Powering a climate-neutral economy

The Energy System Integration and Hydrogen Strategies

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A changing energy landscape towards 2050
Changing energy carriers

Source: Based on EU28 Eurostat/LTS 1.5LIFE/TECH scenarios
Electrification, based on renewables

*Electricity production*

![Electricity production chart](chart.png)
Transformation for the gas industry

Consumption of gaseous fuels per gas type
Reduced import dependency

Energy imports

- Biomass
- Coal
- Natural gas
- Oil
- Dependency

![Energy imports chart showing import dependency over time and across different scenarios.](chart.png)
The Energy System Integration and Hydrogen strategies
Why a Strategy for Energy System Integration? Why now?

1. ESI is necessary to deliver on climate neutrality at the least cost, in line with Green Deal ambitions.

2. ESI helps deliver on other objectives: security of supply, jobs, industrial leadership.

3. ESI presents significant investment opportunities in post-Covid recovery context.
What is energy system integration?

The energy system today:
linear and wasteful flows of energy, in one direction only

Future EU integrated energy system:
energy flows between users and producers, reducing wasted resources and money

Energy System Integration (ESI) is the integrated planning and operation of the energy system ‘as a whole’, across multiple carriers, infrastructures and consumption sectors.
The Energy System Integration Strategy

1. A more **circular and energy efficient** energy system
2. More **electrification** of consumption, based on renewables
3. **Renewable and low carbon fuels** (incl. hydrogen) in hard-to-abate sectors

- **Consumers** can choose the best clean option for their needs
- **Infrastructure** is planned in an integrated way, looking jointly at gas, electricity, heat and hydrogen
- **Digitalisation** fully enables a smarter system
The Hydrogen Strategy – A roadmap to 2050

2024
- 6 GW of renewable hydrogen electrolysers
- Replace existing hydrogen production
- Regulation for liquid hydrogen markets
- Start planning of hydrogen infrastructure

2030
- 40 GW of renewable hydrogen electrolysers
- New applications in steel and transport
- Hydrogen for electricity balancing purposes
- Creation of “Hydrogen Valleys”
- Cross-border logistical infrastructure

2050
- Scale-up to all hard-to-decarbonise sectors
- Expansion of hydrogen-derived synthetic fuels
- EU-wide infrastructure network
- An open international market with € as benchmark
The Hydrogen Strategy – A full value chain approach

- An investment agenda
- Boosting demand and scaling up production
- Develop hydrogen infrastructure and markets
- Research and innovation
- International cooperation
Thank you for your attention!
The Energy System Integration Strategy
A more circular and energy efficient energy system

A system in which:
• unavoidable waste streams are reused for energy (circularity)
• the least energy-intensive options are prioritised

Energy efficiency
• EC guidance to MS on the energy efficiency first principle (non-legislative)
• Review of the “Primary Energy Factor” (EED)

A more circular energy system
• Regulatory framework for the reuse of waste heat from industry and data centres (RED / EED)
• Funding for mobilization of agriculture waste and residues and “circular” rural energy communities (CAP, structural funds, LIFE)
A deep electrification of consumption, based on renewable electricity

A system in which:
• consumption is increasingly electrified, in particular buildings, transport and some industrial processes
• electricity is largely produced from renewables
• new loads (electric vehicles, heat pumps) are integrated and contribute to system flexibility

Ensure continued growth in renewable electricity supply
• Offshore renewable strategy
• Explore green public procurement for renewable electricity (RED)
• Tackle remaining barriers and ensure high ambition through RED review

Accelerate electrification of energy consumption
• Renovation Wave
• Additional measures for electrification of heating, cooling and transport in RED revision
• Electrification of industry through Industrial Emissions Directive review
• Revise CO2 emission standards for cars

Accelerate roll-out of electric vehicles infrastructure and their integration
• Support 1 million charging points by 2025 through InvestEU and CEF
• Revision of the AFID
• Revision of TEN-E and TEN-T
• Network code on Demand Side flexibility
Renewable and low carbon fuels for hard-to-abate sectors (incl. hydrogen)

A system in which:
• the potential for sustainable biogas and biofuels is fully exploited
• renewable and low carbon hydrogen increasingly plays a role in industry and transport
• carbon capture is used to produce synthetic fuels, as a last option

A greater uptake of renewable and low carbon fuels

• Terminology and certification framework for all renewable and low carbon fuels
• Additional demand-side measures to “pull” RES and low carbon fuels (RED, transport initiatives)
• Financing of flagship carbon-neutral industrial clusters
• Financing for fertilisers based on renewable hydrogen
• Scale up carbon capture and use for the production of synthetic fuels
• Certification of carbon removals

Actions under the Hydrogen Strategy
Transversal enablers: markets, infrastructure, digitalisation

A system in which:
- Consumers receive clear information, price signals, to choose the best clean option for their needs
- Markets are fit for decentralised, renewable electricity and gases
- Infrastructure is planned in an integrated way, looking jointly at gas, electricity, heat and hydrogen
- Digitalisation fully enables a smarter system

| Markets | • Guidance to MS on non-energy price components (taxes, charges and levies)  
- ETD revision and ETS extension; State aid framework revision  
- Revision legislative framework for a competitive decarbonized gas market |
| Consumers | • Consumer information campaign (non legislative)  
- Information on sustainability of industrial products |
| Infrastructure | • TEN-E and TEN-T revisions  
- Review scope and governance of TYNDP process (TEN-E, other)  
- Stronger incentives for smart district heating and cooling (RED, funding) |
| Digitalisation | • Digitalisation of Energy Action Plan (non legislative)  
- Network Code on Cybersecurity in electricity  
- New clean energy research/innovation outlook to drive R&I agenda |
Markets

Clean Energy Package

- Made electricity markets fit to
  - Integrate renewable electricity and flexibility
  - Improve market signals
  - Challenge:
    - implementation, esp. completion of market coupling (day-ahead and intraday trading)

Revision of legislative framework

- For a competitive decarbonized gas market
  - Distributed production of renewable gases: connect to infrastructure and provide for market access
  - Ensure interoperability across gas systems and Member States (revision of technical rules, e.g. gas quality specifications)

Figure 33: Consumption of gaseous fuels

Note: “carbon-free” gases refer to e-gas, biogas and waste-gas.

Source: Eurostat (2015), PRIMES.
The Hydrogen Strategy
Hydrogen – What and Why?

Hydrogen:
• Feedstock, fuel, energy carrier / storage
• Does not emit CO2, no air pollution
• Essential to reach our climate ambition (hard-to-abate sectors)
• Europe is highly competitive in clean hydrogen technologies manufacturing

Which hydrogen:
Currently: fossil-based hydrogen
Our vision: Renewable, and in a transitional period low-carbon hydrogen (fossil-based hydrogen with carbon capture and electricity based) for:
• Replacing existing hydrogen production
• Industry (fertilisers and steel) and transport (e.g. heavy duty road vehicles; in the longer term: maritime and aviation)

Issues:
• Cost-competitiveness
• Technological maturity (cost-effective electrolysers)
• Renewable energy & scale: 2x40 GW by 2030
Hydrogen – fostering demand

Renewable, and in a transitional period low-carbon hydrogen, for:
• Replacing existing hydrogen production
• Green fertilisers and green steel
• Local buses, commercial fleets, or specific parts of the rail network
• Heavy duty road vehicles
• In the longer term, maritime and aviation

Supporting end-consumers
• EU strategy on clean steel
• Sustainable and Smart Mobility Strategy

Creating markets
• Specific end-use sector quotas of renewable hydrogen or its derivatives
• Liquid markets with commodity-based hydrogen trading
• Open and competitive hydrogen market with solid price signals
• Hydrogen infrastructure access to all consumers
Hydrogen – supply and infrastructure

**Scaling up renewable hydrogen**, and in a transitional period low-carbon hydrogen, through:

- Supporting producers through support mechanisms
- Develop a EU-wide hydrogen infrastructure

### Producers

- Common low-carbon threshold for hydrogen production facilities
- Certification of renewable and low-carbon hydrogen
- Revision of the Emission Trading Scheme
- Carbon Contract for Differences
- Market-based support schemes for renewable hydrogen

### Infrastructure

- Revision of the TEN-E and internal gas market legislation to ensure interoperability, common quality standards, and cross-border operational rules
- Network of refuelling stations through Alternative Fuels Infrastructure Directive
- Revision of TYNDPs to ensure full integration of hydrogen infrastructure
Hydrogen – research and innovation

Maintain and strengthen **EU’s global leadership role** through support:
- Establish Clean Hydrogen Partnership
- Targeted research and innovation in Horizon Europe
- ETS Innovation Fund

**Scale-up production**
- Larger size, more efficient and cost-effective electrolysers
- Mass manufacturing capability and new materials
- Break-through solutions like direct solar hydrogen

**Infrastructure**
- Distribute, store and dispense hydrogen at large volumes
- Repurposing of existing gas infrastructure
- Adaptation of LNG terminals

**End-use applications**
- New industrial processes
- Multi MW-fuel cells
- Hydrogen-derived synthetic fuels for the maritime and aviation sector

**Cross-cutting areas**
- Improved harmonized safety standards
- Reduced environmental impacts and sustainability
- Critical raw materials, re-use and recycling
Hydrogen – the international dimension

Strengthening Europe’s global leadership role and putting renewable hydrogen high on its strategic agenda

Bilateral and regional cooperation

- Clean hydrogen support under Neighbourhood Investment Platform
- Joint hydrogen research and development programmes through Association Agreements
- Hydrogen collaboration under the Africa-Europe Green Initiative
- Mainstream hydrogen in energy diplomacy, climate, research, trade and international cooperation

Multilateral fora

- Set common GHG emission reduction standards and sustainability criteria
- New Clean Hydrogen mission within Mission Innovation and the Clean energy Ministerial Hydrogen Initiative
- Further collaboration through e.g. UN, G20, IRENA, EnC