

Security of Sustainable Energy Supplies

The background is a vibrant blue with a complex network of white lines and dots, resembling a technical or data visualization. A large, semi-transparent radar chart is centered in the upper half, with concentric circles and radial lines. The chart has a bright yellow-green spot at its center. Below the radar chart, there are faint, stylized outlines of power transmission towers. At the bottom of the image, there is a horizontal band of green and orange, suggesting a landscape or a base layer.

Prof.dr.sc. Neven Duić,

EASAC Energy Programme Co-Chair

Dr William Gillett

EASAC Energy Programme Director

EASAC

28 National Science Academies
from EU, CH, NO, & UK

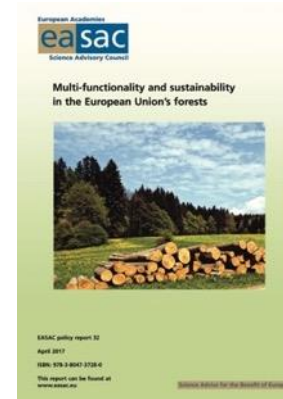
Mission:

- science-based advice for policy makers
- NOT policy for science (research policy)
- BUT highlight gaps in research and skills

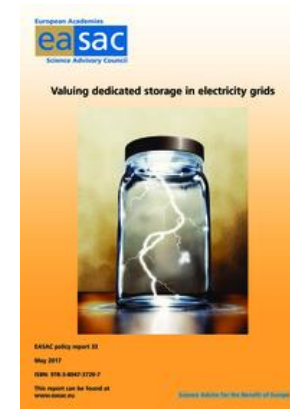
Security of Sustainable Energy Supplies

- builds on previous EASAC reports
- report drafted in rapidly evolving geopolitical context (Feb '24 - Mar '25)

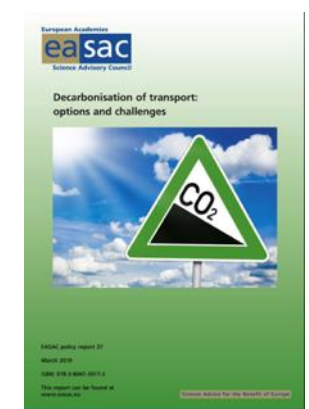
Energy Reports



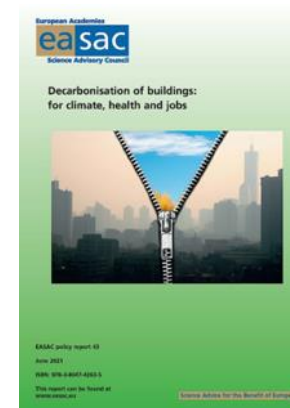
Forests 2017



Storage 2017



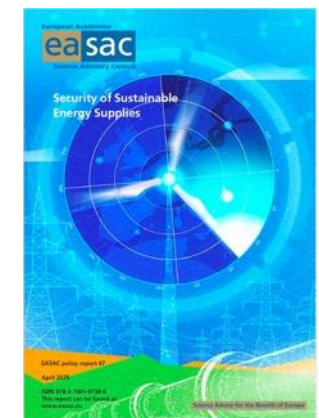
Transport 2019



Buildings 2021



Future of gas 2023



Security of sustainable
energy supplies 2025

Working Group on SoSES

Nominated expert	Country
Prof. Reinhard Haas	Austria
Prof Thijs van de Graaf	Belgium
Prof Claire Dupont (co-chair)	Belgium
Prof Neven Duic	Croatia
Prof Soteris Kalogirou	Cyprus
Dr. Antonín Fejfar	Czech Republic
Dr. Rita Sik-Simon	Czech Republic
Prof Frede Blaabjerg	Denmark
Prof Alar Konist	Estonia
Prof Paula Kivimaa (co-chair)	Finland
Bertrand Charmaison	France
Costis Stambolis	Greece
Dr Bálint Hartmann	Hungary

Nominated expert	Country
Prof Attila Imre	Hungary
Dr Vidas Lekavičius	Lithuania
Prof Koen Kok	Netherlands
Dr Gerd Kjølle	Norway
Prof Magnus Korpås	Norway
Prof. Piotr Lampart	Poland
Prof. Manuel Collares-Pereira	Portugal
Prof. Dr. Ionut Purica	Romania
Prof. Dr. David P Serrano	Spain
Prof Mathias Ekstedt	Sweden
Prof. Bert Allard	Sweden
Prof Russell McKenna	Switzerland
Prof Benjamin Sovacool	UK

26 experts from
21 countries

SoSES Report: “a Starting Point” for Discussion

0. Executive summary : Highlights, Infographic, Recommendations

1. Introduction

2. The energy transition (switch from fossil fuels to sustainable energies)

3. Sustainable energy technologies, energy carriers, and fuels (strategic roles)

4. Critical and strategic raw materials (metals & rare earth elements)

5. Cyber security (digitalised EU energy sector must be protected)

6. The European electricity system (grid flexibility management)

7. Energy security risks, benefits, and threats (what more must be done?)

8. Conclusions

Energy security – what does it mean ?

“Uninterrupted availability of energy supplies at affordable prices”

Threats

Volatile geopolitics: malicious attacks and cyberattacks on energy infrastructure, supply chains, and trade

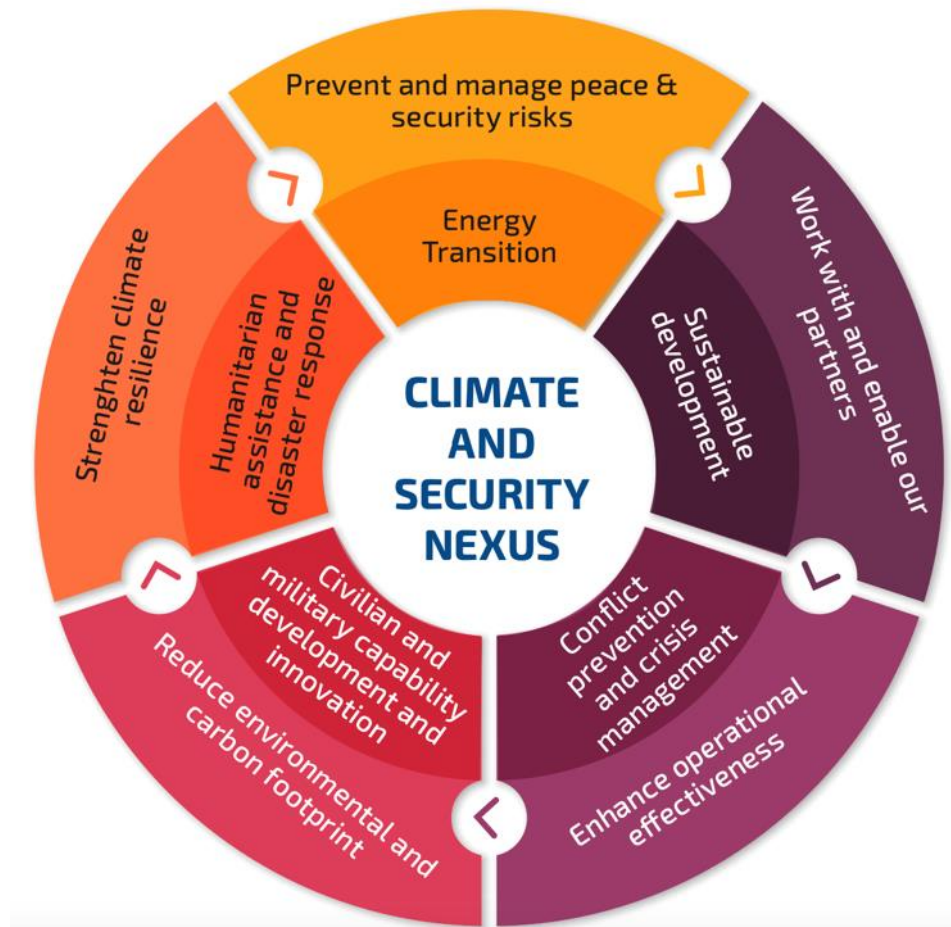
Climate change: climate damage, growing cooling demand

Old thinking: Import to Europe

New thinking: Invest in Europe



EU policies on security have a long history



EU Strategic Compass, 2023

More focus needed on implementation

- Foreign affairs and security policy
 - Green Deal
 - European Economic Security Strategy
 - Resilience and critical entities and infrastructure
 - Cyber security acts
 - Net Zero Industry Act
 - Critical Raw Materials Act
 - Clean Industrial Deal
- ➡ **No security without energy security**

European energy policy trilemma

Focus has shifted from sustainability to security

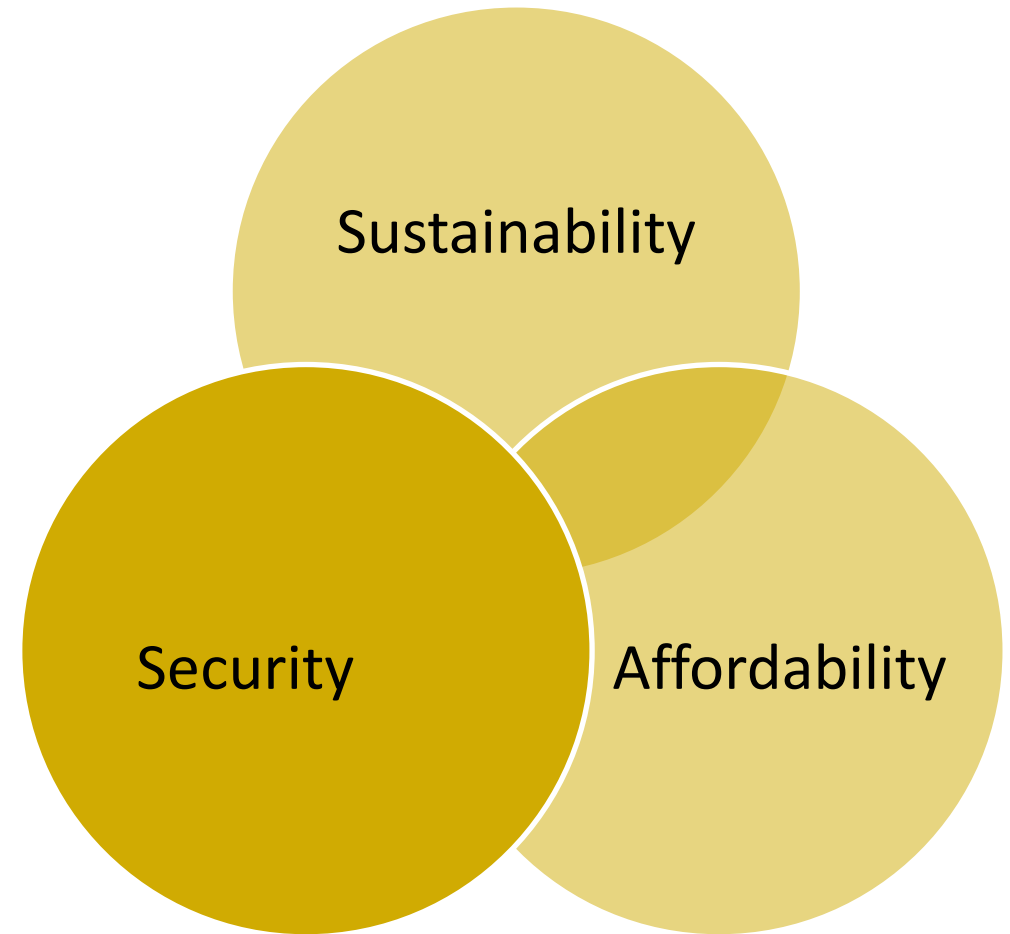
Green Deal

work with global markets to reduce GHG emissions

REPowerEU

Clean Industrial Deal

respond urgently to geopolitical attacks



Invasion of Ukraine highlighted security risks

Europe is too dependent on imported fuels

- *Natural gas* 45% from Russia in 2022
- *LNG* 45% from USA in 2024
- *Nuclear fuels* 79% from Russia in 2023

Europe is too dependent on imported energy technologies & materials

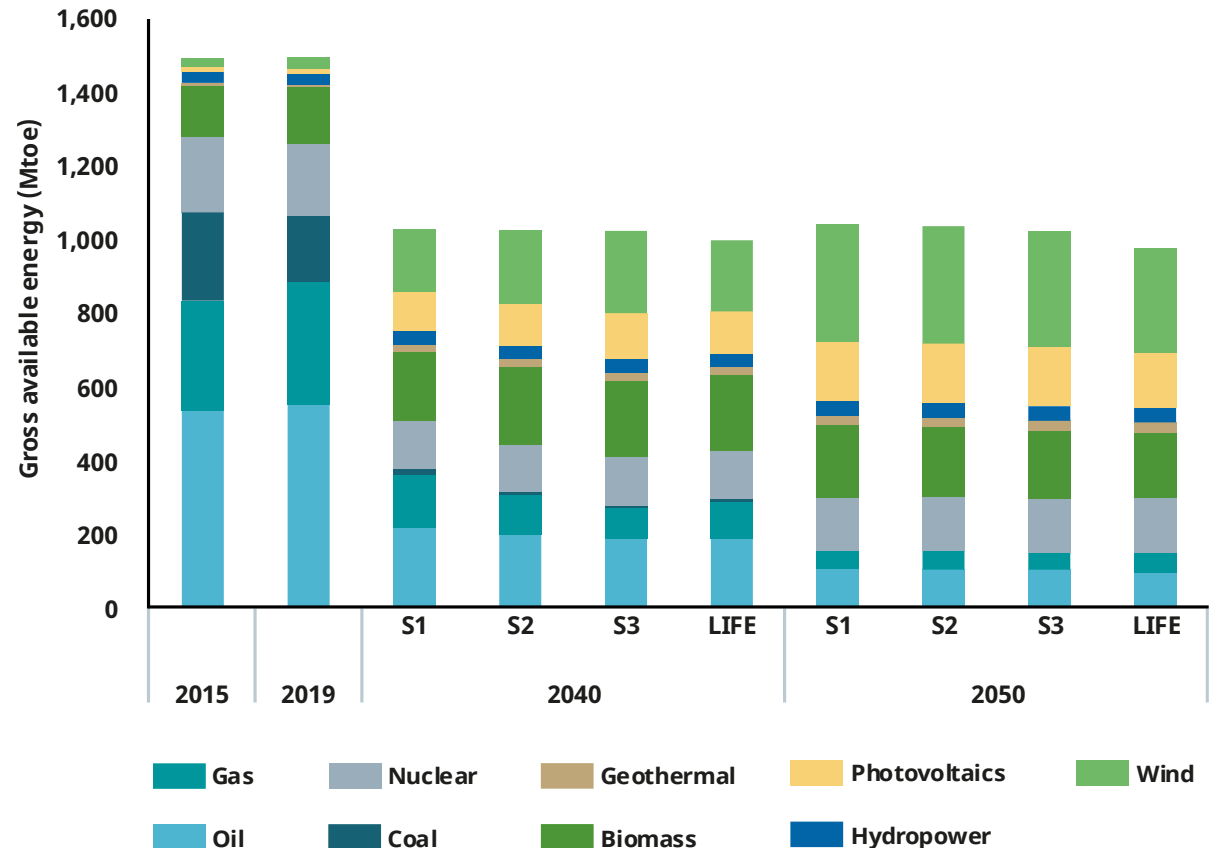
- *Solar cells* > 90% from China
- *Batteries* growing demand for EV & stationary unit imports
- *Rare earth elements* 98% from China in 2022
- *Critical raw materials* supply chains lack diversity and labour protection

Cyberattacks on grids doubled between 2020 and 2022 (Eurelectric)

Many energy systems and scenarios are being modelled

Emerging trends:

- EU electricity supplies could double by 2050, but primary energy supply will fall
- Rapid growth in variable renewables
- Hydrogen will be used in industry, transport as hydrogen based fuels, & possibly managing grid flexibility
- High % renewables can be feasible



Security policies for energy consumption & infrastructure

Energy efficiency first

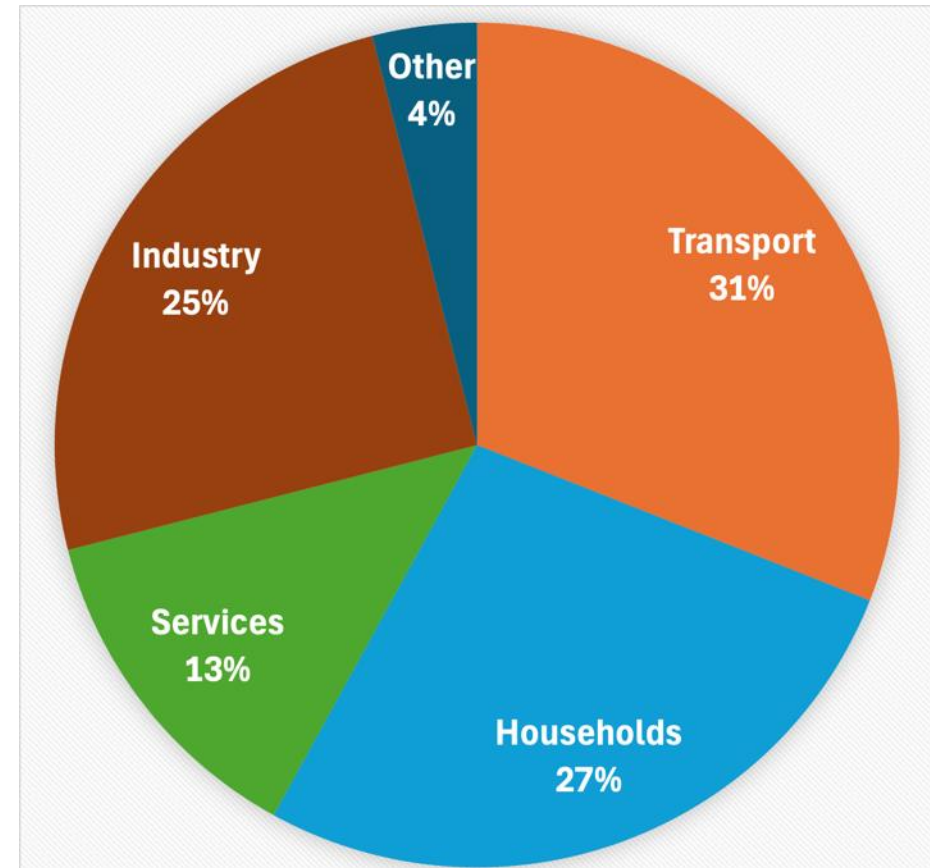
- Reduce energy demand
- Circular economy
- Embodied energy in materials & systems

Energy market design

- Demand response (time-of-use tariffs)
- Integration
- Capacity mechanisms (Dunkelflaute)

Military, cyber & extreme weather protection

- Critical infrastructure



EU 27 final energy consumption 2022

Security policies for fuel and energy technology supplies

Transition away from fossil fuels

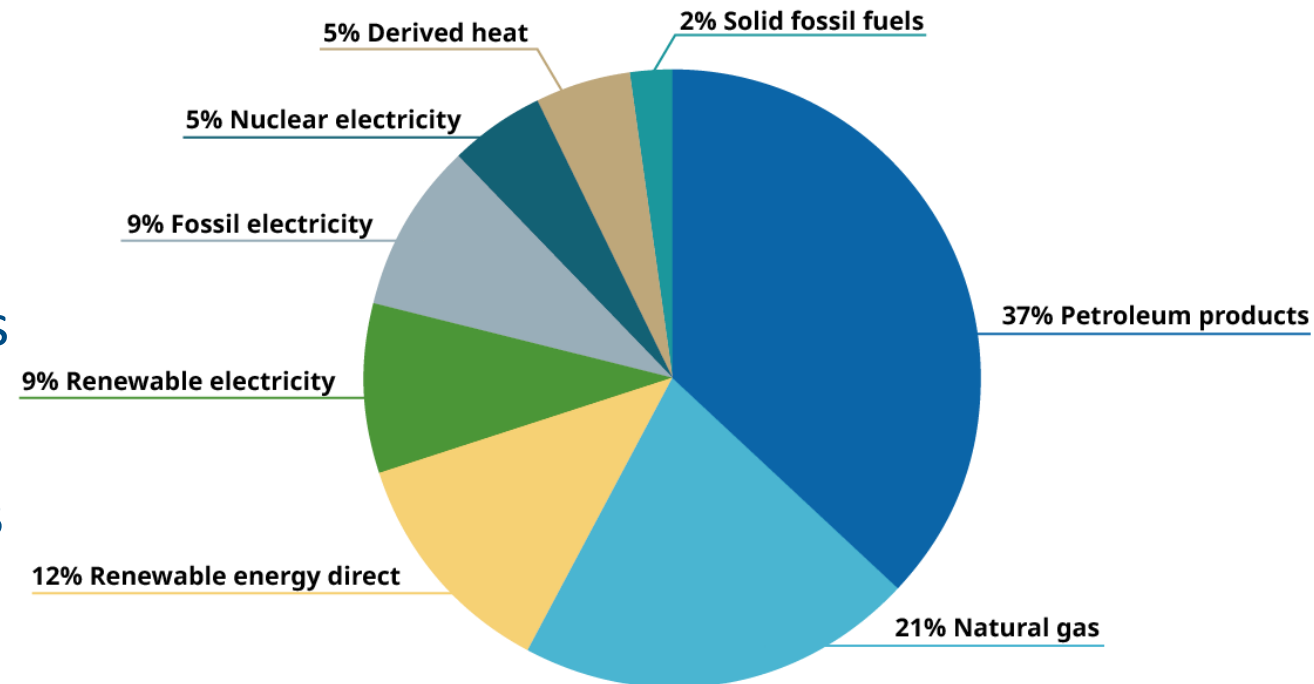
Produce more fuels & technologies in Europe

Coordinate fuel purchasing (EU Platform)

- Fossil (short term) and renewable fuels
- Enriched uranium for nuclear reactors

Diversify supplies of critical raw materials

- Partner with suppliers in 3rd countries
- More extraction & processing in Europe



EU 27 final energy consumption 2022

Grid flexibility and integration improve energy security

Electricity mix with grid flexibility

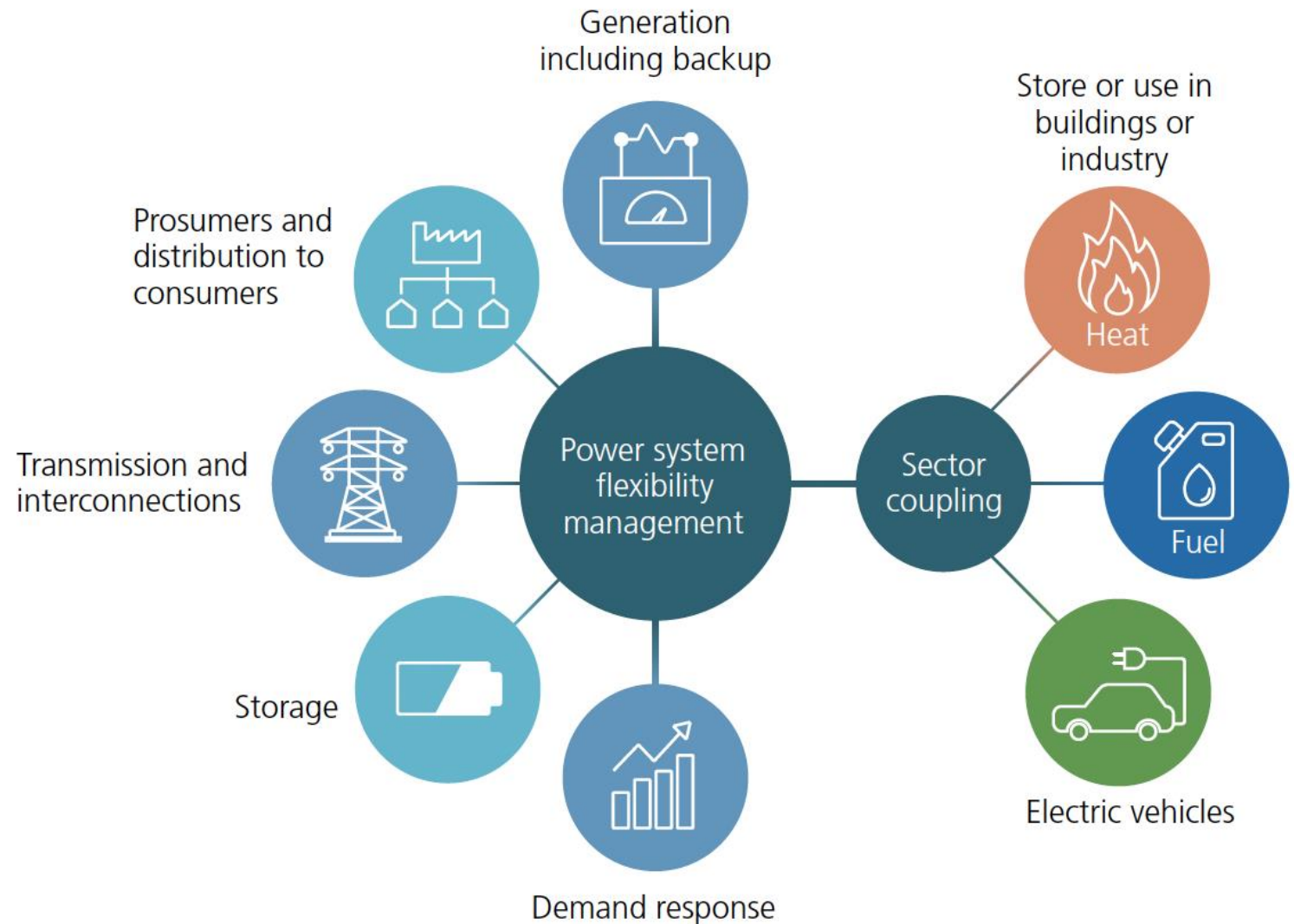
- Variable renewables
- Nuclear (large and SMR)
- Backup generation

Integration lowers costs

Integration options

- District heating / cooling
- Electric vehicles
- Hydrogen and e-fuels
- Carbon capture & storage

Cyber protection (digitalisation)



Invest in Energy Security - create value in Europe

Mobilise long term public and private financing:

- Strengthen electricity infrastructure and interconnectors
- Manufacture electricity generators (VRES, Nuclear, SMR, CCS, ..)
- Manufacture end-use technologies (EVs, heat pumps, ..)
- District heating/cooling
- Storage of electricity (Battery Alliance)
- Storage of heat (for buildings and industry)
- Sustainable hydrogen and e-fuels
- Critical raw materials extraction and processing



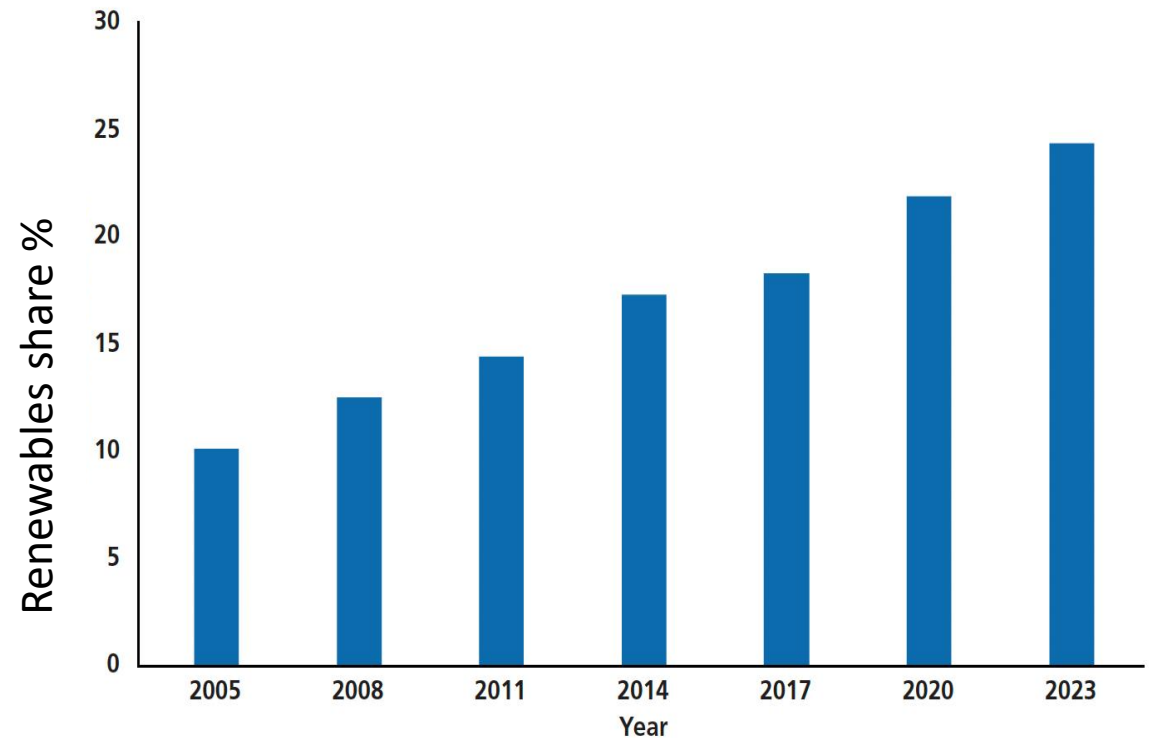
Transition to Sustainable Energy Brings Security Benefits

Energy security benefits

- Less dependence on fossil fuel imports
- Less volatile energy prices
- Less conflicts in energy markets
- Less supply interruptions

Wider benefits

- Lower climate damage and health costs (due to lower GHG emissions)
- Value creation in Europe (local production of fuels and technologies)



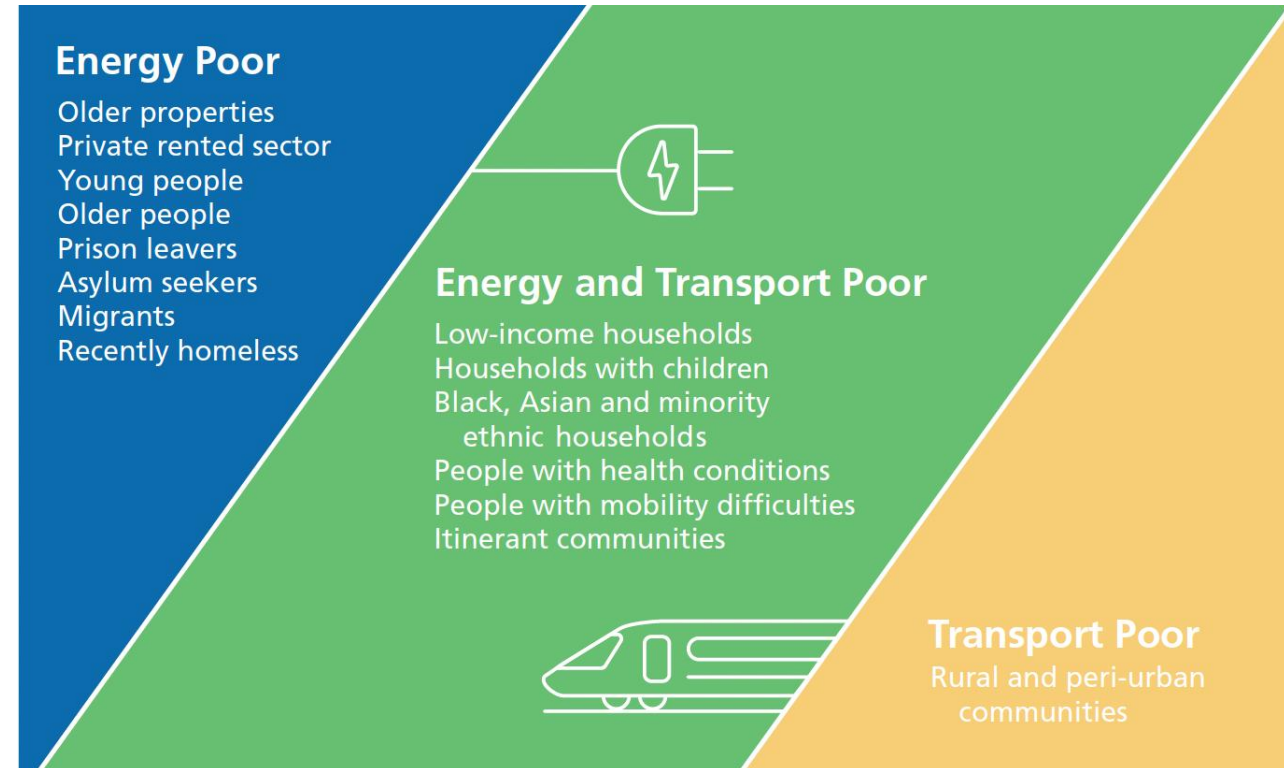
“Fair Transition” to reduce energy poverty

High prices incentivise energy saving but
“Polluter pays” is not affordable for all

Vulnerable groups and households need support (eg EU Social Climate Fund):

- for investing in energy efficiency to reduce energy needs
- To pay their energy bills

Engage with citizens to accelerate the transition (empower local communities)



Energy efficiency first

‘Energy efficiency first’ for electrification of end uses with sustainable electricity supplies

- Energy efficiency is a ‘no regrets’ option for investors in end-use energy systems because it reduces energy demand, which improves energy security.
- Yet, growth in electricity demand is expected via electrification of transport, industry and heating. Hence, more efficient and time responsive use of electricity can substantially help energy security.



Electricity market measures can stimulate energy efficiency and security

- Advanced models for long-term contracts, such as Power Purchase Agreements and Contracts for Difference, can stimulate investments into sustainable energy supplies
- For end-users, including prosumers and energy communities, dynamic (bi-directional) pricing and time-dependent tariff schemes work as incentives
- Flexibility measures including storage and strong interconnections, with transparent dynamic pricing signals and price spreads to facilitate demand response and cross-border trading



Concluding remarks – coordinate & implement policies

- **Energy security – phase out fossil fuel imports**
Invest in electricity infrastructure, and in fuel and technology production
Prepare defences for cyber and malicious attacks, & diversify supply chains
- **Sustainability - reduce GHG emissions**
Invest in sustainable energy to reduce climate damage and improve health
Demonstrate global leadership, and help others to follow
- **Affordability – mobilise long term investment financing**
Engage with consumers to reduce energy demand and investment needs
Help strategic industries and vulnerable groups (reduce energy poverty)
- **Science (evidence)-based EU policies** help to build investor confidence
Support foresight, research, training, and skills development for energy security

Thank you!

No Security without Energy Security

Key Energy Security Threats

- Geopolitical disruption
- Increase of physical and cyberattacks
- Interruption of fuel and technology supply chains
- Volatile prices and growing energy poverty
- Escalating climate costs
- Lack of system flexibility

Old Thinking: Import to Europe

98%
2022

Rare Earth
Elements (REEs)

Source: European
Commission

98%
2022

Crude oil and
petroleum products

Source: European
Commission

45%
2022

Gas
from Russia

Source: European
Commission

45%
2024

LNG
from the USA

Source: European
LNG-Tracker

New Thinking: Invest in Europe

Put energy efficiency first with circular economy
Transition away from fossil fuels
Enhance cyber and physical security
Incentivise flexibility and market integration
Produce fuels and technologies in Europe
Prioritise decentralised systems
Empower communities with a fair transition
Diversify suppliers

More resilient systems
More value creation in Europe
Better trade balance
Fewer climate and health costs
Less energy poverty

Investments in sustainable energies are investments in
Europe's energy security!