovation** in the EU’s decarbonisation efforts, while reinforcing the European Employment and Social Innovation programme (EaSI) aims of supporting social and labour market policy innovations.¹⁶

The **LIFE programme** is the EU’s dedicated funding instrument for the environment and climate action, supporting the demonstration and scaling-up of innovative technologies in this field. Although it has a relatively limited proposed budget envelope of €5.5bn it complements larger EU programmes such as Horizon Europe and Cohesion policy funds.¹⁷ These synergies and co-working with other funds that finance large-scale deployment are crucial to replicate and demonstrate results obtained under the LIFE programme.

The **Modernisation Fund** will have an envelope of €9.3bn for facilitating the decarbonisation of central and eastern European member states (CEE).¹⁸ Resourced through the sale of ETS allowances, the fund will address gaps in energy system investment. This covers the modernisation of large and small scale infrastructure across the energy system, including renewables, energy efficiency, storage, and interconnection. It will also help to develop transition pathways in carbon intensive regions of member states.¹⁹

¹⁵ E3G (2018) ‘4 priorities for a future-oriented Connecting Europe Facility’ <https://www.e3g.org/library/4-priorities-for-a-future-oriented-connecting-europe-facility>

¹⁶ Institut Jacques Delors (2019) ‘Mainstreaming Innovation Funding in the EU Budget’, [https://www.europarl.europa.eu/thinktank/en/document.html?reference=IPOL_STU\(2019\)636471](https://www.europarl.europa.eu/thinktank/en/document.html?reference=IPOL_STU(2019)636471)

¹⁷ European Commission (2018), Proposal Establishing a Programme for the Environment and Climate Action (LIFE) <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2018%3A385%3AFIN>

¹⁸ CEPS (2019) ‘The opportunities of the Modernisation Fund for the energy transition in Central and Eastern Europe’ https://www.ceps.eu/wp-content/uploads/2019/06/PI2019_09_Modernisation_Fund_Paper.pdf

¹⁹ European Commission, ‘Revision for phase 4 (2021-2030)’ https://ec.europa.eu/clima/policies/ets/revision_en [accessed 8 December 2019]



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Priority 1: Solution-driven innovation for climate neutrality

The EU has only a short time frame within which it must act to be aligned with the Paris Agreement and deliver climate neutrality by 2050. The time-restricted nature of this means innovation cannot be left solely to markets. Clear policy signals and institutional support are required to give direction and create options for the market, which allows low carbon innovation to be taken forward and deployed commercially.

To this end, a key feature of Horizon Europe will be the adoption of a ‘mission-oriented’ approach to policy making. These missions are defined as “a portfolio of excellence-based and impact driven R&I actions across disciplines and sectors” – which means using multiple policy tools across different sectors and parts of society, to ensure innovation is focused on a clear and defined goal.²⁰

The Commission identified five high-level policy areas for this, of which one is ‘Adaptation to Climate Change including Societal Transformation’. Taking a multisectoral and targeted approach to delivering a policy goal can maximise the effectiveness of innovation and investments. This also extends to social innovation, as the missions are designed to be open to multiple, bottom-up approaches that take account of citizens’ and societal needs.²¹

> **Align member state and EU R&I priorities to increase clean innovation funding**

While it is essential for the EU’s own innovation funding tools to all be focused on delivering climate neutrality, achieving this objective requires member state priorities to be aligned with this objective as well. In creating this consistency, the overall size of the clean innovation funding envelope would be increased, and member states would be maximising the impact of EU funds for domestic investment. Direct-EU funding represents only a minor share of public investment in member states’ research and innovation, at only 8%, compared to a share of up to 30% by national governments.²²

The Horizon Europe fund will include European Partnerships with member states, that work alongside the private sector and non-governmental organisations to improve R&I that contributes to the ‘Global Challenges and European Industrial Competitiveness’ pillar of HEU. These partnerships between the EU and member states need to be leveraged so that joint priorities on delivering climate neutrality are developed.

²⁰ Council of the European Union (2018) Proposal for a Regulation of the European Parliament and of the Council establishing Horizon Europe - the Framework Programme for Research and Innovation, laying down its rules for participation and dissemination, 2018/0224 (COD)

²¹ Ministry of Economic Affairs and Employment of Finland (2019) ‘Missions as a strategic tool in Horizon Europe’ <https://eu2019.fi/documents/11707387/14482217/Presidency+discussion+paper+-+Missions+as+a+strategic+tool+in+Horizon+Europe.pdf>

²² See Climate Strategies (2018) ‘Funding Innovation to Deliver EU Competitive Climate Leadership’ <https://europeanclimate.org/wp-content/uploads/2018/11/Web-version-FINAL.pdf>



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> **Mission-oriented innovation needs clear governance and a learning body**

Although the Commission has selected the mission areas and appointed mission boards, the absence of a clear proposed governance framework or overarching body means it is how unclear these policies would work alongside other funds. The governance process for missions will therefore be critical for their effectiveness, making it essential that a learning body is created, drawing on experience from all sectors and stakeholders. The overall success of the missions process will also require commitment from directorates within the Commission, as well as member state governments and regional authorities. The ability to engage and inspire the wider stakeholder community including at individual citizen level will also be crucial to this, as climate neutrality must be delivered in a fair and equitable manner.

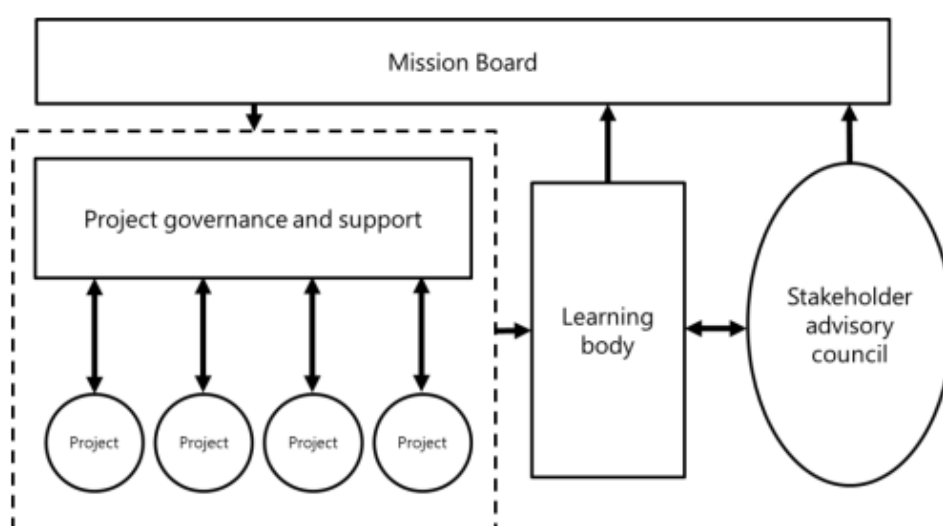


Figure 2: High level mission governance structure²³

²³ E3G (2019) 'Mission-Based Innovation for Climate and Energy: Mission Design and Governance' https://www.e3g.org/docs/Mission-based_innovation_for_climate_and_energy.pdf



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Priority 2: Facilitate deployment of innovation

A key challenge of deploying innovation at-scale is ensuring there is a sufficient demand from markets and the sectors to use the innovation. Mission-oriented development is one way of addressing this (see *Priority 1: solution-drive innovation for climate neutrality*), but in general there is insufficient support for the deployment of innovative, low carbon technology in the EU. Making sure innovation is actually deployed is a crucial element of reorganising the EU's energy, industrial and transport sectors and meeting climate neutrality.

Although EU policies on early innovation and giving a 'push' are largely successful, there remains insufficient 'pull' from markets and deployment-focused policies to ensure innovation reaches markets and commercialisation. Some MFF and ETS-funded innovation support schemes (such as InvestEU and the CEE-focused Innovation Fund) go some-way to address existing gaps in financial support for innovative technology compared to mature technology. For example, the €10.5bn EIC fund, under HEU, will support the scaling-up of start-ups and SMEs working on zero-emissions technologies.²⁴

> **Improve the deployment of innovative technology**

The development of innovative low carbon technologies is, by itself, not sufficient to ensure that it will be deployed to market and rolled out where it can be used. Once a new innovation has been developed, the absence of a stable pathway to commercialisation can mean that deployment does not happen at the scale required for climate neutrality. Existing technologies and new innovation are both needed to reach climate neutrality, but the EU's primary technology deployment policies are not sufficient to ensure innovation is deployed at scale.

For example, the deployment of energy network infrastructure under CEF does not explicitly incentivise deploying innovation – even if it has already been funded through other EU innovation programmes. CEF does not support innovation as the policy is designed to improve cross-border infrastructure connections between member states. But electricity grid innovation (in particular to increase renewables penetration, system flexibility and trading) is a crucial element for delivering climate neutrality. However, there is a disconnect between the deployment of new technologies and the energy system that the EU will to achieve climate neutrality.²⁵ This is a missed opportunity for EU spending to assist with the deployment of innovative technologies, rather than funding research and development alone.

²⁴ European Commission (2019) 'Enhanced European Innovation Council (EIC) pilot' <https://ec.europa.eu/research/eic/index.cfm> [accessed 24 October 2019]

²⁵ E3G (2018) '4 priorities for a future-oriented Connecting Europe Facility' <https://www.e3g.org/library/4-priorities-for-a-future-oriented-connecting-europe-facility>



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Innovation funding therefore should facilitate the deployment of these technologies to achieve wide-ranging changes in energy use, with linked deployment and innovation funds. Policies should identify and support the infrastructure that will allow for roll-out of innovation, and what instruments are needed to facilitate scaled-up deployment. This is also key for deployment of existing technologies that are at pre-commercialisation stage and yet to be deployed at scale.

> **Redefine the understanding of infrastructure and how it will operate**

There should be a change in how infrastructure is conceptualised and understood in deployment policies. The nature of infrastructure and how we want it to operate is changing because of decarbonisation, decentralisation and digitalisation, but existing policy frameworks do not best address these processes. Future planning will not be a binary choice between the current energy system and a more innovative one; instead, there will be a combination of technologies at different scales and provision of different services, with different time cycles for innovation and infrastructure.

Innovation funding instruments must therefore take account of how the energy system is changing, so that the most suitable, cost effective, and appropriate innovation is being supported for this sector. As deep decarbonisation of the energy system and social implications it induces accelerate, it will become ever more important to have local and regional-specific infrastructure solutions. In the innovation field, this will mean recognising that there will be many different solutions for different geographies in the EU, particularly in terms of renewable electricity, industrial decarbonisation and low carbon transport and e-mobility. This means EU funding instruments must work with national member state plans and strategies to best recognise the local requirements and solutions, and support innovation accordingly.²⁶

As part of this, policies must also recognise that there are different project lead-in and development times across future technology (for example between software and physical infrastructure). There also an issue with differing life cycles, with typical CEF-funded projects and PCIs lasting for multiple decades while digital innovation and systems could be superseded and require replacement in under ten years.²⁷

²⁶ E3G (2019) 'EU Energy System Decarbonisation Policy: Breaking the Logjam'
https://www.e3g.org/docs/3_12_19_E3G_EU_Energy_System_Decarbonisation_Policy.pdf

²⁷ E3G (2017) 'Infrastructure for a changing energy system: the next generation of policies for the European Union'
<https://www.e3g.org/library/infrastructure-for-a-changing-energy-system-the-next-generation-of-policies>



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Priority 3: Cover all stages of the innovation process

Innovation takes place across all stages of the development of technology, beyond just early stage research, extending through commercialisation, deployment and business models related to how the technology will be used. Although the EU has a range of funds that support innovation, it is unclear if there is sufficient support for the specific areas of the innovation process that need it most. Not all funds have the same level of focus on clean innovation or individual stages of innovation.

Moreover, some have different eligibility criteria or geographic criteria (e.g. the Modernisation fund is applicable to only CEE countries). While the diversity of policy fields and stakeholders working on innovation is a positive, the variability in how each approaches clean energy innovation could be detrimental to the overall aim of reaching climate neutrality.

> Targeted support for all stages of innovation and development

The EU's funding instruments for supporting innovation cover the whole innovation ecosystem, extending across research bodies, the private sector, higher education, and member state institutions. However, funding the whole ecosystem does not ensure the whole innovation development pathway is funded. It is also unclear if the range of innovation funding tools provide adequate support and encourage innovation that will lead to emissions reductions and climate neutrality.

The Commission has made efforts to address this and sought to close gaps in innovation and research funding with the creation of the European Innovation Council (EIC) in 2017 to address the so-called 'valley of death' for innovation projects that fail to reach commercialisation. But targeted support for the development, demonstration, and commercialisation phases of innovation should be given where necessary, reflecting the specific needs of innovative technology, and the end-use sector where it can help decarbonise.

> Innovation policy should extend beyond the Technology Readiness Level

The Technology Readiness Level (TRL) is the EU's primary tool for measuring the progress of innovation. It is a key element of the EU's publicly funded research, but its inclusion in Horizon Europe and other funds has been criticised because of its unsuitability for measuring innovation outside of its original, narrow application.²⁸ The TRL was first used in the mid-twentieth century for space exploration, and it has limitations when being applied to an evolving environment such as the energy system, which has a high number of interacting sectors and variables, as well as significant incremental innovation (as opposed to breakthrough).

²⁸ Russell Group (August 2018) 'Russell Group position on the Horizon Europe proposals'
<https://russellgroup.ac.uk/media/5710/russell-group-position-paper-on-horizon-europe-proposals-august-2018.pdf>



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It can also neglect the commercialisation and deployment stage of product development, which sits beyond the final stage of the TRL. To avoid a piecemeal approach to funding and one particular stage of innovation receiving an over-sized share of financial and regulatory support, the approach to innovation should be expanded beyond the narrow focus of the Technology Readiness Level (TRL).²⁹

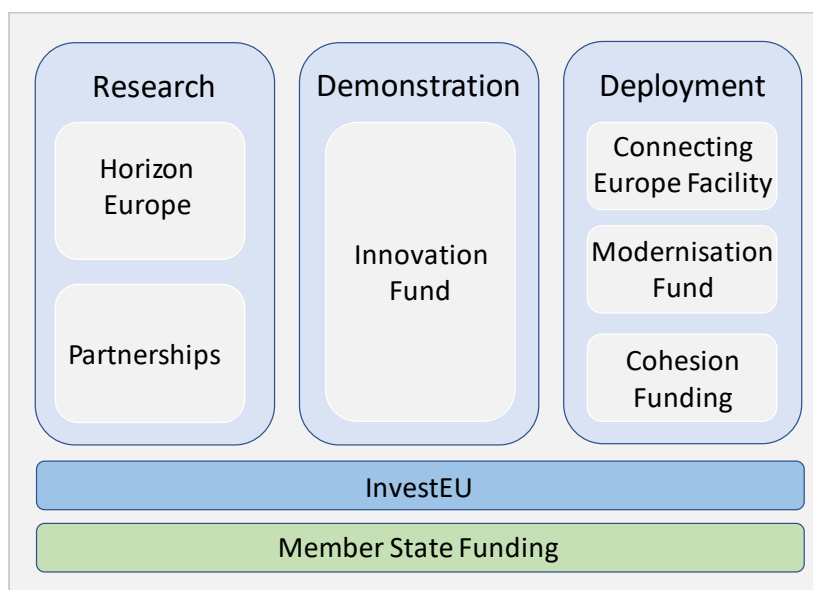


Figure 3: EU funds and stages of innovation

²⁹ European Commission (2019) Horizon 2020 Work Programme 2018-2020, General Annex G, C (2019) 4575



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Priority 4: Funds must be socially and geographically inclusive

Achieving climate neutrality requires deep-seated changes to the way individuals and societies live and work, and how they use and interact with energy. Better understanding and support for the social dynamic of climate neutrality and the clean transition will be crucial for the next phase of technological development and innovation, when consumers will be more active and current behaviours will be disrupted. Because the implementation of the transition and achieving climate neutrality depends on a social transition (as well as technological and regulatory), policies on delivering and funding the clean transition must have a social science and humanities (SSH) dimension at their core. It must also cover all regions of the EU, and ensure R&I and economic disparities are not reinforced or widened.

> **Integrate the SSH perspective into R&I policies on the energy transition**

The initial phases of innovation in the clean energy transition during the 1990s and 2000s were energy supply sectors, and largely separated from consumers. These early developments did not change what consumers did or how they interacted with energy, and the derived demand for the services energy provided remained the same. But innovation is increasingly taking place in more parts of the energy system, and there have been shifts in both how energy is consumed, and the services demanded from it. Digitalisation, energy decentralisation, and the requirement to change society's use of energy to meet climate neutrality, mean there is a rapidly growing suite of consumer-facing innovation.³⁰

However, with the changing energy system there is a growing need for dedicated research and funding to properly understand what behavioural change is required from consumers. This includes how best to ensure they are active participants in the transition and understanding the need for public acceptability and consent in the reorganising of the relationship between energy and society.³¹

With consumers becoming more active in the consumption of energy, there also needs to be a better understanding of how they interact with disruptive innovation and what barriers there will be to the uptake of new technologies.³² To properly understand these changes and social requirements of the energy transition, SSH should be integrated into the core of R&I policies on climate neutrality, rather than being a peripheral or separate area of research.

³⁰ Ofgem (2017) 'Future Insights Series: The Futures of Domestic Energy Consumption' https://www.ofgem.gov.uk/system/files/docs/2017/03/ofg958_future_insights_series_4_0.pdf

³¹ Lennon, B, et al. (2019) Community acceptability and the energy transition: a citizens' perspective, *Energy, Sustainability and Society*, 9 (35),

³² Abbas, M, et. Al. (2016) The effect of innovation and consumer related factors on consumer resistance to innovation, *Cogent Business and Management*, 4 (1)



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> **Dedicate resources to research on behavioural aspects of innovation**

Because the transition to climate neutrality is as much a social transition as a technological one, it is crucial for the social consequences, adequacy and acceptance of innovation and new technology (as part of achieving climate neutrality) to be fully understood. Although the missions process aims to ensure there is better inclusion and representation of civil society in the innovation process. R&I should also be linked to the employment, education and training instruments found under ESF+ to ensure there is a full understanding of the role that innovation will play in the transition from fossil fuel industries with climate neutrality.

There should also be dedicated funding resources to support research on the behavioural aspects of innovation to ensure that they are with carried out with an understanding of the SSH perspective., Previous research funded under Horizon 2020 on energy-related SSH must be continued under HEU and retain a strong presence in its final design, with an integrated SSH element to R&I policy, becoming the default. More generally, there should also be a formal exchange between energy-SSH and relevant SSH fields and European Commission policy-makers to ensure better representation of SSH in existing policy frameworks. This could include creating a dedicated SSH structure similar to the European Technology and Innovation Platforms (ETIPs), adding SSH to existing ETIPs, or working with the European Energy Research Alliance (EERA).

> **Target R&I funds to remove geographic disparities across recipients**

There is a divide between western and eastern European member states in innovation performance and actual scientific and technology outputs. EU policy and funding has reduced some of the disparity in innovation performance gaps, but the divide remains.³³ This is reflected in the distribution of Horizon 2020 projects, with 54% of them in the UK, Germany, Spain, Italy and France.³⁴ This disparity reinforces the economic divide between member states, and could slow down the transition to climate neutrality by reducing confidence in countries' ability to take advantage of the transition and the benefits for jobs and competitiveness.

This is also a lost opportunity to reduce the cost of technology by better including CEE countries in the value chain of the production of existing technologies. This could help with deployment at-scale, cheaper production, and greater take up of clean technologies in CEE countries. Ensuring synergies between separate innovation funds is crucial to addressing this, but a real R&I transition strategy is needed to make sure R&I climate-related funds can serve to enable the transition in all regions of the EU.

³³ European Commission (2018) 'Science, Research and Innovation Performance of the EU 2018' https://ec.europa.eu/info/sites/info/files/rec-17-015-srip-report2018_mep-web-20180228.pdf

³⁴ European Commission (2017) 'Horizon 2020 in full swing – Three years on' https://ec.europa.eu/programmes/horizon2020/sites/horizon2020/files/h2020_threeyearson_a4_horizontal_2018_web.pdf p.27



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Conclusion

The scale of action required for the EU to meet climate neutrality by mid-century requires unprecedented restructuring of technological, economic and social systems in a short time window. The urgency of the need to tackle climate change, and the technological and social needs created by this, means the importance of innovation across all member states and their economies will continue growing. This reinforces the need for the EU to have a dedicated clean innovation policy framework that can deliver the following:

- > **Incentivise low carbon R&I across all sectors, technologies and geographies.** To ensure the contribution of low carbon R&I is maximised, EU funds need to support all stages of innovation, including deployment and commercialisation. They should also work across all sectors of the economy that need to decarbonise, and ensure the clean transition adds value and progresses in all regions of the EU.
- > **Increased effectiveness of R&I funds through building a single policy aim.** The impact and overall effectiveness of the various funds that support innovation can be maximised by ensuring they are focused on high level policy outcomes. A channelling and coordinating of funds towards reaching climate neutrality would help the development and deployment of clean innovation and ultimately reduce EU carbon emissions.
- > **A coherent ‘one policy’ type of approach to R&I funds used for decarbonisation.** A single policy approach articulated around the specific need of promoting clean innovation to achieve climate neutrality is crucial. Although the means to do this already exist, they need to be deployed in a more targeted manner so innovation can be more effective in supporting EU decarbonisation goals throughout relevant policy areas. This would also help avoid competition between various R&I priorities (e.g. health, land use, and transport) which leads to competition between various fields and dilutes decarbonisation concerns.
- > **Co-designed funds to ensure synergies between them.** While different funds support innovation approaches in different ways, targeting different outcomes, there must be consistency and synergies between them. This includes being aligned with climate neutrality, climate mainstreaming, and seeking to engage all levels of society and regions of the EU, which are all essential for climate neutrality.



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About E3G

E3G is an independent, non-profit European organisation operating in the public interest to accelerate the global transition to sustainable development. E3G builds cross-sectoral coalitions to achieve carefully defined outcomes, chosen for their capacity to leverage change. E3G works closely with like-minded partners in government, politics, business, civil society, science, the media, public interest foundations and elsewhere.

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