



ENERGY RESEARCH & INNOVATION:

INVEST NOW FOR NET-ZERO EMISSIONS BY 2050

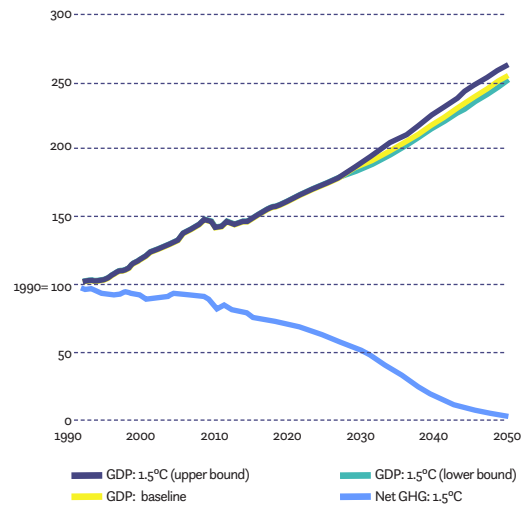
Strategic importance of decarbonising European energy systems:

- ✓ Energy is responsible for three-quarters of direct GHG emissions in the EU, and energy supply contributes the lion's share (28%).
- ✓ Decarbonising Europe's energy supply is forecast to result in a 2.1% increase in GDP and create 1.8 million additional jobs by 2050.
- ✓ A net-zero energy system will position Europe to deliver innovative clean technologies and services into a projected €5 trillion global market.
- ✓ Moving to a net-zero emissions in energy can save European families up to €23 billion on their energy bills.
- ✓ Energy poverty that affects 54+ million EU citizens can be addressed through a just energy transition to net-zero emissions through efficiency and innovation.
- ✓ A decarbonised European energy system requires strong innovation investment in five areas: 1. Dispatchable power; 2. Variable renewable energy; 3. Transmission and distribution; 4. Storage; and 5. Energy efficiency.

Innovation investments accelerate decarbonisation of EU's energy system

| Innovation area | Major innovation investment needed |
|---|--|
| Clean Power System | Dispatchable low carbon generation (such as flexible hydro, geothermal, biogas generation) Ultra-Low-Cost variable renewable power (wind, solar, ocean) |
| Energy Efficiency in Buildings & Industry | Next generation buildings fabrics & materials Smart appliances and building controls |
| Long Duration Storage | Long-duration/ seasonal electricity and thermal energy storage technologies (such as flow batteries and molten salt storage) Green hydrogen as an energy storage carrier Synthetic methane (e-gas) |
| Smart Electrification and Transmission | Energy system digitalisation for sector and consumer integration and overall system optimisation Demand side response (DSR) sources Connected electric vehicles, fuel cell, heavy goods vehicles, battery electric vehicles Deep electrification of energy services for industry, transport, and buildings Ultra-Low-Cost Transmission Next-Generation Ultra-Flexible Grid Management |

Energy sector decarbonisation enables EU GDP / GHG emissions decoupling

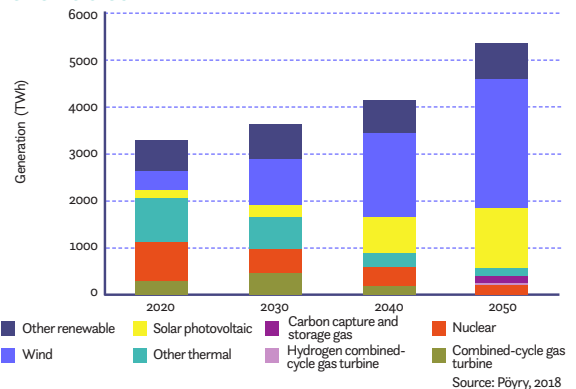


Case Study
Solving renewable energy storage with steel

Founded in 2016, innovative German startup Lumenion is developing an energy storage system that could be applied across different sectors and markets, including agriculture, heavy industry and housing.

- ✓ At present, Lumenion is working on a 2.4-megawatt pilot storage project at a 1970s-era apartment development near Berlin's main international airport.
- ✓ Surplus energy delivered to the apartments is stored in steel rods -that essentially act as high-temperature thermal batteries-, then heat is delivered to residents for space heating and to warm water.
- ✓ Heat from Lumenion storage systems can also be converted to steam and used for generating electricity.
- ✓ If the pilot project is successful, it could be scaled up to large industrial sites across Europe, helping usher in an era when renewable energy supplies are better managed, cheaper and more widely deployed.

Europe's power generation transformation to net-zero emissions by 2050. Dominated by renewables



"We must mobilise dedicated funds [...] to spur innovation of new clean technologies in industry and the power sector, and to support the modernisation of energy systems..."

Frans Timmermans,
Vice-President of the European Commission



ENERGY RESEARCH & INNOVATION:

ALIGNED POLICY ENVIRONMENT REQUIRED TO SCALE-UP INVESTMENTS

Innovation required to accelerate energy sector decarbonisation:

The EU's vision for a climate-neutral Europe by 2050 requires investing in innovative solutions and aligning policy efforts to guarantee social fairness and a just transition. The core steps are:

- 1 Maximise benefits from energy efficiency
- 2 Fully decarbonise energy supply
- 3 Develop smart network infrastructure and interconnections
- 4 Advance large scale-energy storage
- 5 Increase the digitalisation of energy systems and further the integration of sectors

Demand side R&I priorities

- » Society engagement and innovation to promote the benefits of efficiency.
- » Widespread electrification will need business model innovation in residential and commercial buildings.
- » Gas networks will need to transition to deliver heat primarily via green molecules.
- » Better-connected EV charging networks and more fuel cell innovation for cars and trucks.
- » Innovation to accelerate Demand Side Response (DSR) from large energy consumers and from residences.

Supply side R&I priorities

- » Boost cost performance and reliability of renewable energy sources like solar PV, wind and ocean power.
- » Make the grid more flexible and secure through: increased data processing to predict and manage variations in renewable energy supplies; increased use of batteries; and increased use of integrated local energy systems, microgrids and modular solutions.
- » Increase renewable-based production of green hydrogen.
- » Develop infrastructure for safe and cost-efficient transport, seasonal storage and provision of green hydrogen.

R&I investments require an aligned policy environment to decarbonise energy

- 1 Prioritise concurrent implementation of Clean Energy for All Europeans Package and the Clean Mobility Package
- 2 Align EU energy infrastructure policies and financial instruments with the EU's climate neutrality goal
- 3 Engage demand side to maximise energy efficiency potential and deliver a just transition
- 4 Fund innovative demonstration projects to test and scale up technologies
- 5 Develop a robust innovation agenda around smart electrification in order to accelerate the deployment, at scale, of lab-proven inventions

Developing new transparent energy producing surfaces

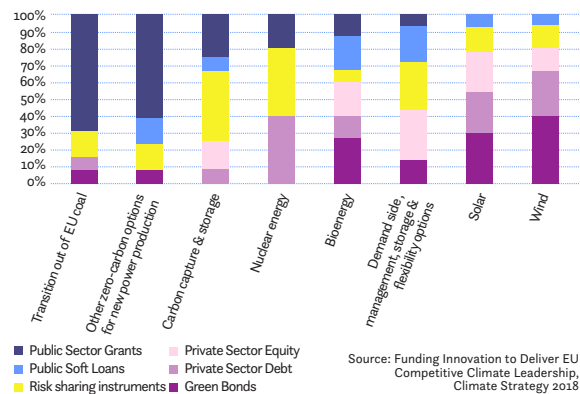
Case Study



Founded in 2018, Peafowl has developed a new plasmonic solar cell technology which can generate power from transparent surfaces (windows and displays).

- ✓ Plasmonic nanoparticles have the capacity to absorb upwards of ten times as much light as other conventional materials.
- ✓ Plasmonic solar cells are 300-500 nanometers thick, about a hundred times thinner than hair. In addition, these ultra-thin cells can be integrated into other products to create self-powered devices without interfering with aesthetics.
- ✓ Peafowl's solar cells are manufactured at a low price through a printing process without the use of toxic materials.
- ✓ Key benefits:
 - Highly transparent
 - Eliminates batteries or extends battery life
 - Can be printed onto any surface
 - Multi-colour or colourless

Finance instruments necessary for the delivery of decarbonised EU energy



Participant Institutions:

CLIMATE & STRATEGY PARTNERS



JDEC - JACQUES DELORS ENERGY CENTRE

