Interreg
Danube Transnational Programme
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STRIDE Smart grid workshop

Lecture 4

Energy & Energy Policies in Europe

Project co-funded by the Europen Union (ERDF, IPA).

Interreg
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Energy & Energy Policies in Europe

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Content

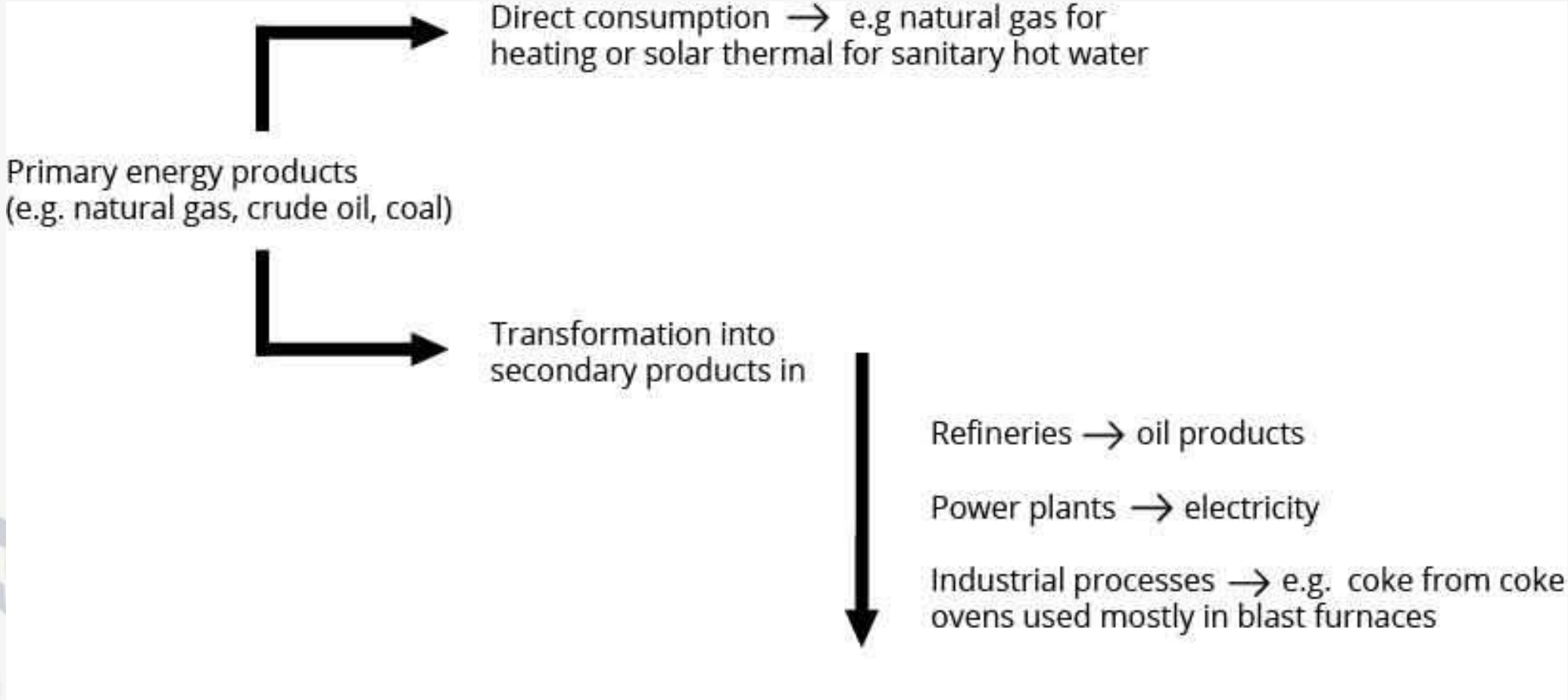
- Review of energy production and consumption in European Union
- International goals
- EU goals
- Policy documents
- Regulations, directives

Project co-funded by the Europen Union (ERDF, IPA).

Where does our energy come from?

Project co-funded by the Europen Union (ERDF, IPA).

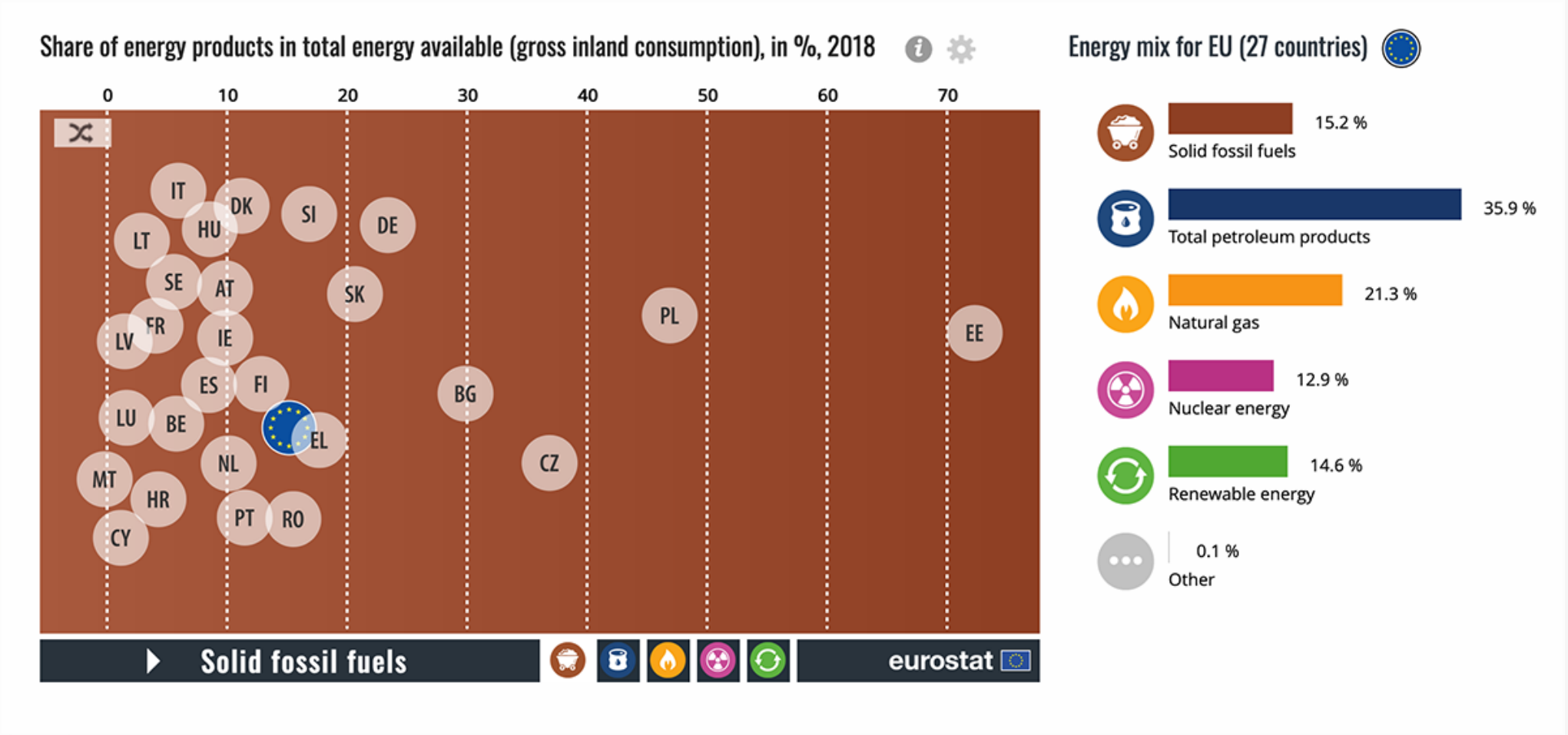
Energy transformation: primary vs final



Project co-funded by the Europen Union (ERDF, IPA).

Source: https://ec.europa.eu/eurostat/cache/infographs/energy/bloc-3a.html

Where does our energy come from? (1)



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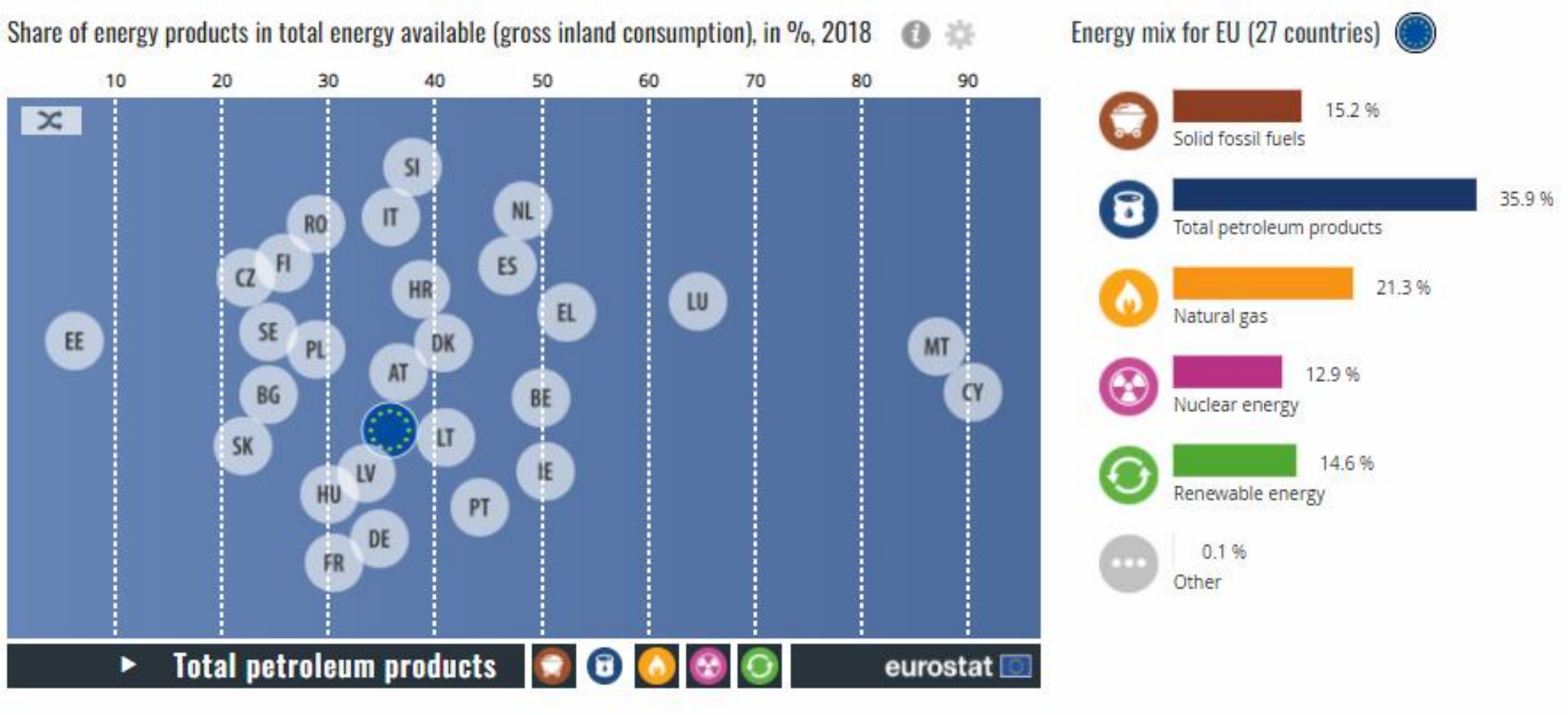
Where does our energy come from? (2)



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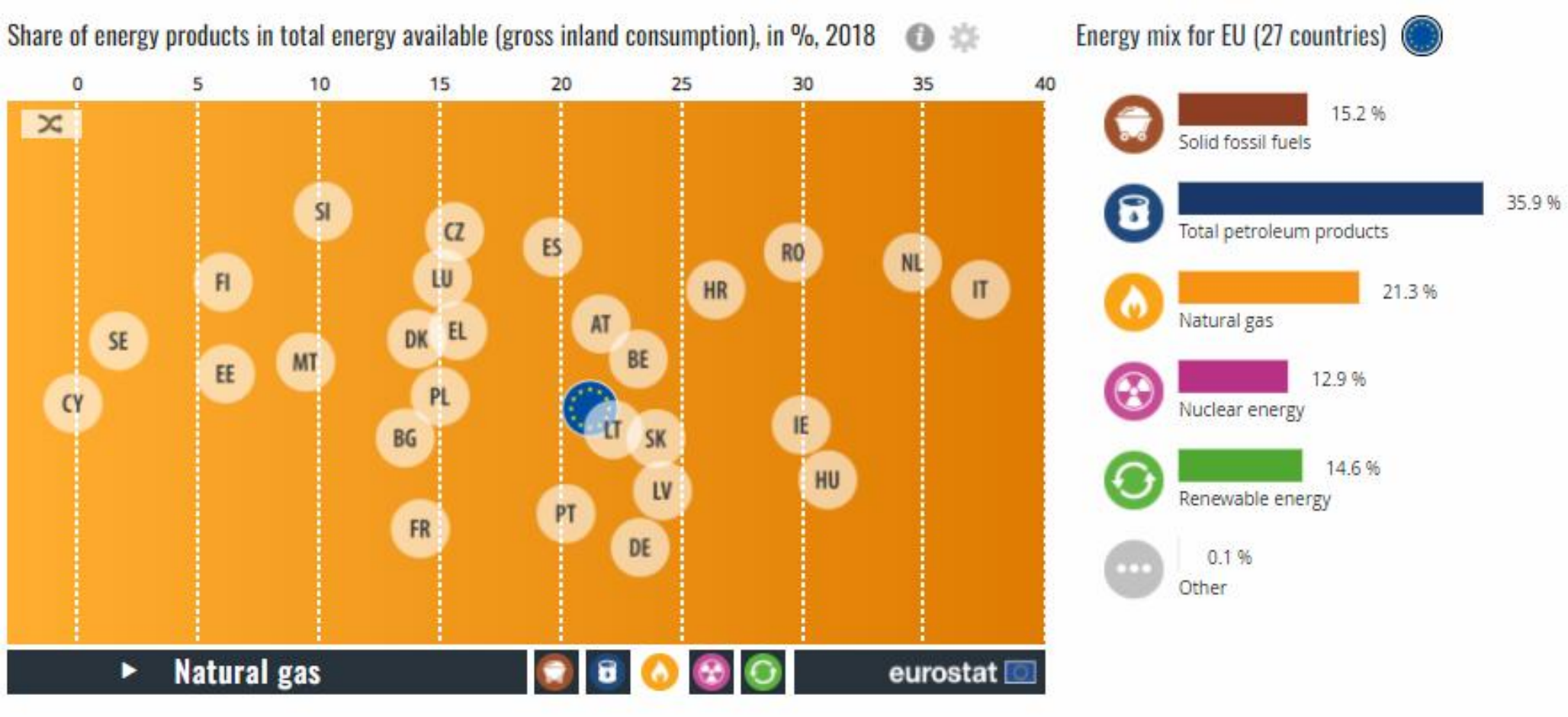
Where does our energy come from? (3)



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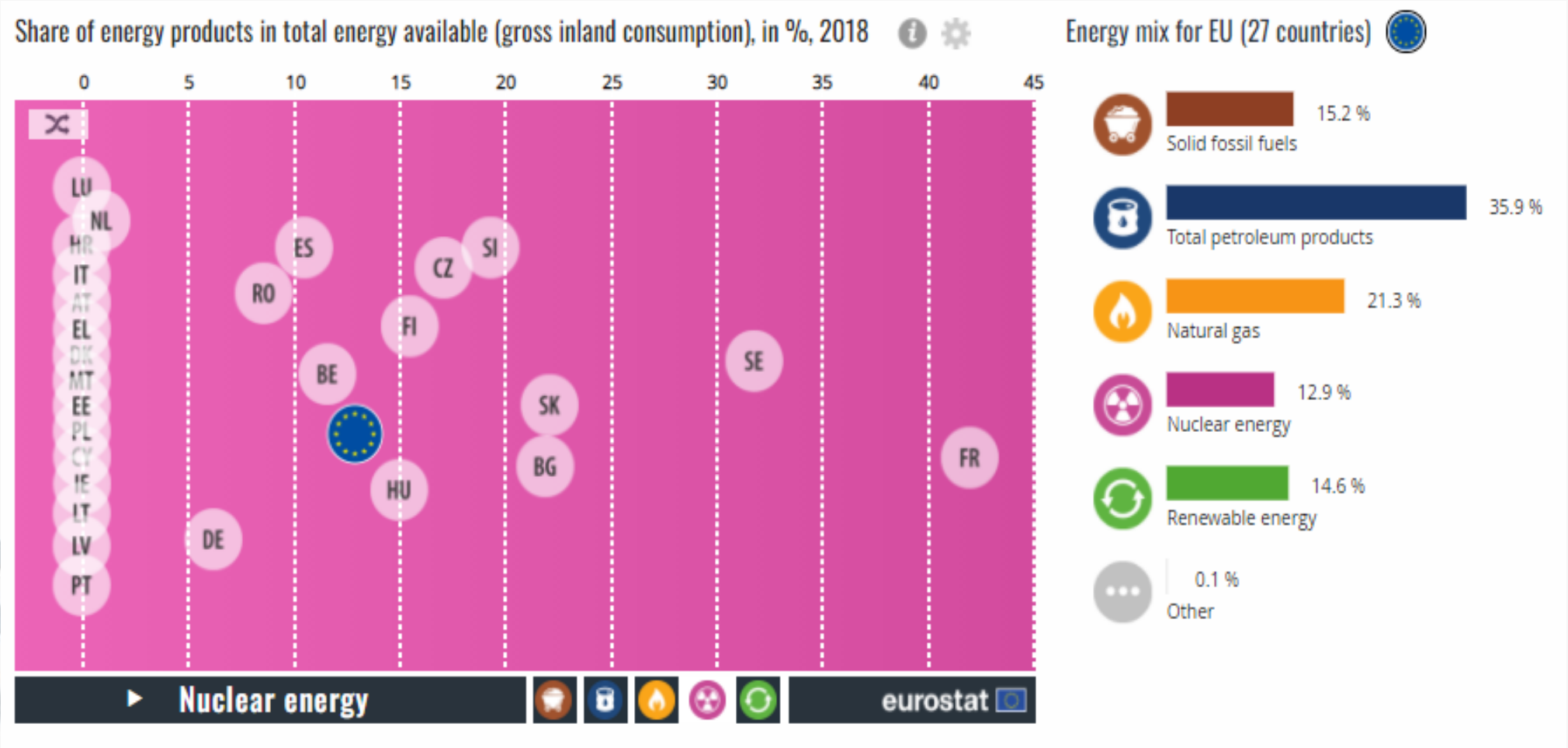
Project co-funded by the Europen Union (ERDF, IPA).

Where does our energy come from? (4)



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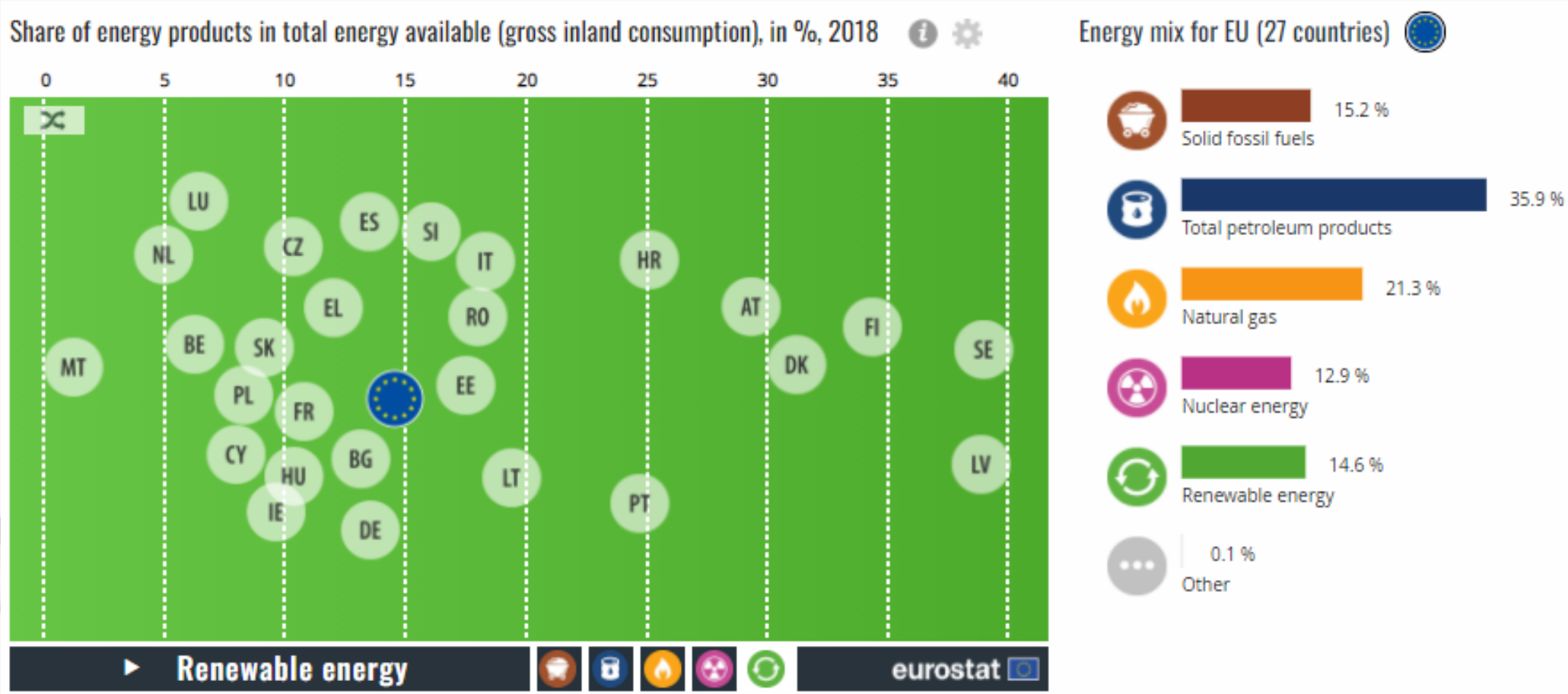
Where does our energy come from? (5)



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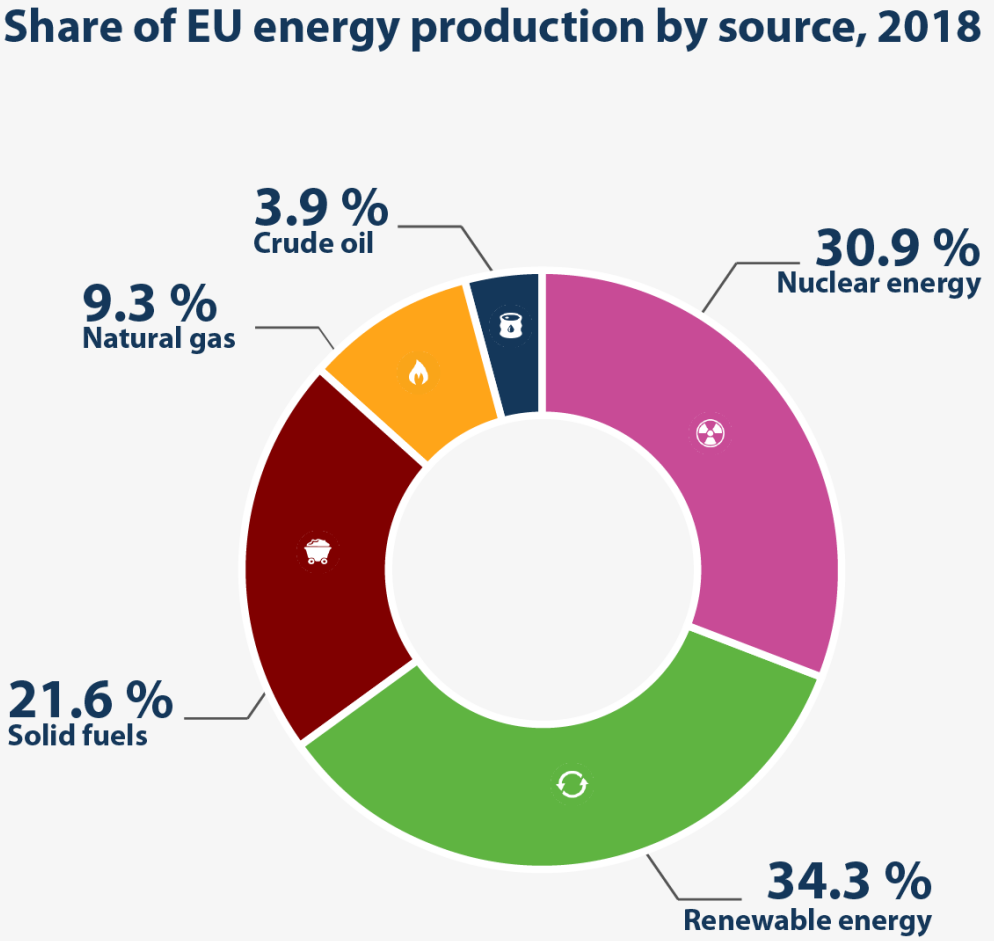
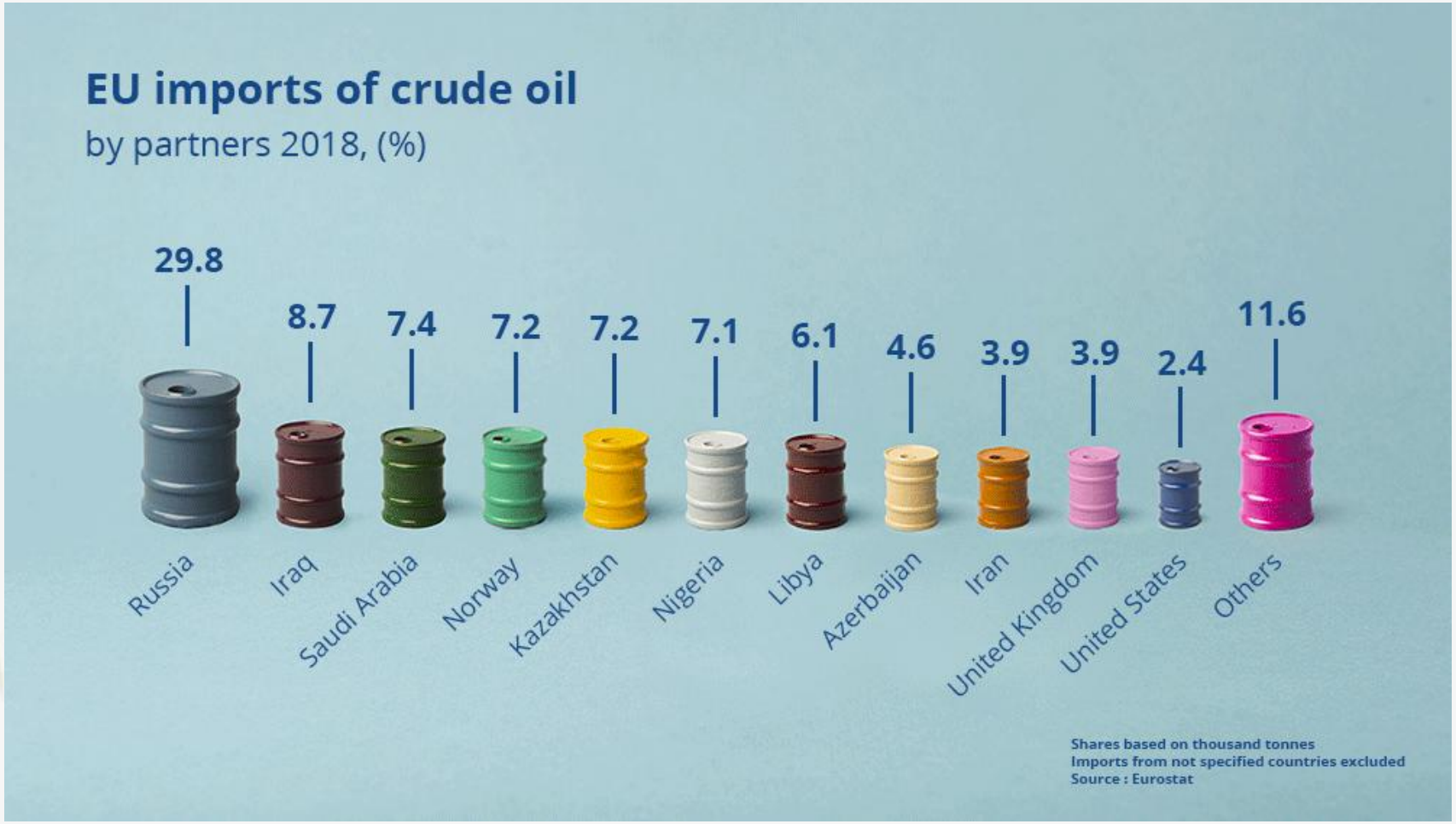
Where does our energy come from? (6)



Project co-funded by the Europen Union (ERDF, IPA).

Source: https://ec.europa.eu/eurostat/cache/infographs/energy/bloc-2b.html

Where does our energy come from? (7)



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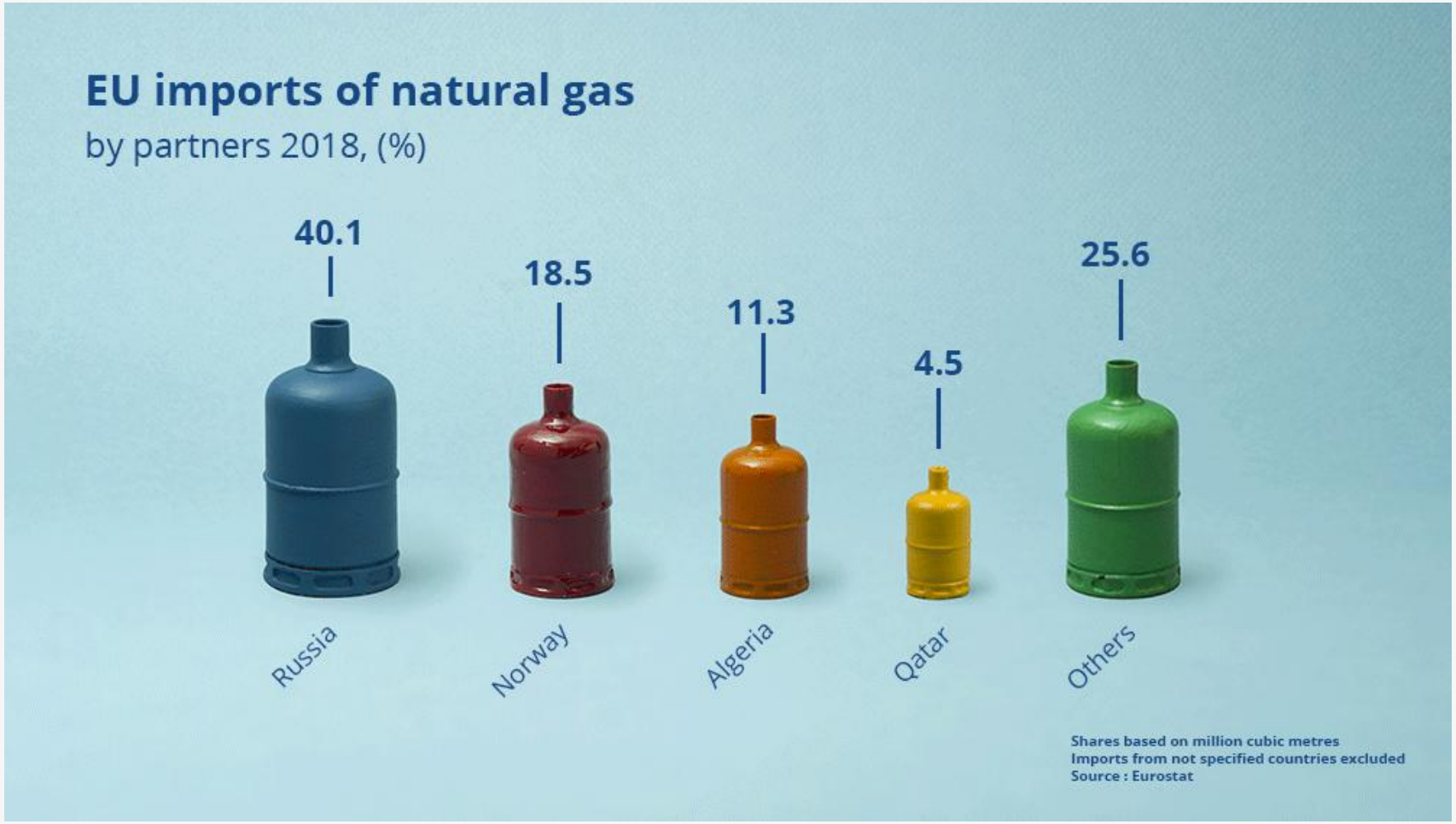
Where does our energy come from? (8)



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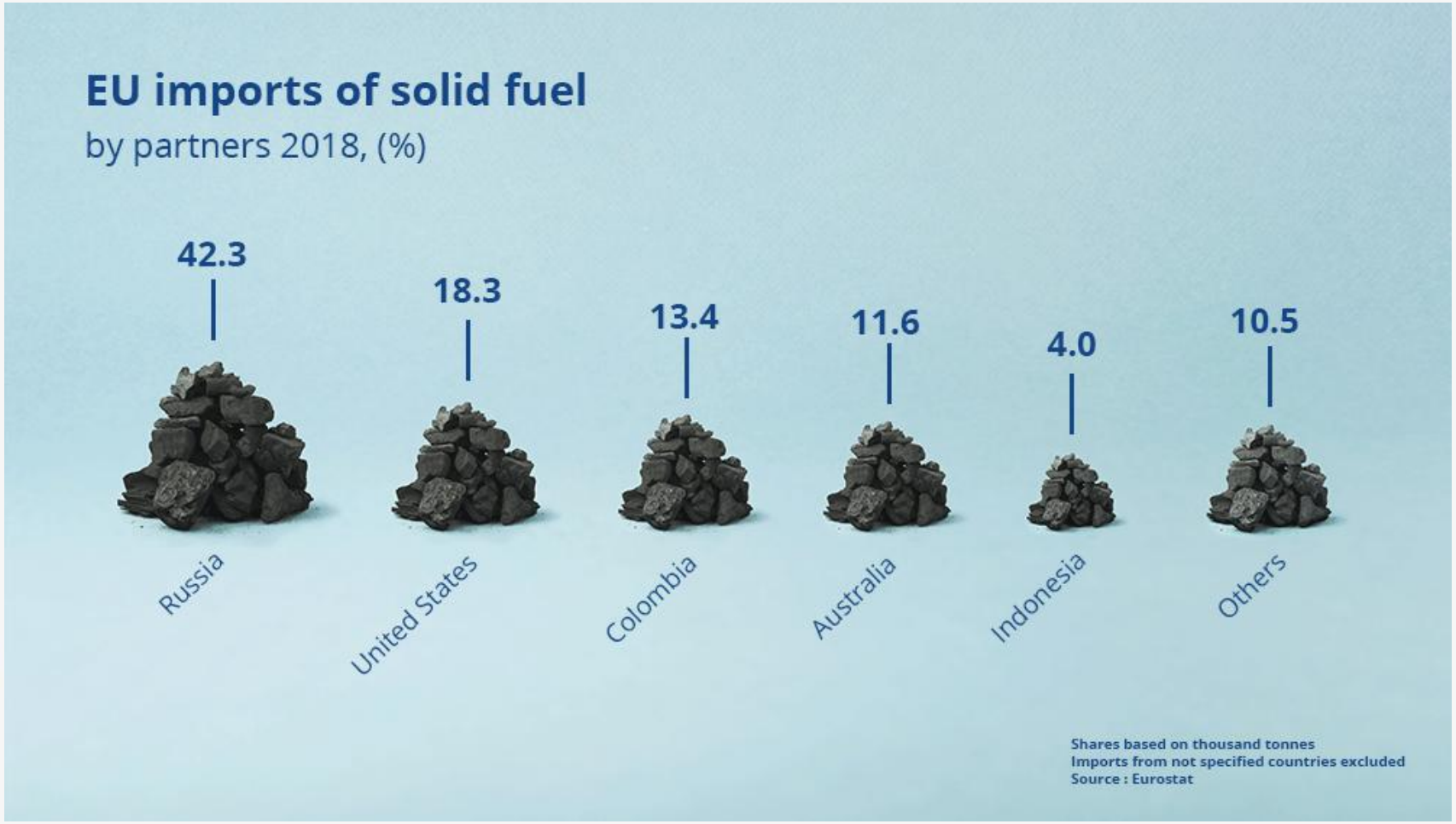
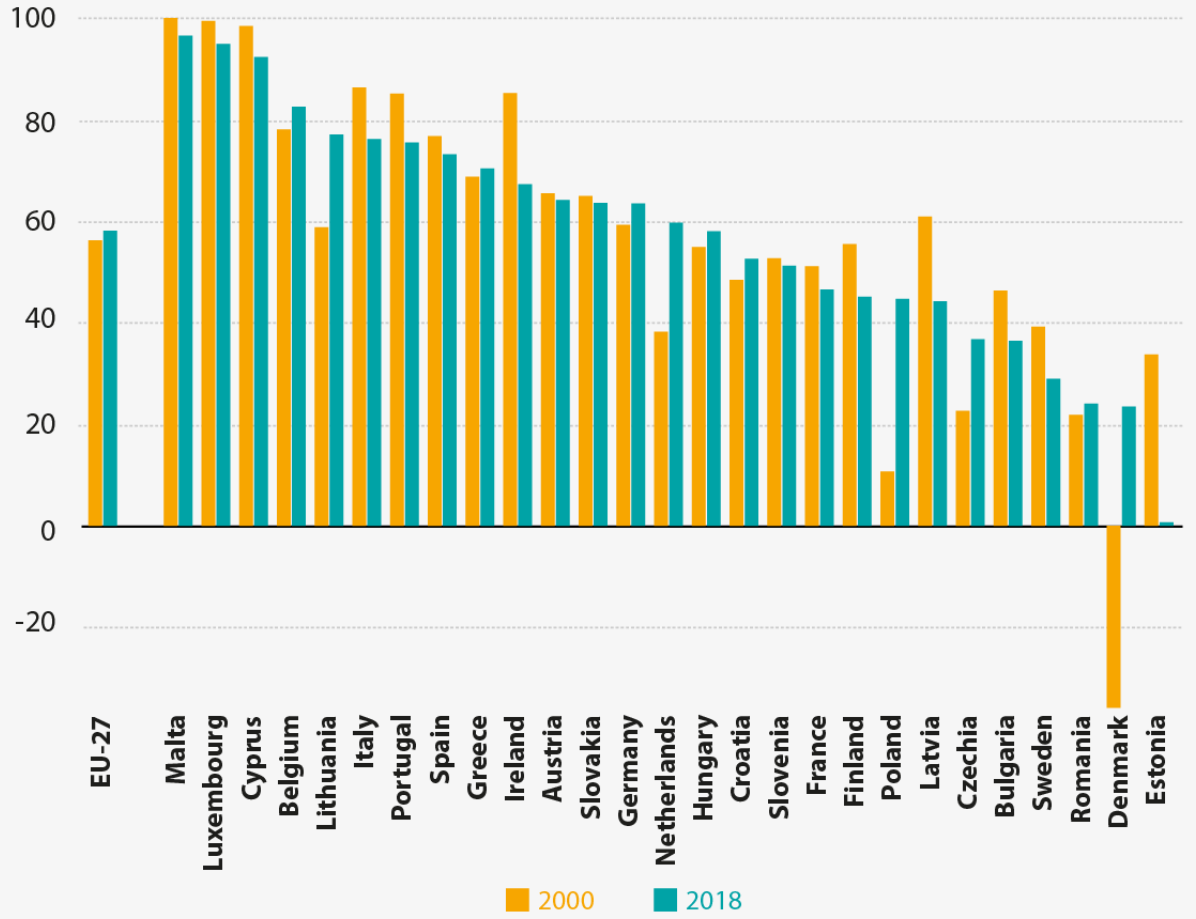


Project co-funded by the Europen Union (ERDF, IPA).

Source: https://ec.europa.eu/eurostat/cache/infographs/energy/bloc-2c.html

Energy dependency rate (%)



Source: Eurostat

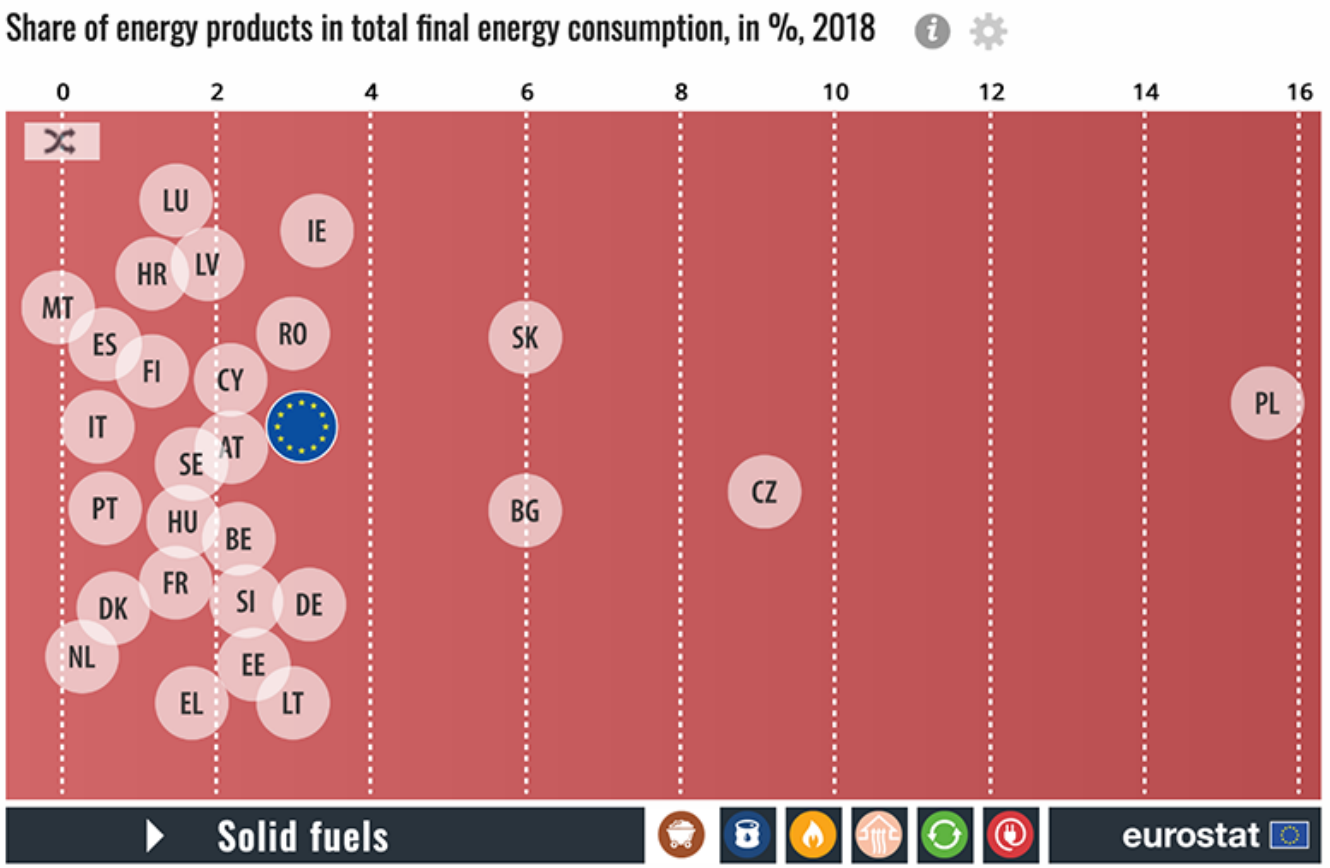
Source: https://ec.europa.eu/eurostat/cache/infographs/energy/bloc-2c.html

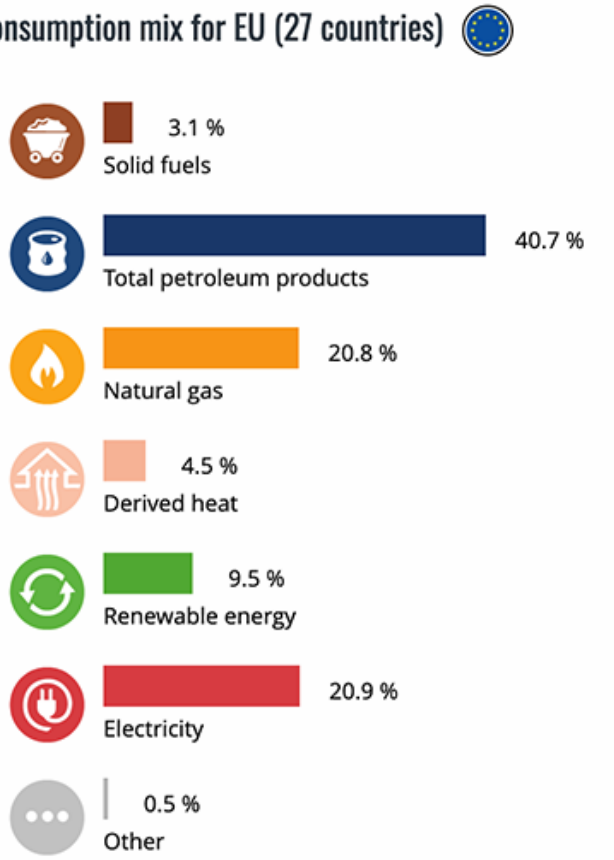
Project co-funded by the Europen Union (ERDF, IPA).

How do we consume our energy?

Project co-funded by the Europen Union (ERDF, IPA).

How do we consume our energy? (1)

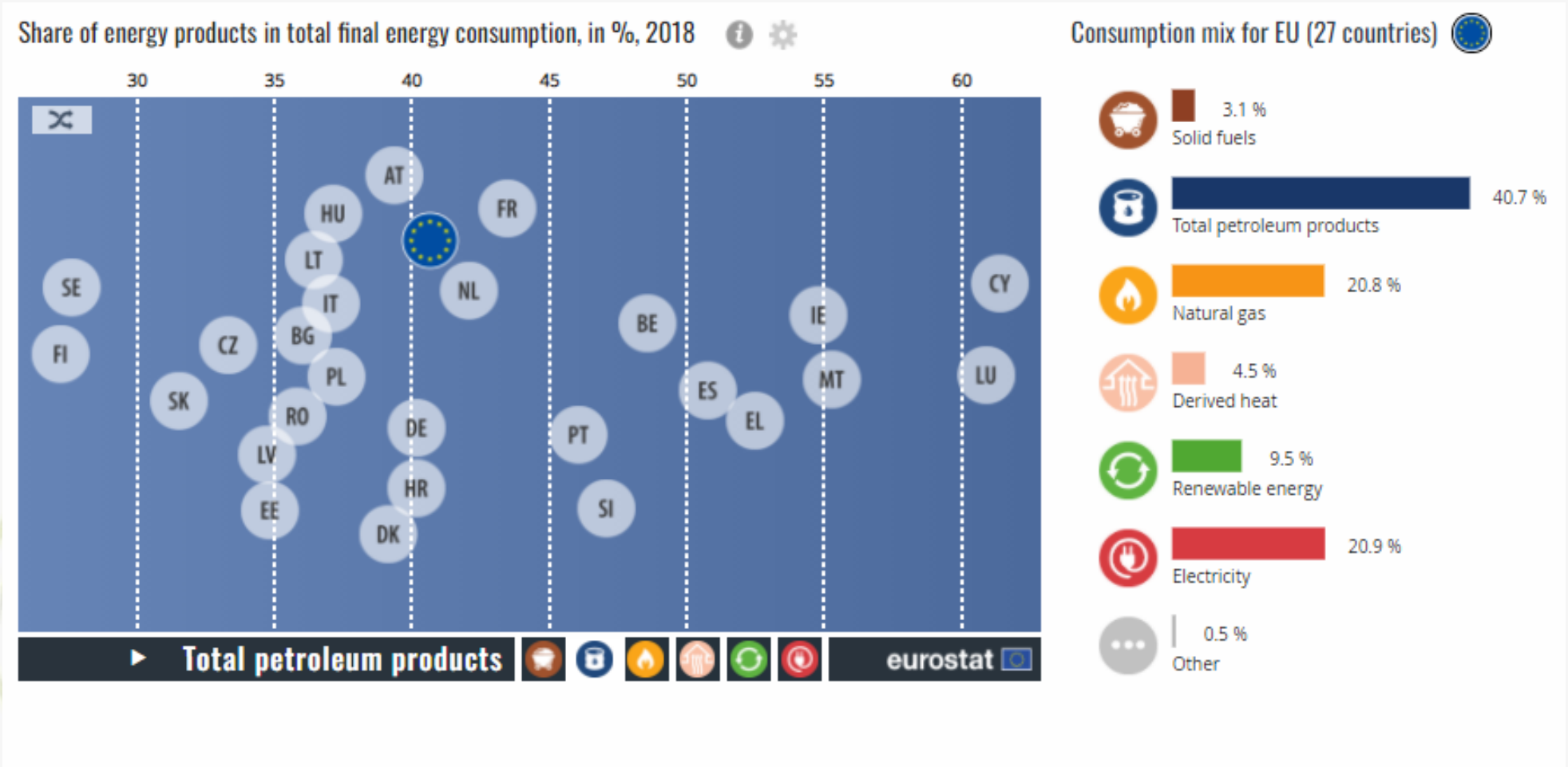




Source: https://ec.europa.eu/eurostat/cache/infographs/energy/bloc-3a.html

Project co-funded by the Europen Union (ERDF, IPA).

How do we consume our energy? (2)



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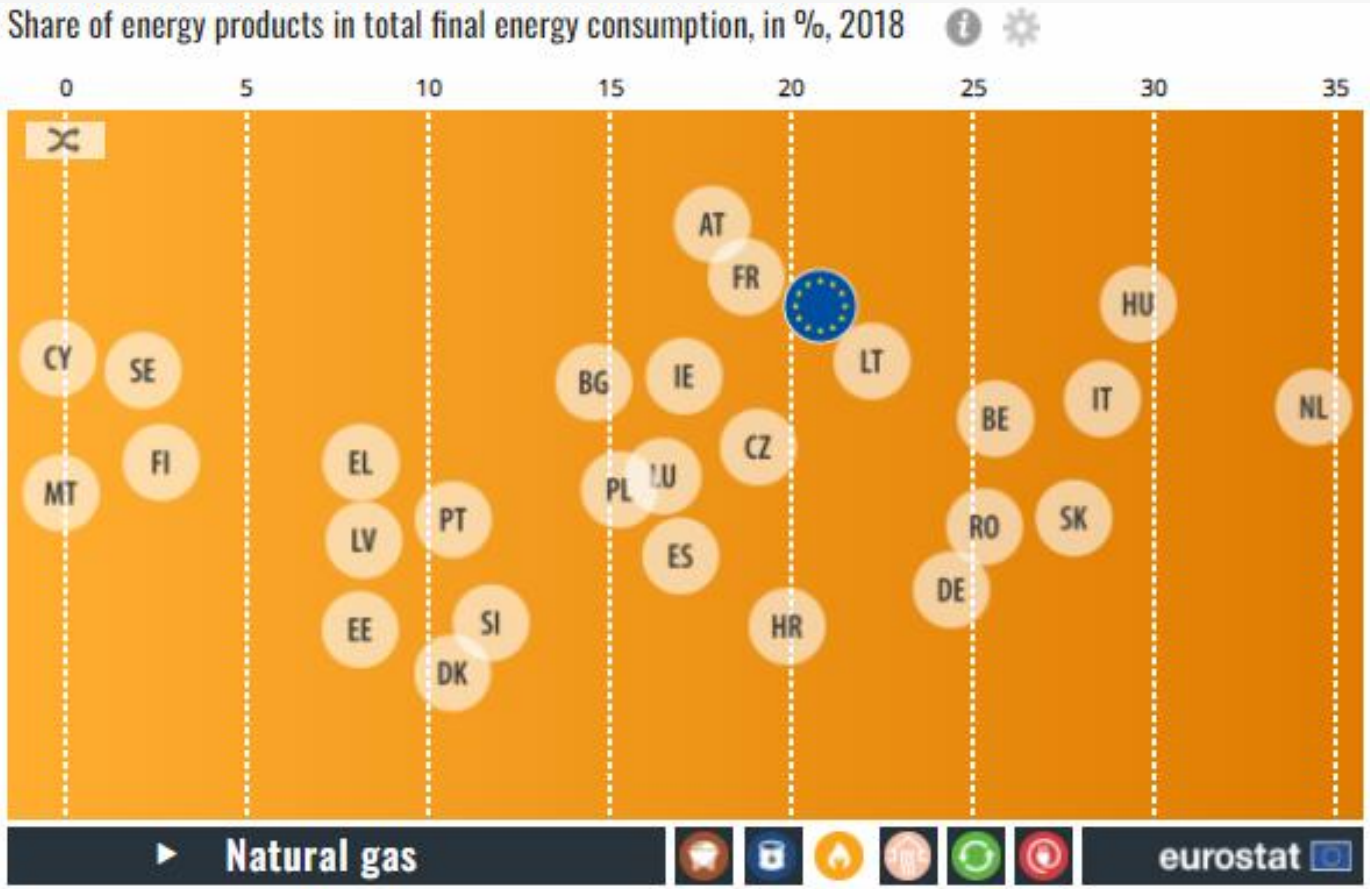

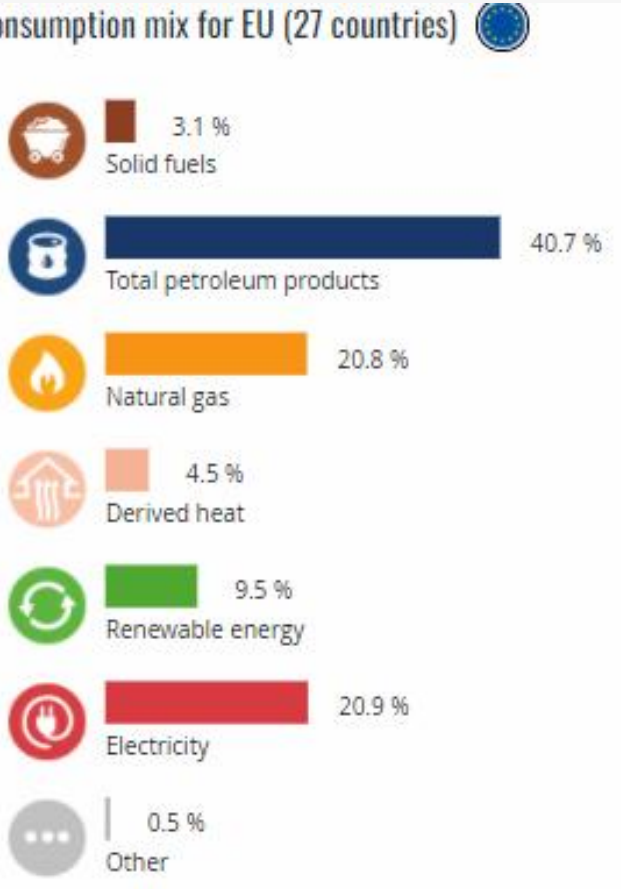

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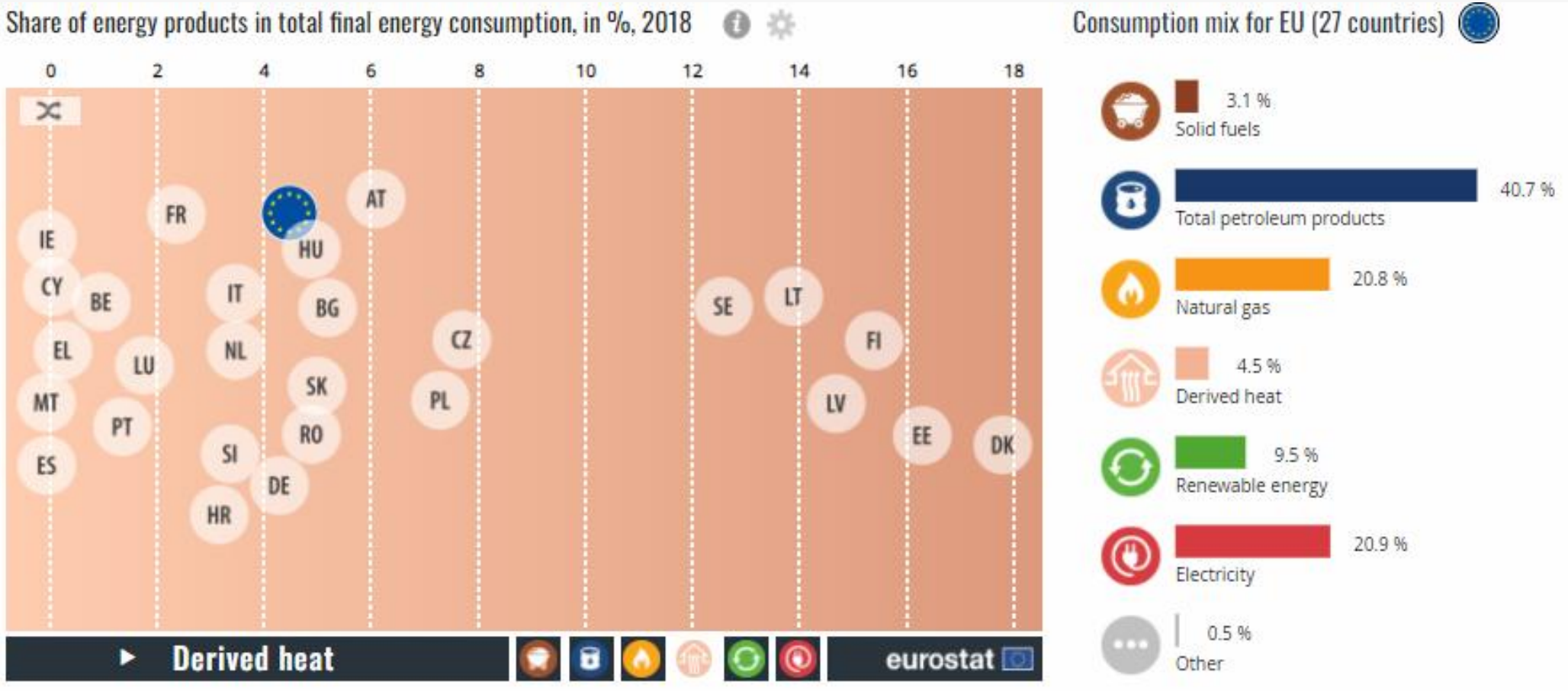

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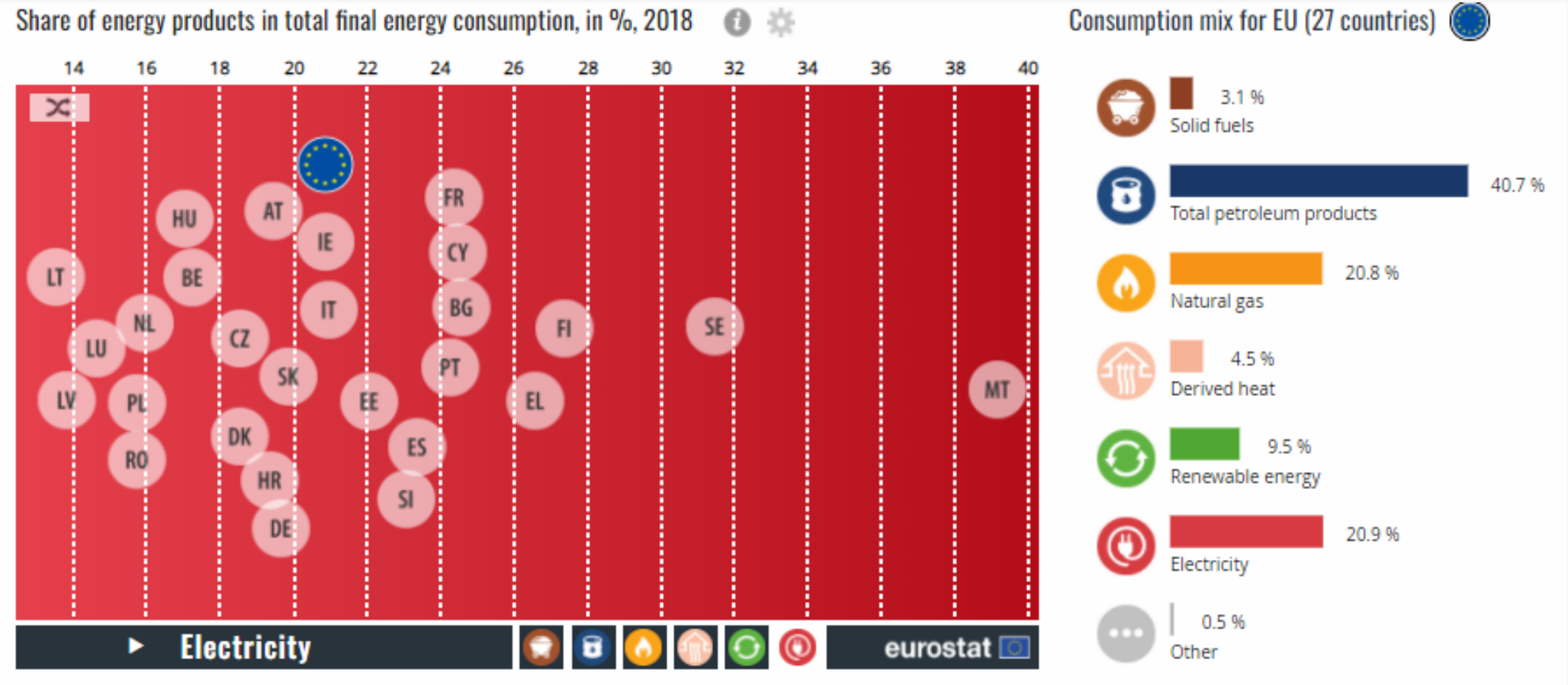

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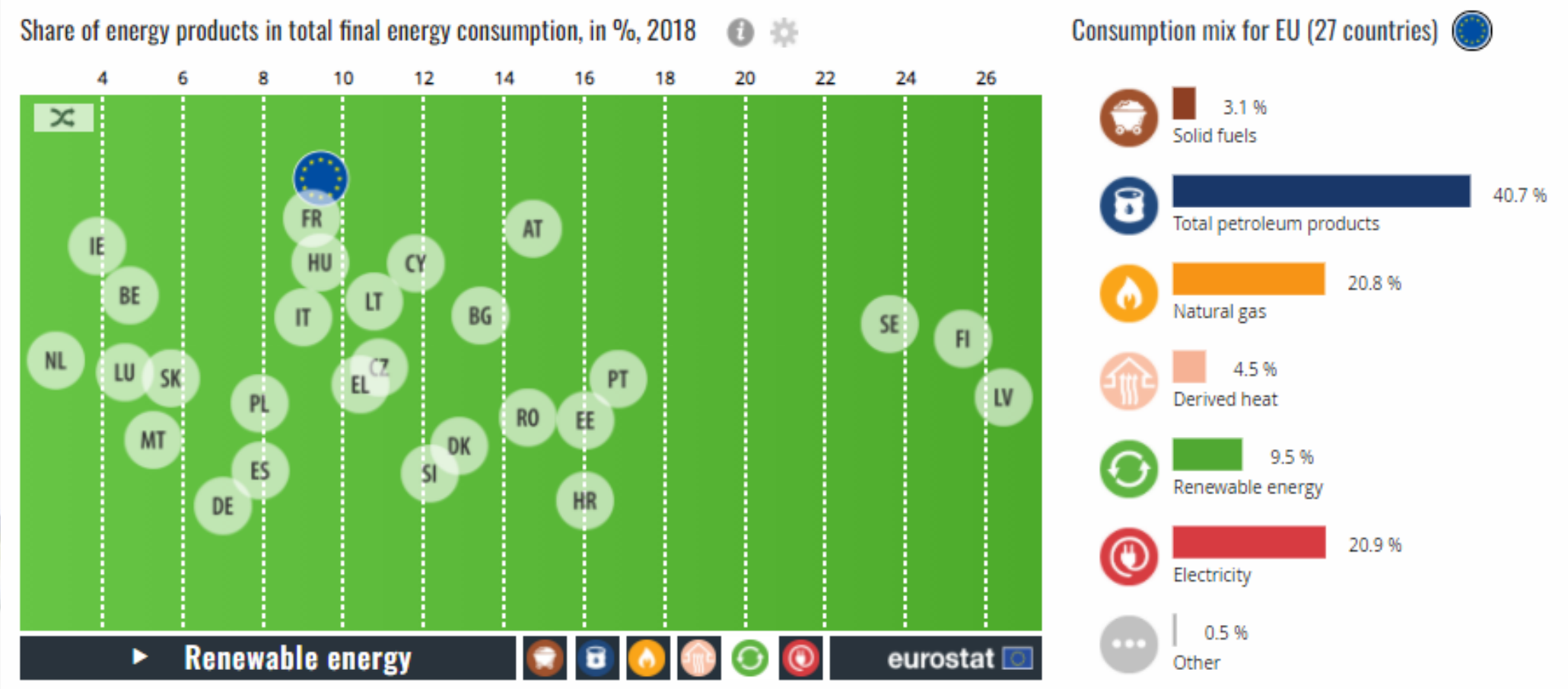


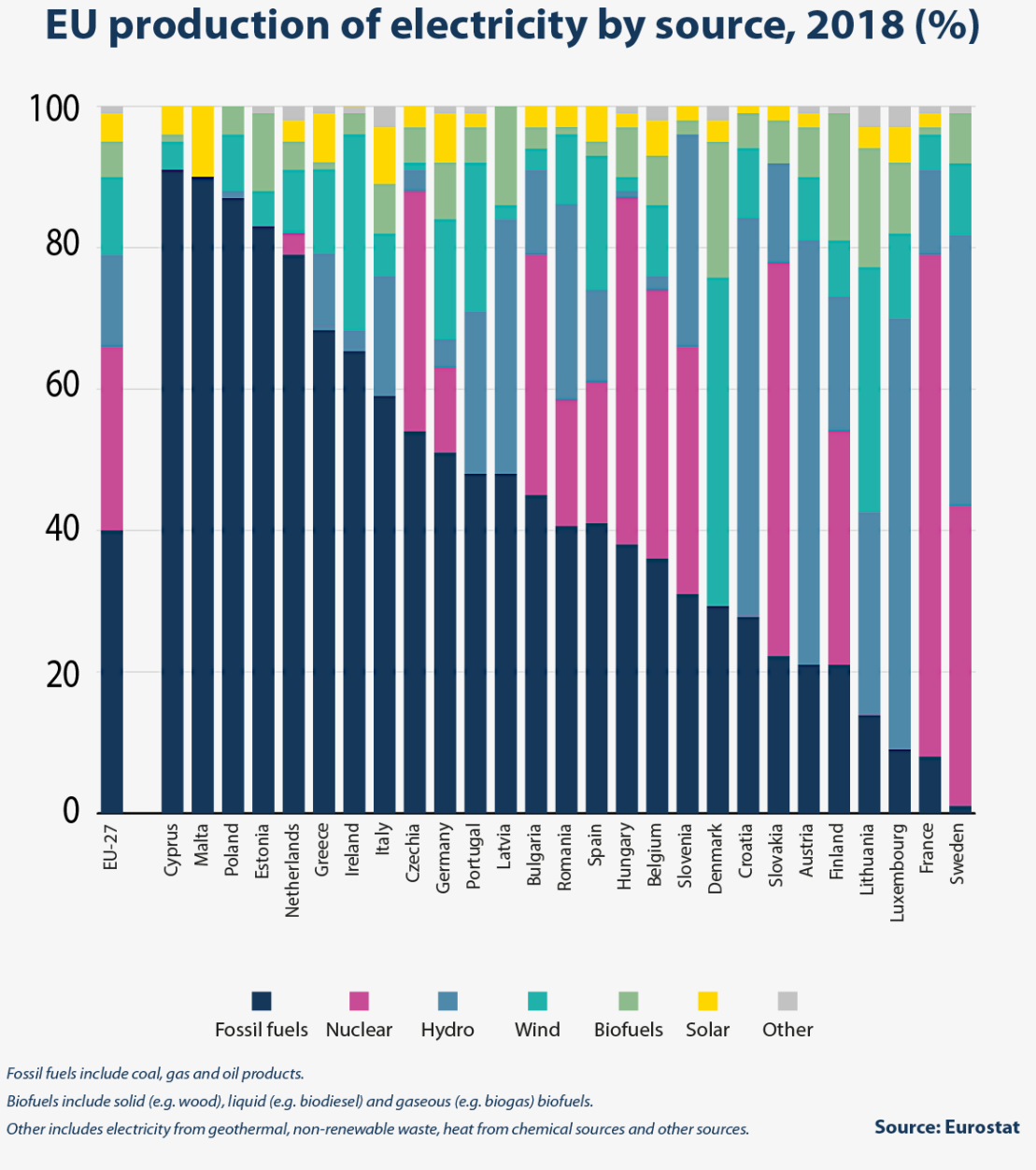
Source: https://ec.europa.eu/eurostat/cache/infographs/energy/bloc-3a.html

Project co-funded by the Europen Union (ERDF, IPA).

Electricity, gas and CO_2 as a market goods?

Project co-funded by the Europen Union (ERDF, IPA).

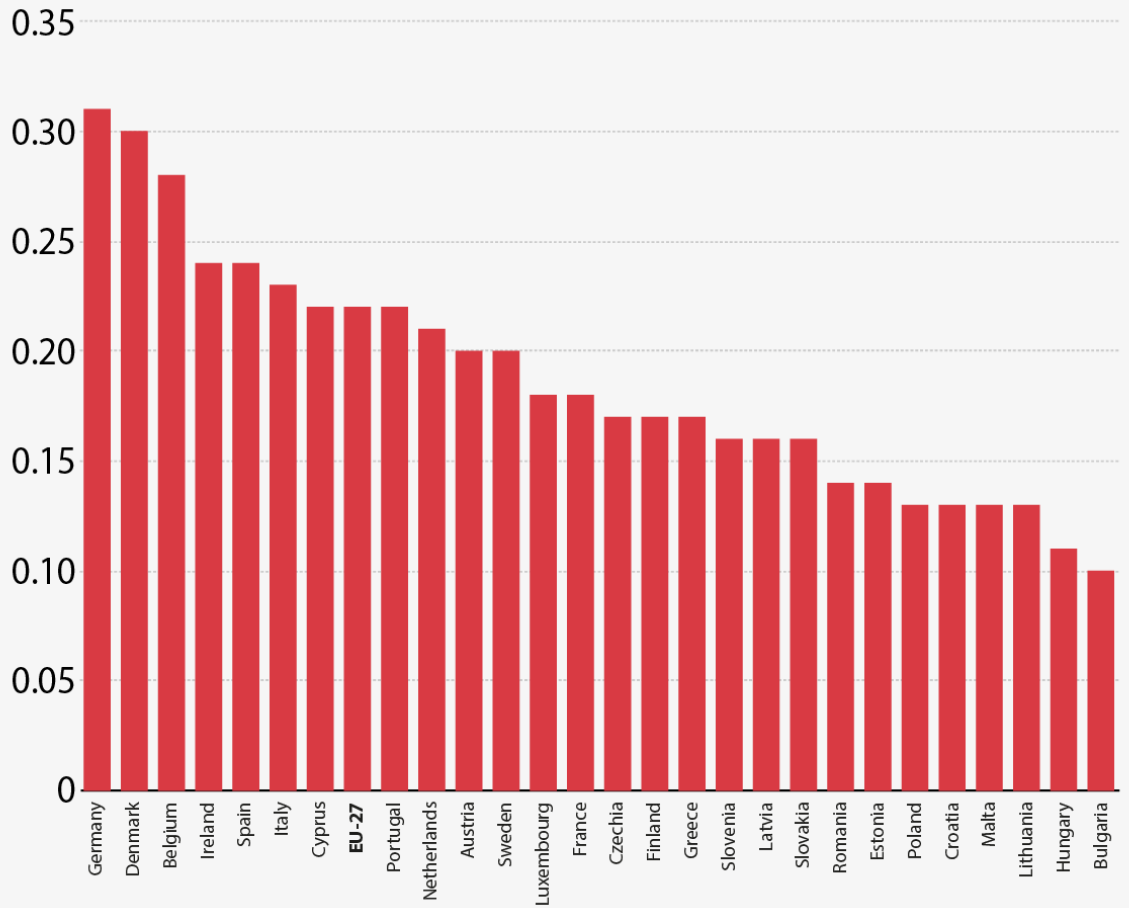
EU generation of electricity by source, 2018 (%)



Source: https://ec.europa.eu/eurostat/cache/infographs/energy/bloc-3b.html

Project co-funded by the Europen Union (ERDF, IPA).

Electricity prices for households 2019 (EUR/kWh)



For Member States not belonging to the euro area, the exchange rate to the euro may have an impact. **Source: Eurostat**

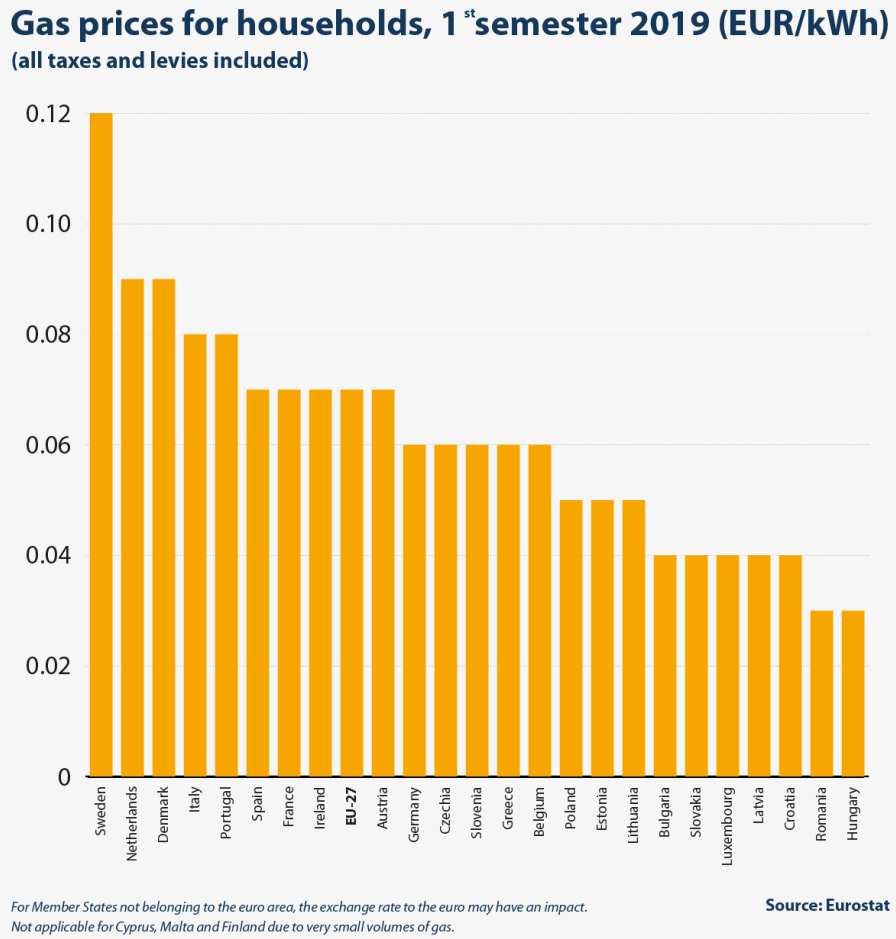
(all taxes and levies included)

Source: https://ec.europa.eu/eurostat/cache/infographs/energy/bloc-3c.html

Project co-funded by the Europen Union (ERDF, IPA).

Gas prices for households 2019 (EUR/kWh)

(all taxes and levies included)

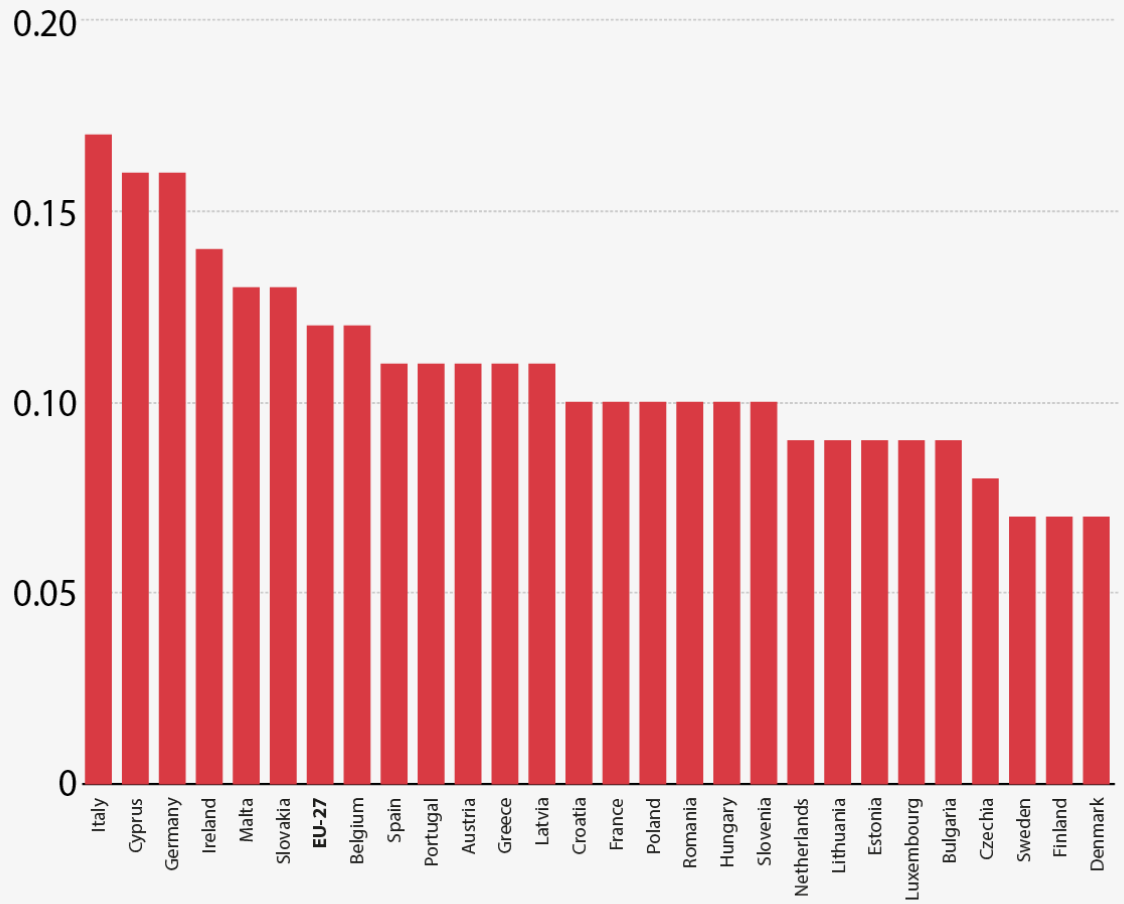


Source: https://ec.europa.eu/eurostat/cache/infographs/energy/bloc-3c.html

Project co-funded by the Europen Union (ERDF, IPA).

Electricity prices for non-household 2019 (EUR/kWh)

(all taxes and levies included)



For Member States not belonging to the euro area, the exchange rate to the euro may have an impact. **Source: Eurostat**

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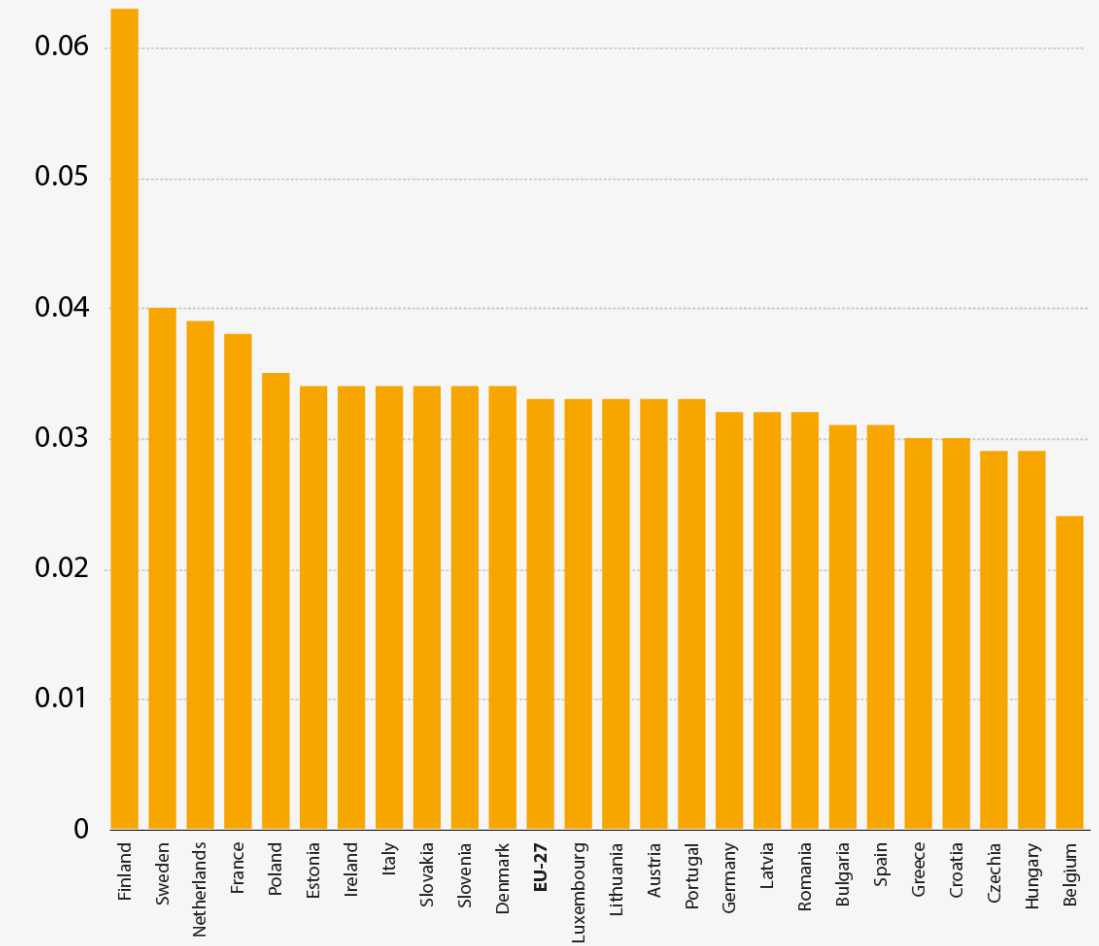
Gas prices for non-household 2019 (EUR/kWh)

(all taxes and levies included)



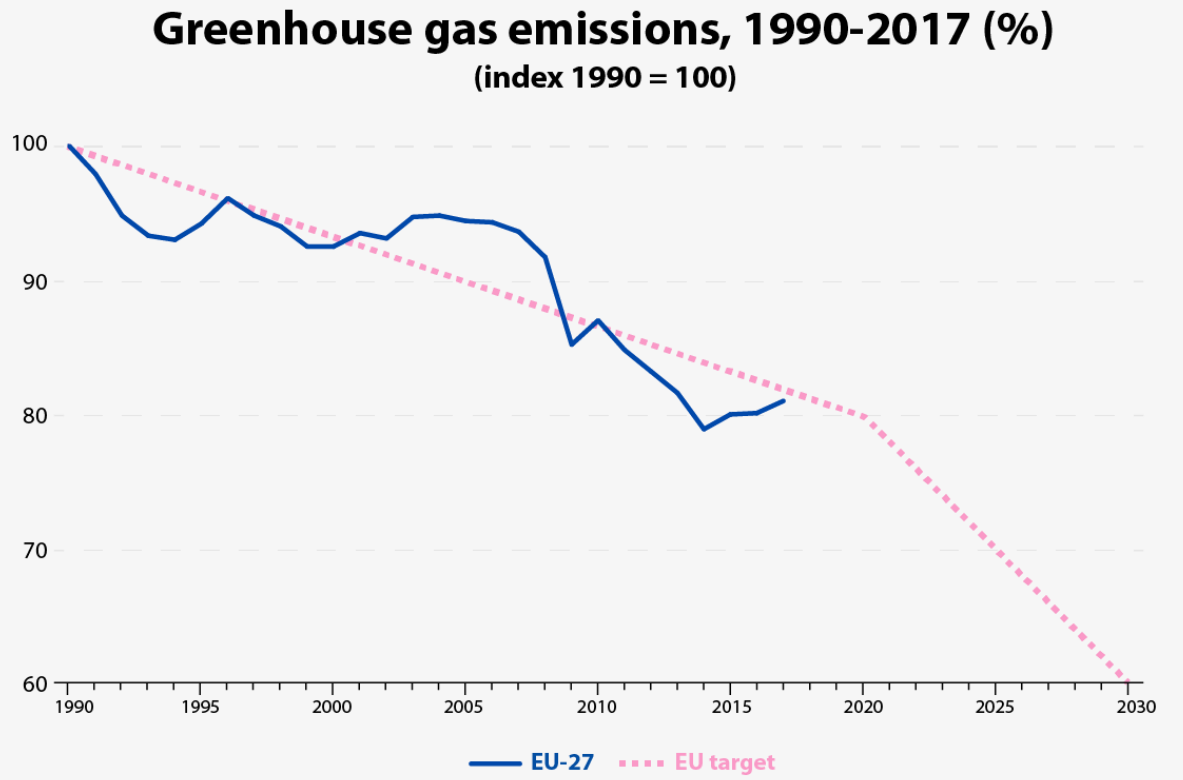
For Member States not belonging to the euro area, the exchange rate to the euro may have an impact.
Not applicable for Cyprus and Malta due to very small volumes of gas.

Source: Eurostat

Source: https://ec.europa.eu/eurostat/cache/infographs/energy/bloc-3c.html

Project co-funded by the Europen Union (ERDF, IPA).

Greenhouse gas emissions 1990-2017 (%)

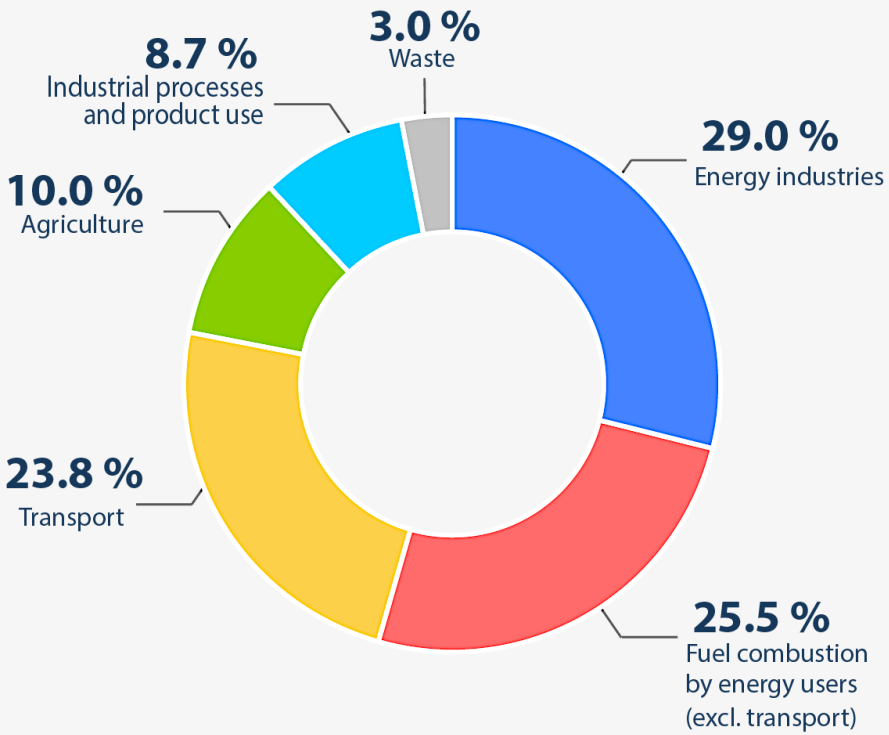


Source: European Environment Agency
Data including international aviation and indirect CO_2 emissions, excluding land use, land use change and forestry

Source: https://ec.europa.eu/eurostat/cache/infographs/energy/bloc-4a.html

Project co-funded by the Europen Union (ERDF, IPA).

Share of EU greenhouse gas emission by source, 2017



Energy industries: *Emissions from fuel combustion and to a certain extent fugitive emissions from energy industries, for example in public electricity, heat production and petroleum refining.*

Fuel combustion by users (excl. transport): *Emissions from fuel combustion by manufacturing industries and construction and small scale fuel combustion, for example, space heating and hot water production for households, commercial buildings, agriculture and forestry.*

Transport: *Emissions from fuel combustion of domestic and international aviation, road transport, railways and domestic navigation.*

Agriculture: *This includes among others emissions from livestock-enteric fermentation – greenhouse gases that are produced when animals digest their food, emissions from manure management and emissions from agricultural soils.*

Industrial processes: *Emissions occurring from chemical reactions during the production of e.g.: cement, glass etc.*

Waste: *Emissions from landfills, wastewater treatment and composting among others.*

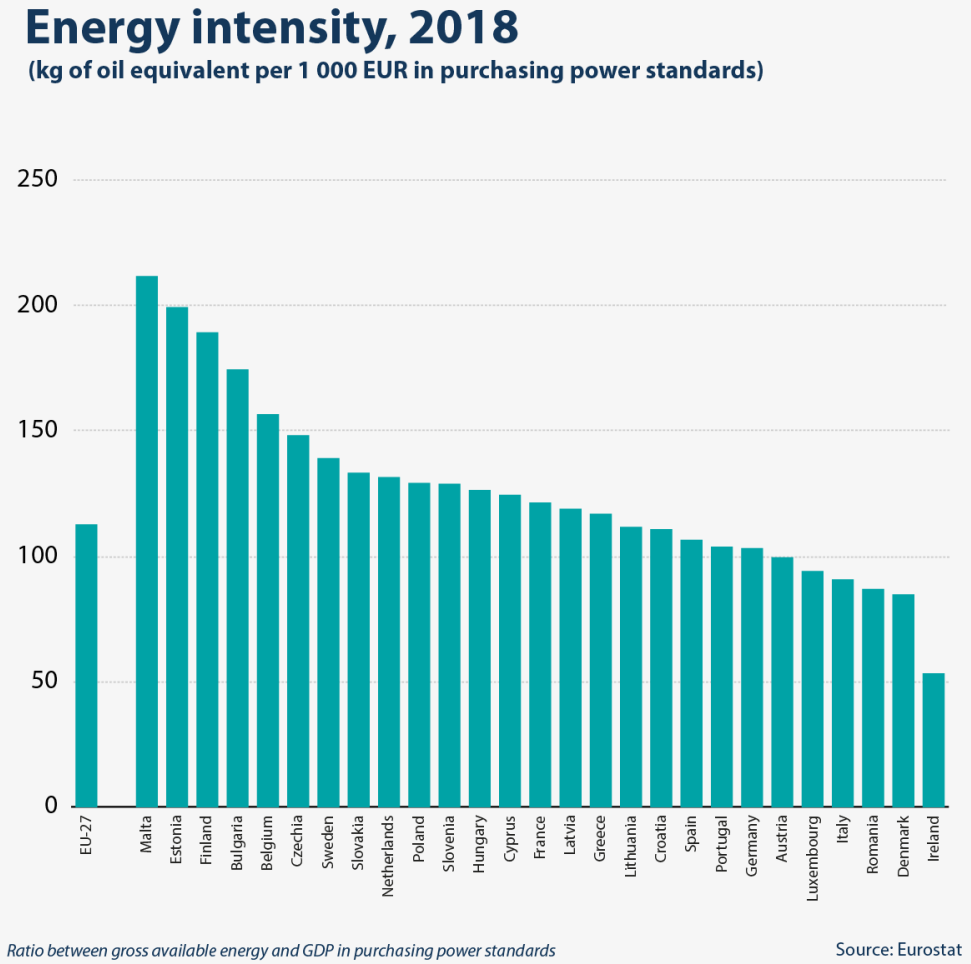
Data including international aviation, excluding indirect CO2 emissions and land use, land use charge and forestry.

Source: European Environment Agency

Source: https://ec.europa.eu/eurostat/cache/infographs/energy/bloc-4a.html

Project co-funded by the Europen Union (ERDF, IPA).

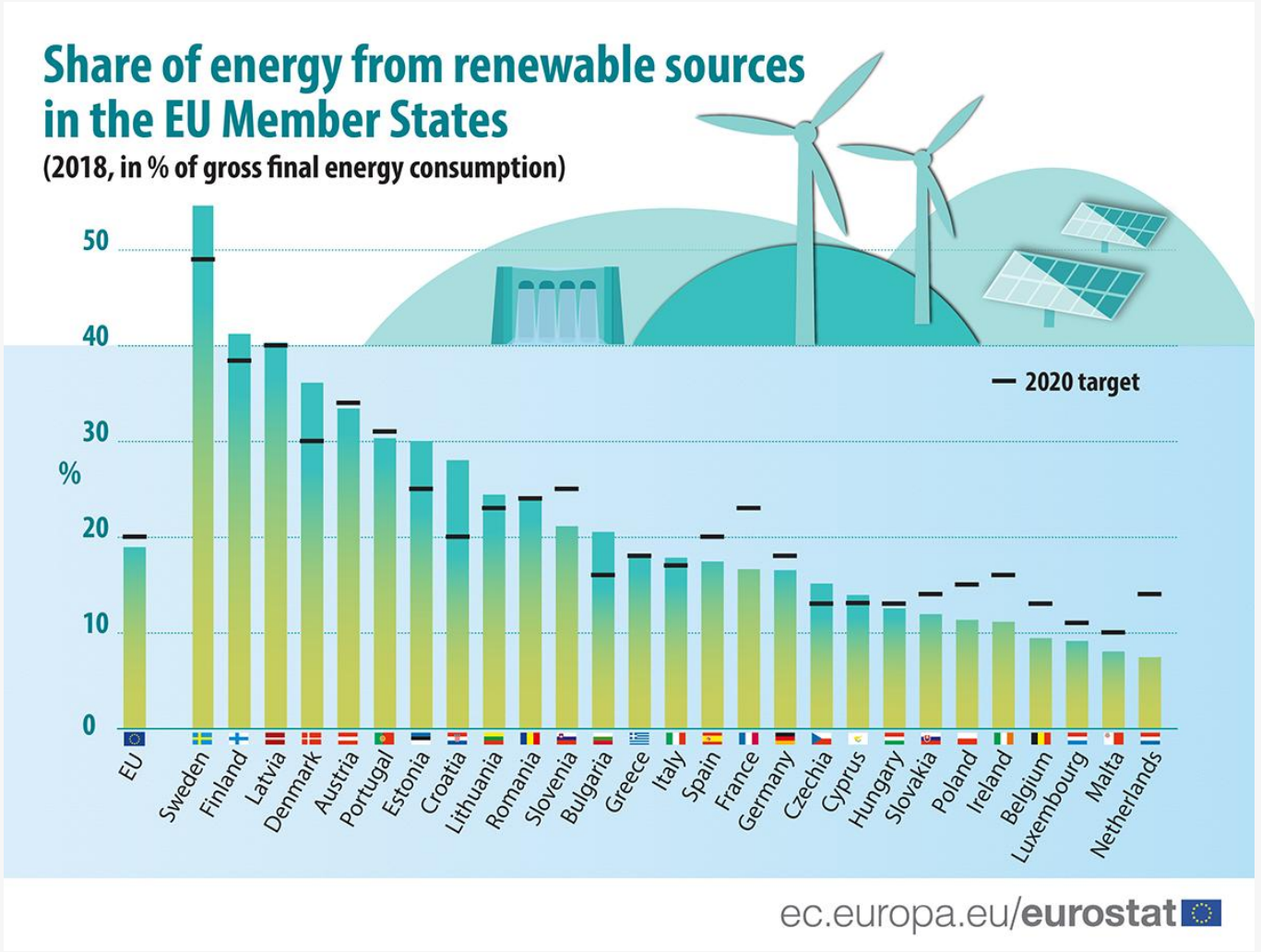
Energy intensity, 2018



Source: https://ec.europa.eu/eurostat/cache/infographs/energy/bloc-4b.html

Project co-funded by the Europen Union (ERDF, IPA).

Share of energy from RES in the EU Member States



Source: https://ec.europa.eu/eurostat/cache/infographs/energy/bloc-4c.html

Project co-funded by the Europen Union (ERDF, IPA).

The Smart grid international "framework"

Project co-funded by the Europen Union (ERDF, IPA).

International goals

- Kyoto 1997, Japan
- Became **international law** in 2005
- International agreement that aimed to **reduce CO2 emissions**
- EU: pledged to cut emissions by **8%**, USA **6%**
- USA dropped out in 2001
- **Doha Amendment 2012** – second commitment period, new reduction targets

Project co-funded by the Europen Union (ERDF, IPA).

Some targets

TARGETS FOR THE EU-15 COUNTRIES UNDER „BURDEN-SHARING" (2008-2012)		TARGETS FOR THE REMAINING EU MEMBER STATES (2008-2012)	
EU-15	-8%	Bulgaria	-8%
Austria	-13%	Croatia	-5%
Belgium	-7.5%	Czech Republic	-8%
Denmark	-21%	Estonia	-8%
Finland	0%	Hungary	-6%
France	0%	Latvia	-8%
Germany	-21%	Lithuania	-8%
Greece	+25%	Poland	-6%
Ireland	+13%	Romania	-8%
Italy	-6.5%	Slovakia	-8%
Luxembourg	-28%	Slovenia	-8%
Netherlands	-6%		
Portugal	+27%	Cyprus	N/A
Spain	+15%	Malta	N/A
Sweden	+4%		
United Kingdom	-12.5%		

Source: https://ec.europa.eu/clima/policies/strategies/progress/kyoto_1_en

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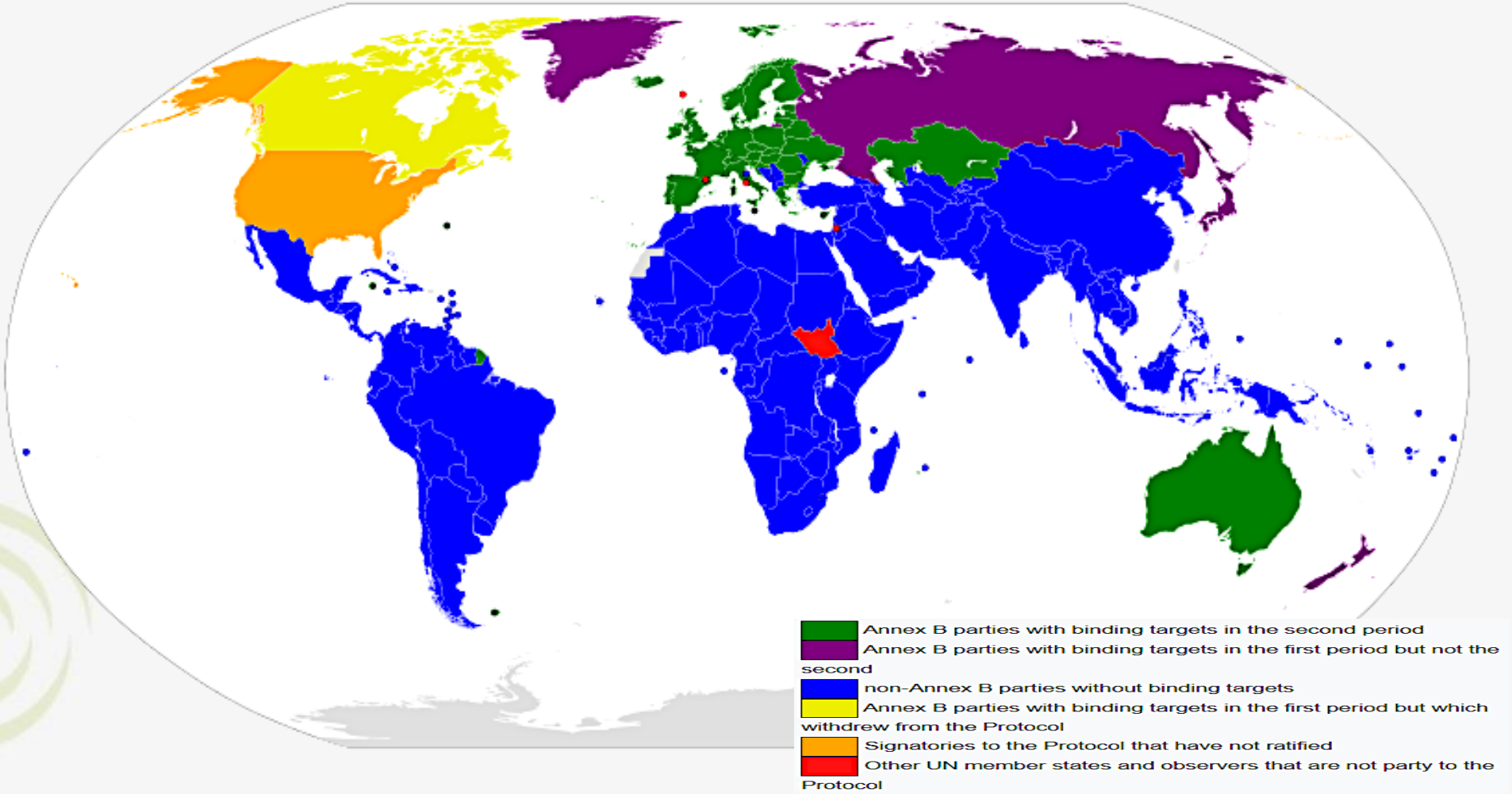
Kyoto Parties



Source: https://en.wikipedia.org/wiki/Kyoto_Protocol

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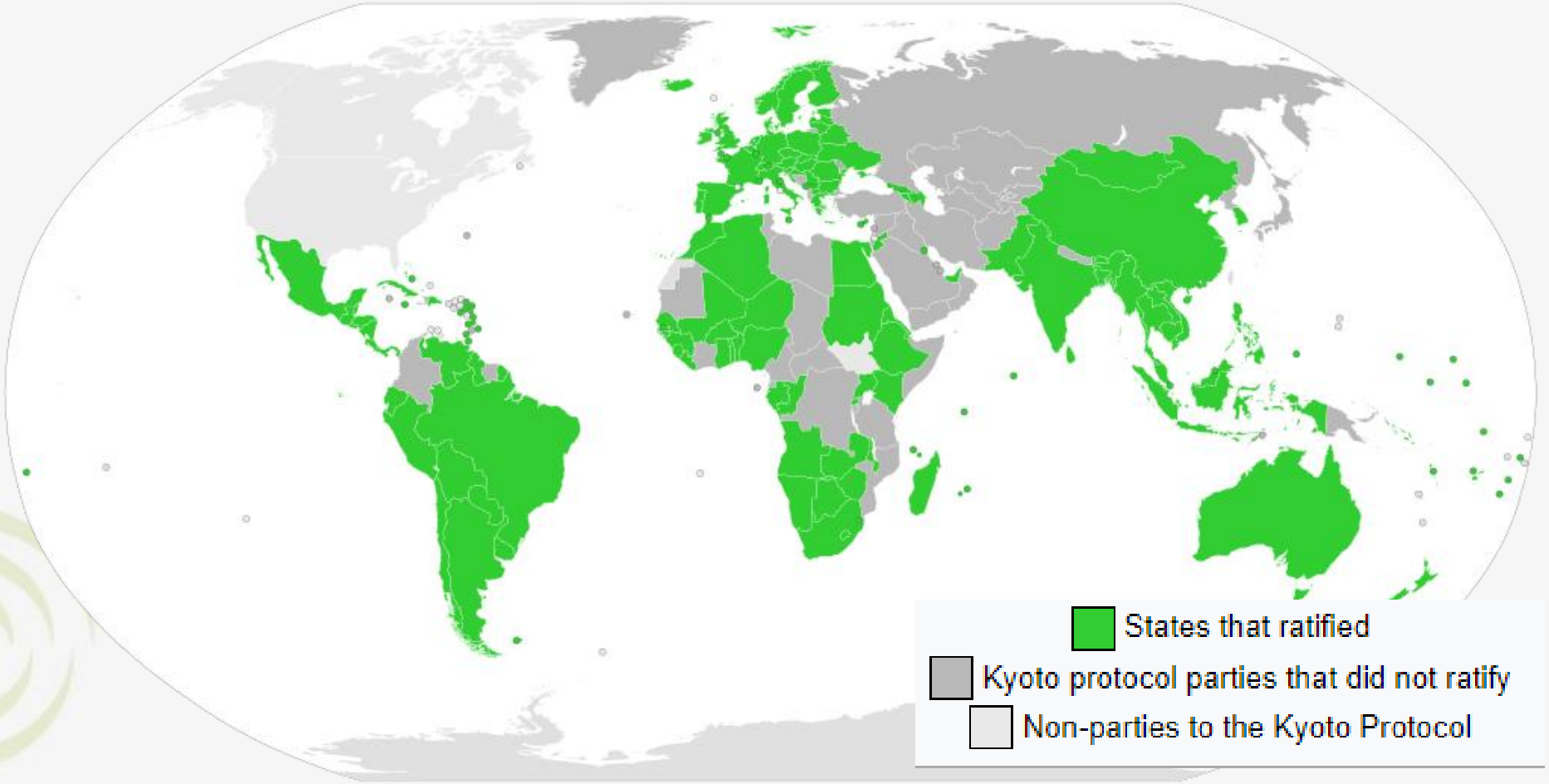
Doha Agreement Parties



Source: https://en.wikipedia.org/wiki/Kyoto_Protocol

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Paris Agreement

- Adopted by nearly every nation in 2015 to address climate change
- **Effective from 4 November 2016**
- **European Parliament ratified it on 5 October 2016**
- Limit the Earth's temperature increase in this century to 2°C and to pursue efforts to limit it even further to 1.5°C
- USA dropped out, but the new president has decided to join back

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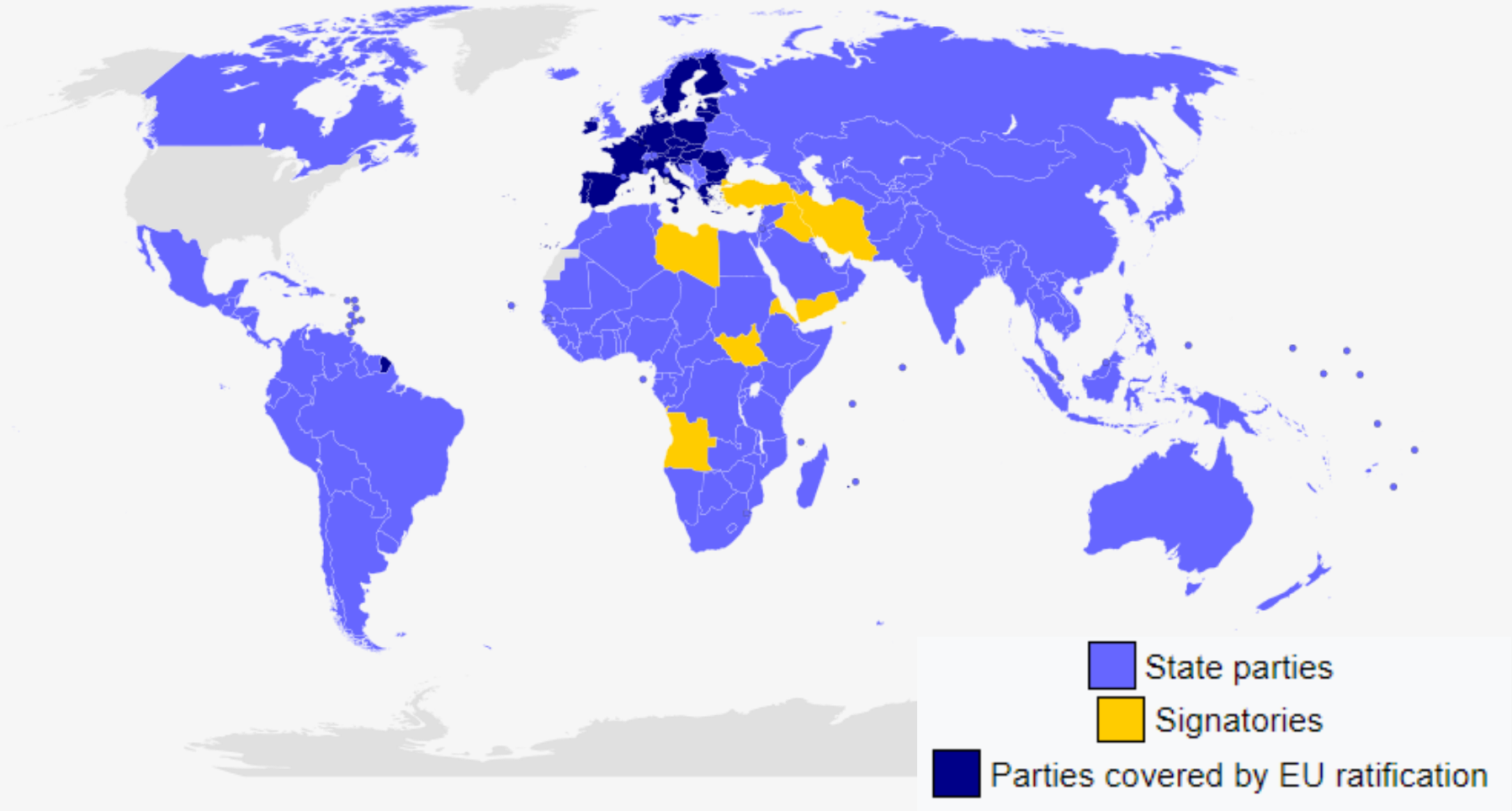
Paris Agreement Parties



Source: https://en.wikipedia.org/wiki/Paris_Agreement#/media/File:ParisAgreement.svg

Project co-funded by the Europen Union (ERDF, IPA).

What about the policies?

Project co-funded by the Europen Union (ERDF, IPA).

Policy documents

- Directives
- Regulatives
- Green Paper
- COM
- EC standardization mandates

Project co-funded by the Europen Union (ERDF, IPA).

Directives

- **DIRECTIVE 2001/77/EC** – on the promotion of electricity produced from renewable energy sources in the internal electricity market
- **DIRECTIVE 2003/54/EC** – concerning common rules for the internal market in electricity and repealing Directive 96/92/EC
- **DIRECTIVE 2006/32/EC** – on energy end-use efficiency and energy services and repealing Council Directive 93/67/EC (9% in 10 years)
- **DIRECTIVE 2009/72/EC** – on unbundling options and open market access

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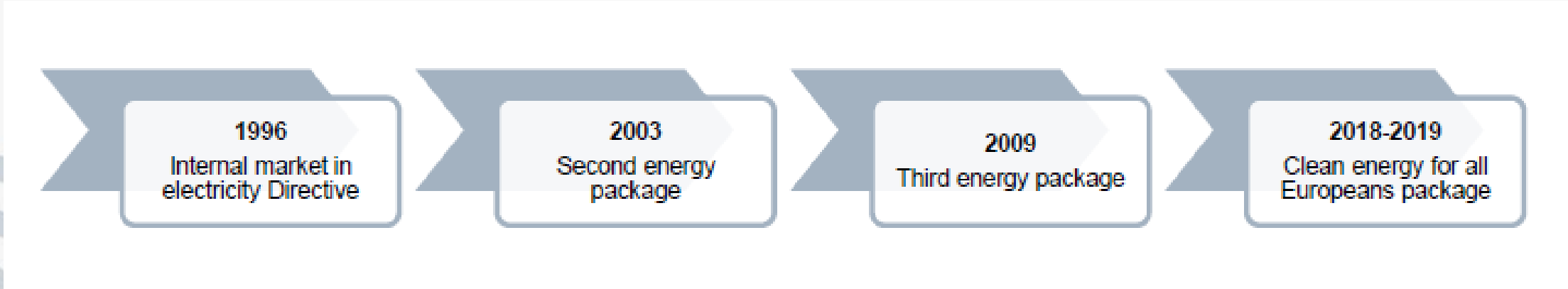
Liberalisation

- A liberalised internal market has been established through four legislative packages
- It is founded on the unbundling of supply, generation and networks; providing market access to third parties and ensuring competition



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First Energy Package

- **Directive 96/92/EC**
- allowing third-party network access and vertical unbundling (TSO and DSO must be separated from the competitive market participants)
- allowing large consumers to choose their supplier

Project co-funded by the Europen Union (ERDF, IPA).

Second Energy Package

- **Directive 2003/54/EC**
- started promoting renewables
- allowed all consumers to choose suppliers
- established independent energy sector regulators in all member states

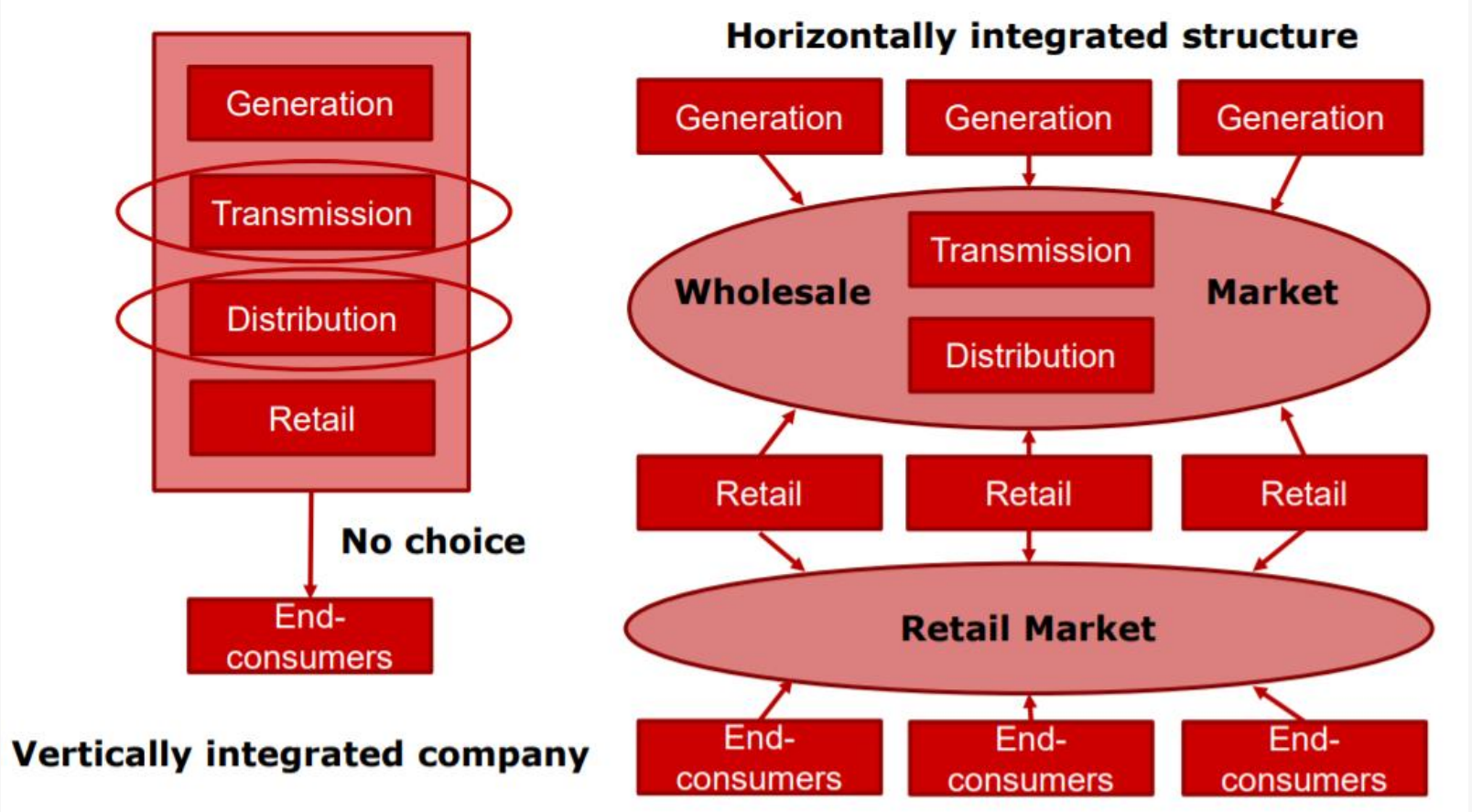
Project co-funded by the Europen Union (ERDF, IPA).

Third Energy Package

- **Directive 2009/72/EC**
- allows open access to the market for all participants
- requires further development of cross-border interconnections to ensure security of supply and competitive market
- defines **ITO**, **ISO** and **OU** as models for TSO unbundling

Project co-funded by the Europen Union (ERDF, IPA).

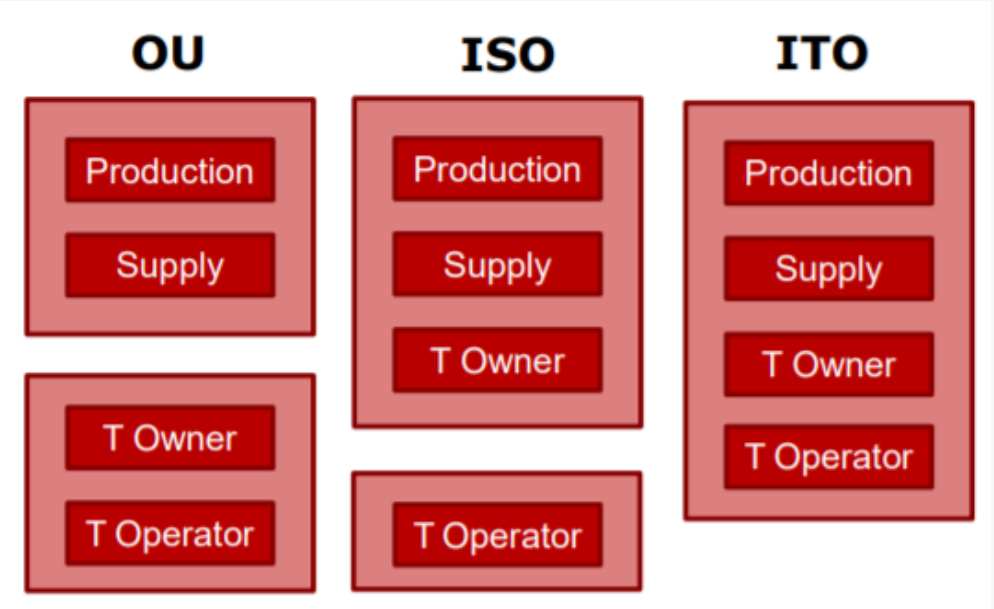
Monopoly vs Liberalisation

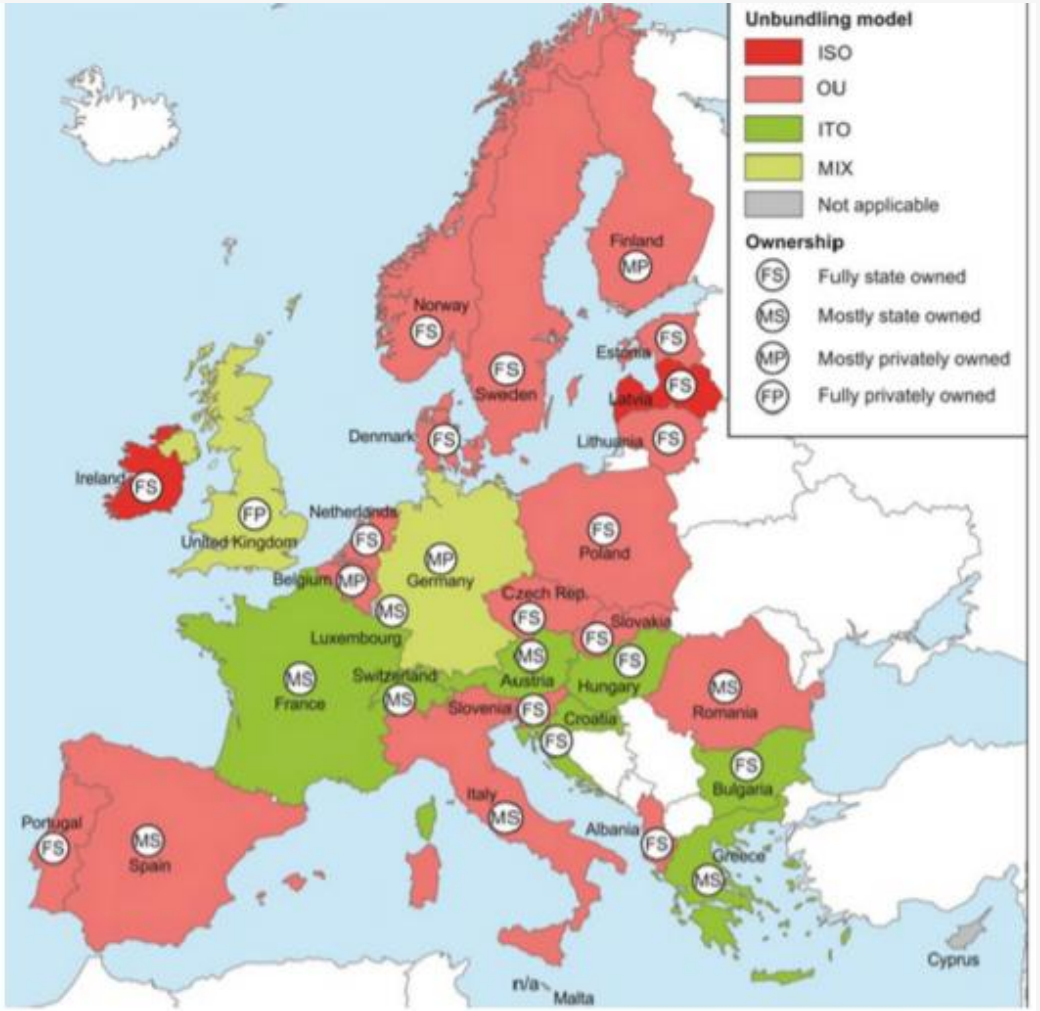


Project co-funded by the Europen Union (ERDF, IPA).

Source: https://www.fer.unizg.hr/_download/repository/Week_1_Electricity_Markets[1].pdf

TSO's in the EU





Source: https://www.fer.unizg.hr/_download/repository/Week_1_Electricity_Markets[1].pdf

Project co-funded by the Europen Union (ERDF, IPA).

Third Energy Package

- **Electricity Regulation EC/714/2009**
  - set rules for cross-border exchanges in electricity
  - establishes ENTSO-E
- **Regulation EC/713/2009**
  - establishment of the ACER

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Clean Energy for all Europeans Package (Fourth Energy Package)

- Legislation on:
  - Energy performance in buildings: completely decarbonize the buildings sector by 2050
  - Renewable energy: 32% by 2030
  - Energy efficiency: 32.5% by 2030
  - Governance regulation: 10-year NECPs for period 2021-2030 by each Member State
  - Electricity market design

Project co-funded by the Europen Union (ERDF, IPA).

National Climate and Energy Plans

- Obligatory for **ALL** Member States
- energy efficiency police for a period of 3 years
- NECPs should cover five dimensions of the Energy Union
- **All citizens can participate**

Project co-funded by the Europen Union (ERDF, IPA).

Clean Energy for all Europeans Package – Electricity Design

- Electricity Directive
- Electricity Regulation
- Risk-Preparedness Regulation
- ACER Regulation

Project co-funded by the Europen Union (ERDF, IPA).

Electricity Regulation

- Regulation EU 2019/943
  - establishing of a fully integrated internal energy market
  - mostly deals with the wholesale markets
  - defines balancing responsibility and balancing mechanisms
- Electricity Regulation and the Grid
  - defines dispatching procedures
  - establishes the European entity for DSOs (EU DSO)

Project co-funded by the Europen Union (ERDF, IPA).

Electricity Regulation

- Electricity Regulation and the Markets
  - Sets up the framework for different markets within a zonal market structure
  - Balancing, day-ahead and intraday, forward market
  - Sets up design principles for capacity mechanisms and markets

Project co-funded by the Europen Union (ERDF, IPA).

Electricity Directive (1)

- Directive EU 2019/944
  - Sets up liberalized power system
  - Mostly deals with retail markets
  - Puts consumers in the center of energy transition by demanding:
    - Dynamic retail price-setting
    - Aggregation of demand response services
    - Better access to information
    - Right for consumers to request the installation of a smart meter

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Electricity Directive (2)

- Electricity Directive and the Grid
  - DSOs should:
    - Enable connection of EV charging stations to the grid
    - Be incentivized to procure flexibility services from grid users
  - TSOs and DSOs should:
    - Own, develop, manage or operate energy storage facilities only if they are necessary for grid operation and there is no other interested parties

Project co-funded by the Europen Union (ERDF, IPA).

Risk Preparedness

- **Regulation EU 2019/941**
- common rules for risk preparedness
  - requires cooperation from member states

Project co-funded by the Europen Union (ERDF, IPA).

The ACER Agency

- The Agency for the Cooperation of the Energy Regulators (ACER)
  - **Regulation EU 2019/942**
    - strengthens the role of ACER
    - responsible for the coordination of regional decision-making

Project co-funded by the Europen Union (ERDF, IPA).

Joint Allocation Office (JAO)

- Facilitates the electricity market by organizing auctions for cross border transmission capacity
- October 2018 – JAO became the Single Allocation Platform (SAP)
- Long-term, short-term auctions
- Y, S, Q, M, W, D, I auctions

Project co-funded by the Europen Union (ERDF, IPA).

Other policies

- Commission Recommendations of 9 March 2012 on preparations for the roll-out of smart metering systems
- Communication from the European Commission and Parliament – Accelerating Clean Energy Innovation
- Standardisation Mandate to CEN, CENELEC and ETSI concerning the charging of electric vehicles

Project co-funded by the Europen Union (ERDF, IPA).

EC standardizations

- M/468 – for electric vehicles
- M/441 – for smart meters
- M/490 – for Smart Grids

Project co-funded by the Europen Union (ERDF, IPA).

M/468 – Charging of Electric Vehicles

- Objectives:
  - interoperability and connectivity between the electricity supply point and the charger of EVs
  - interoperability and connectivity between the charger and the EV and its removable battery
- **EV include**: EVs and PHEVs, electric scooters and electric bicycles
- smart-charging
- CEN, CENELEC and ETSI

Project co-funded by the Europen Union (ERDF, IPA).

M/441 – Smart Meters

- Objectives:
  - enable interoperability of utility meters (water, gas, electricity, heat)
  - to improve customers' awareness
  - to allow adaptation to customers' demands
- Smart Meters Coordination Group
- ESOs, CEN, CENELEC and ETSI

Project co-funded by the Europen Union (ERDF, IPA).

M/490 – Smart Grid Mandate (1)

- Objective:
  - **to develop a set of standards for integration of smart grids**
- Appliances, home automation
- RES, EE, DSM, Transport, Energy Storage
- Smart Grid Cybersecurity
- Coordinated with the M/441 and M/468 mandates

Project co-funded by the Europen Union (ERDF, IPA).

M/490 – Smart Grid Mandate (2)

- **Smart Grid Task Force** – five expert groups focused on smart grid polices and framework
- **6 high level services**:
  - integration of new users
  - efficiency in day-to-day grid operation
  - security, control and quality of supply
  - better planning of future network investment
  - market functioning and customer service
  - involvement of consumers

Project co-funded by the Europen Union (ERDF, IPA).

Literature

- Eurostat database; URL: https://ec.europa.eu/eurostat
- Clean Energy for All Europeans – Electricity Markets course; Faculty of Electrical Engineering and Computing; URL: https://www.fer.unizg.hr/_download/repository/Week_7_Clean_Energy_for_All_Europeans.pdf
- URL: https://eur-lex.europa.eu/homepage.html
- URL: https://ec.europa.eu/energy/topics/energy-strategy/clean-energy-all-europeans_en

Project co-funded by the Europen Union (ERDF, IPA).

Interreg
Danube Transnational Programme
STRIDE

EU climate action and the European Green Deal

Project co-funded by the Europen Union (ERDF, IPA).

Content

- European Green Deal
- Climate Strategies & Targets
- Progress Analysis
- Emissions Monitoring
- Emissions Trading System
- Innovation Fund
- Adaptation to Climate Change

Project co-funded by the Europen Union (ERDF, IPA).

How is EU fighting climate change? (1)

- **Policies:**
  - **2020** & **2030** targets
  - By **2050** – world's **first** climate-neutral continent
  - **European Green Deal** – package of measures
    - Cut GHG emission, invest in R&I
    - initiatives:
      - European Climate Law
      - European Climate Pact
      - 2030 Climate Target Plan
      - 2050 Long-Term Strategy

Project co-funded by the Europen Union (ERDF, IPA).

How is EU fighting climate change? (2)

- By June 2021, the Commission will adopt a new, more ambitious EU strategy in climate change
- International cooperation is extremely important
- Key EU **legislations** and **policies**:
  - EU Emissions Trading System
  - National Targets
  - Forest and agriculture
  - Transport
  - Energy efficiency, renewable energy
  - Low-carbon technologies
  - Protecting the ozone layer, reducing GHG emissions
  - Funding climate action

Project co-funded by the Europen Union (ERDF, IPA).

How is EU fighting climate change? (3)

- **Key areas working together**:
  - Energy
  - Environment
  - Mobility and Transport
  - Regional policy and the low-carbon economy
  - Sustainable finance
  - Industrial policy
  - Trade and sustainable development
  - International cooperation
  - R&I on climate change

Project co-funded by the Europen Union (ERDF, IPA).

European Climate Law

- Aims to write into law the goal set out in the European Green Deal for Europe to become completely climate-neutral by 2050
- Objectives:
  - policies for 2050 target and ensure that transmission is irreversible
  - create a system for monitoring progress
  - provide predictability for investors
- Member States need **strengthen resilience** and **reduce vulnerability** to the effects of climate change

Project co-funded by the Europen Union (ERDF, IPA).

European Climate Pact

- Invites the whole EU to:
  - **connect** and **share** knowledge
  - **learn** about climate change
  - **develop**, **implement** and **scale up** solutions
- Focus areas: green areas, green transport, green buildings, green skills
- Late 2020 – launch event of the European Climate Pact

Project co-funded by the Europen Union (ERDF, IPA).

Climate strategies & targets

- 2020 climate & energy package
- 2030 climate & energy package
- 2050 long-term strategy

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2020 Climate & Energy Package

- 20% cut in GHG emissions (from 1990 levels)
- 20% of EU energy from renewables
- 20% improvement in energy efficiency
- Set in 2007, enacted in legislation in 2009
- Renewable energy target varies based on countries' different starting positions and overall renewable capacity

Project co-funded by the Europen Union (ERDF, IPA).

2030 Climate & Energy Package

- At least 40% cuts in GHG emissions from 1990 levels (later increased to 55%)
- At least 32% share for renewable energy
- At least 32.5% improvement in energy efficiency
- **Benefits**: green jobs, energy security and independence

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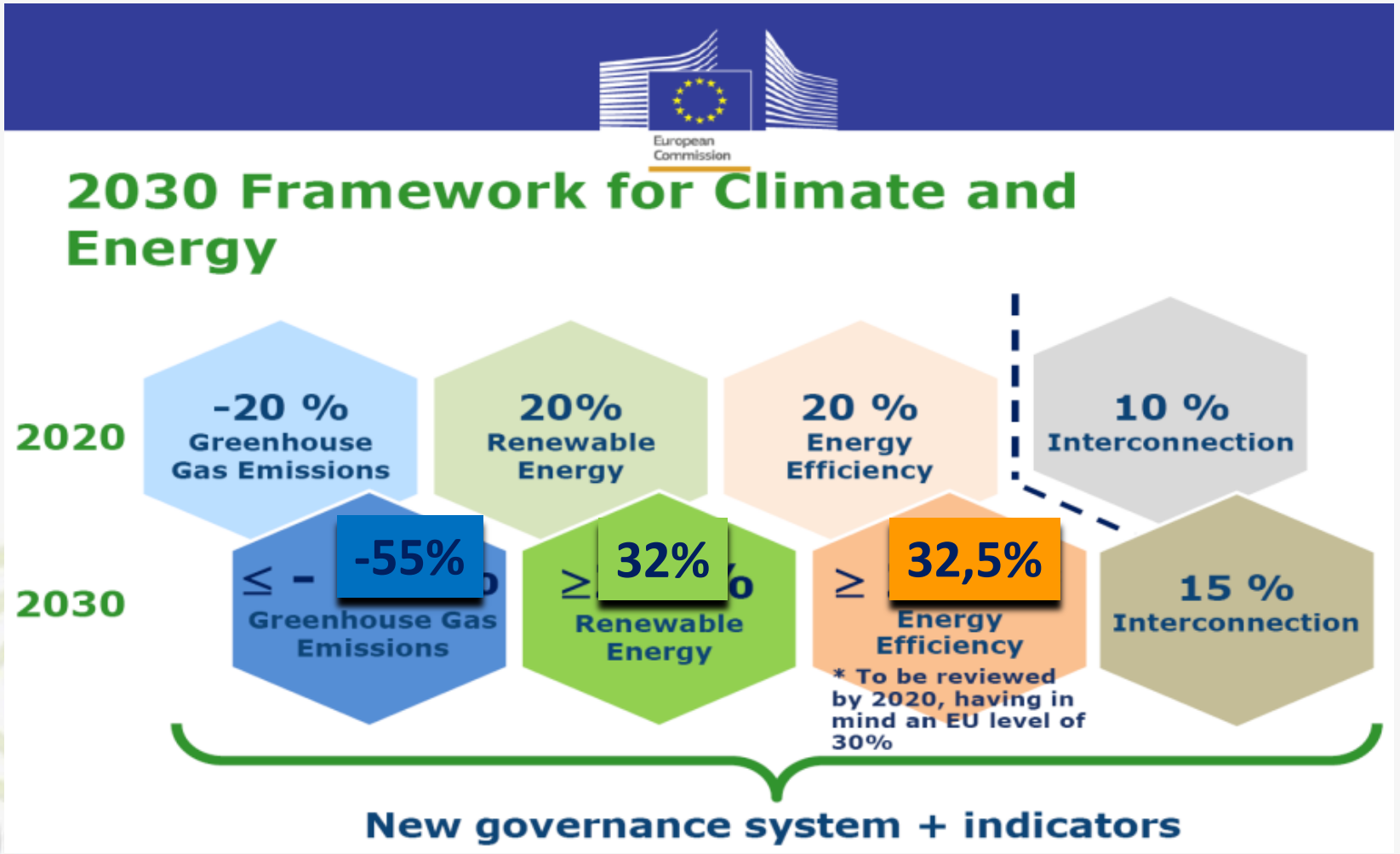
2030 Climate & Energy Package



Project co-funded by the Europen Union (ERDF, IPA).

EU Winter package (clean energy for all Europeans) & Energy Union

- **The package has three main objectives:**
  - **Energy efficiency first**
  - **Achieving global leadership in renewable energy**
  - **Providing a fair deal for consumers**
- **The concept of the Energy Union is based on five key dimensions:**
  1. **Security of supply (energy security, solidarity and trust)**
  2. **Internal market (fully integrated internal energy market - Energy should flow freely throughout the EU - without any technical or regulatory barriers)**
  3. **Energy efficiency (energy efficiency first)**
  4. **Decarbonization (transition to a long-lasting, low-carbon society)**
  5. **Research and innovation (energy union for research, innovation and competitiveness)**

Project co-funded by the Europen Union (ERDF, IPA).

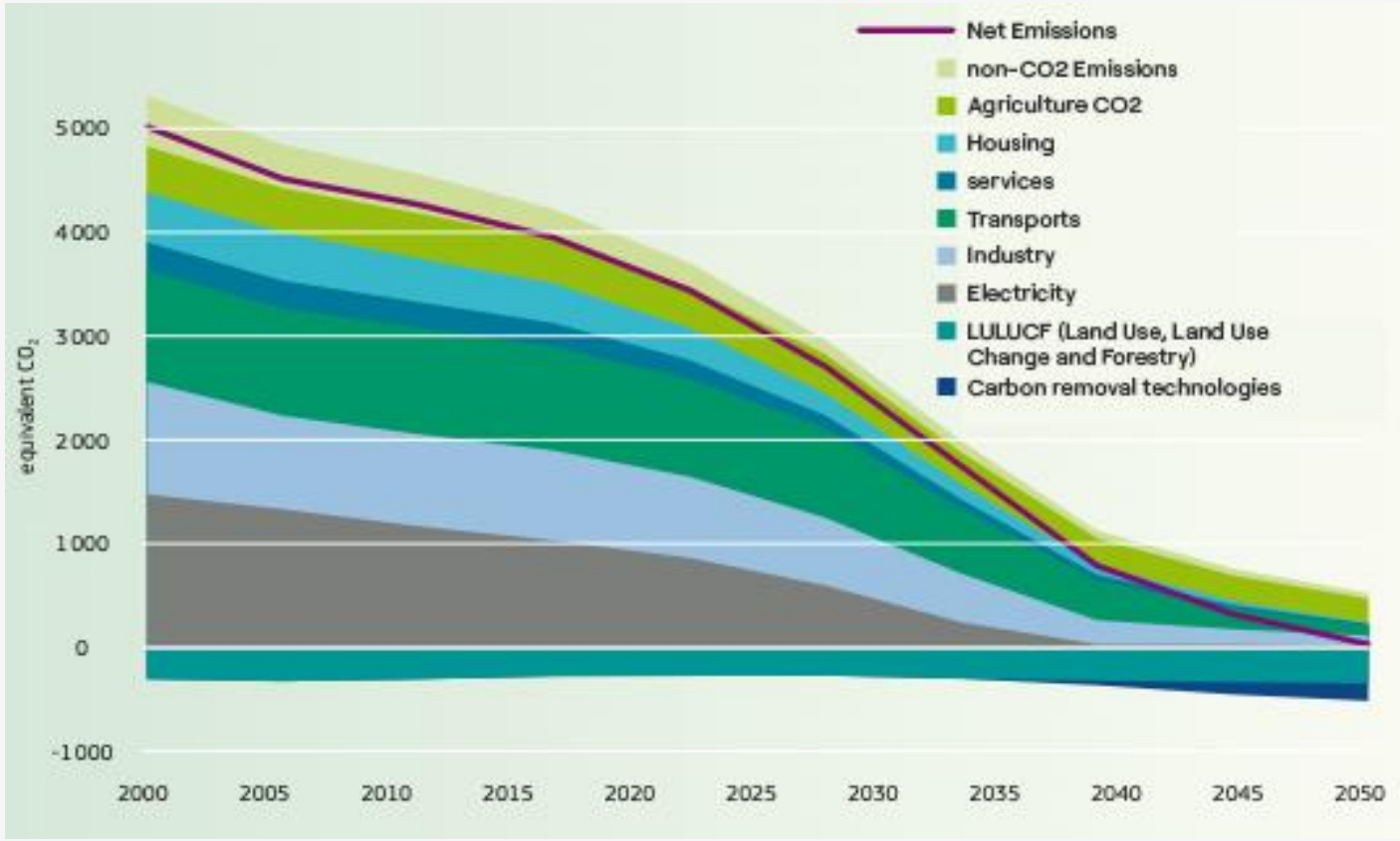
2050 long-term strategy

- Climate-neutral by 2050
- EU's strategy – Paris Agreement and EU objectives
- National strategies
- All parts of society will play a role – cooperation of different sectors is important

Project co-funded by the Europen Union (ERDF, IPA).

2050 long-term strategy - Carbon neutrality

- Carbon neutrality is the balance between carbon emission and its absorption from the atmosphere into carbon sinks.
- In order to achieve climate neutrality, it is necessary to reduce carbon emissions



The reduction of emissions related to electricity production (in gray) will have to be accelerated in order to achieve a fully decarbonised electricity mix in 2040.

Project co-funded by the Europen Union (ERDF, IPA).

Progress analysis

- Latest figures:
  - EU GHG **emissions** were reduced **by 24%** between 1990 and 2019
  - EU **on track** to achieve the set targets
  - From 2018 to 2019, emissions reduced by 3.7%
  - The most significant **decline** - **power** plants

Project co-funded by the Europen Union (ERDF, IPA).

Emissions monitoring & reporting

- The EU and its Member States are required to report to the UN:
  - **Annually** on their GHG emissions
  - **Regularly** on their climate policies and measures and progress towards the targets

Project co-funded by the Europen Union (ERDF, IPA).

Emissions Trading System (EU ETS)

- The world's first major carbon market
- Operates in all EU countries + Iceland, Liechtenstein and Norway
- Limits emissions from more than 11,000 **heavy energy-using installations**
- Covers around **40%** of the EU's GHG emissions
- „Cap and Trade" system

Project co-funded by the Europen Union (ERDF, IPA).

Effort Sharing: Member States' targets (1)

- Establishes binding annual GHG emission targets for Member States for periods 2013-2020 and 2021-2030
- Targets concern emissions from sectors **not included in the EU ETS**
- **Reduction of 10% by 2020 and of 30% by 2030 in those sectors**

- National targets factors: relative wealth, measured by GDP per capita
- Ensuring fairness: higher income states → more ambitious goals
- Croatia can **increase** emissions by 11% until 2020

Project co-funded by the Europen Union (ERDF, IPA).

Effort Sharing: Member States' targets (2)

- **EU ETS** – regulated at EU level
- **Effort Sharing Legislation** – regulated at national level

NATIONAL LEVEL	EU LEVEL
Reducing transport needs and promoting public transport	CO2 emission standards for new cars and vans
Support schemes for retrofitting buildings	Emission reduction from buildings with energy efficient products restrictions on fluorinated industrial gases (F-gases)
More efficient heating and cooling systems and use of renewable energy	Soil protection and waste

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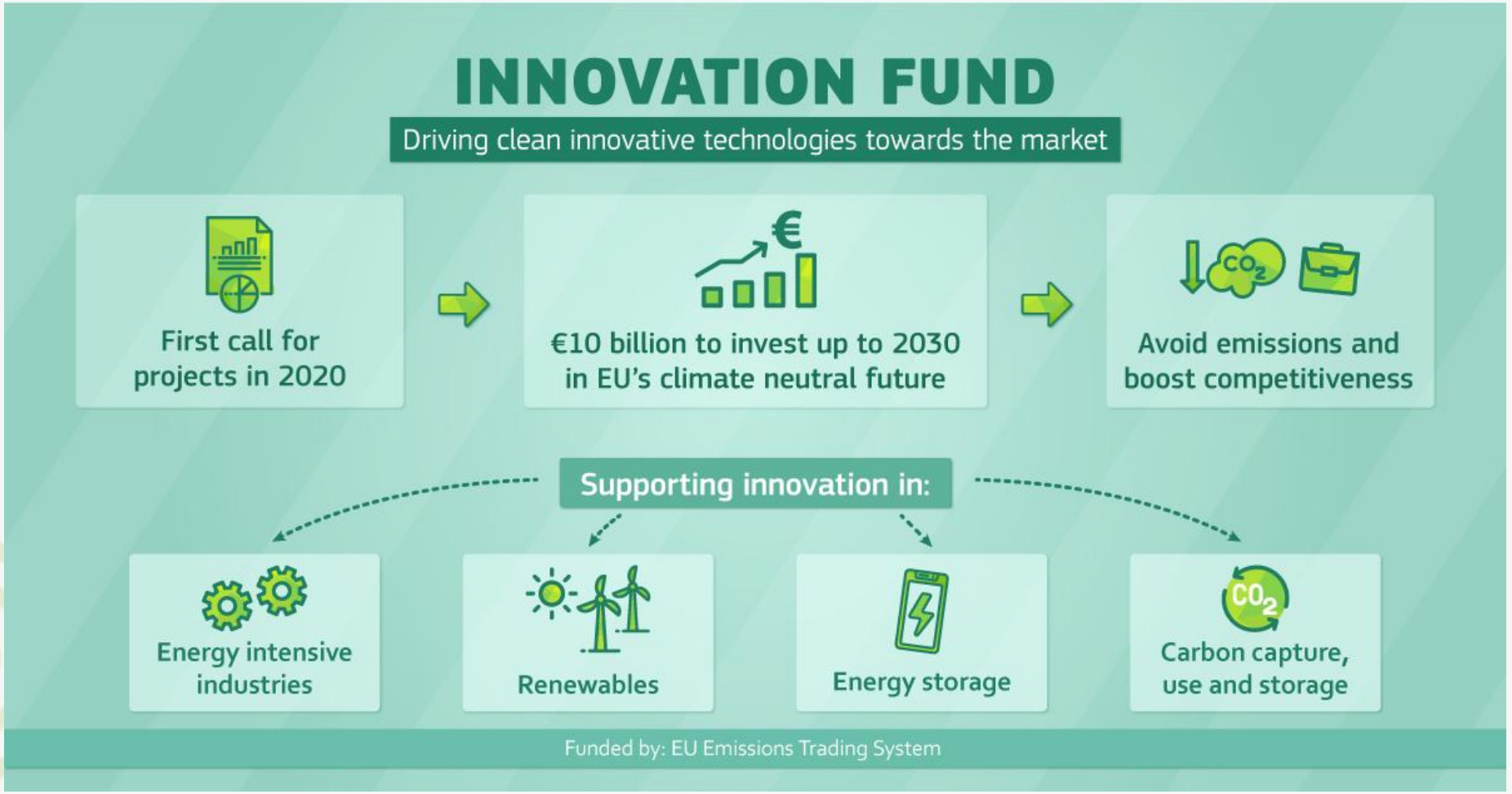
The Innovation Fund



Project co-funded by the Europen Union (ERDF, IPA).

Source: https://ec.europa.eu/clima/policies/innovation-fund_en

Adaptation to climate change (1)

- **How will we be affected?**
  - high temperatures, water availability, floods, droughts, landslides

- **What is EU doing?**
  - in 2021, the European Commission adopted a new **EU strategy on adaptation to climate change**
  - objectives: make adaptation smarter, swifter and more systemic

Project co-funded by the Europen Union (ERDF, IPA).

Adaptation to climate change (2)

- **Financing Adaptation**
  - **5 European Structural and Investment Funds (ESI funds)**
    - European Regional Development Fund (ERDF)
    - European Social Fund (ESF)
    - Cohesion Fund (CF)
    - European Agricultural Fund for Rural Development (EAFRD)
    - European Maritime and Fisheries Fund (EMFF)
  - **Horizon 2020** – promote R&D on climate change
  - **LIFE** – finances a wide range of projects related to climate change

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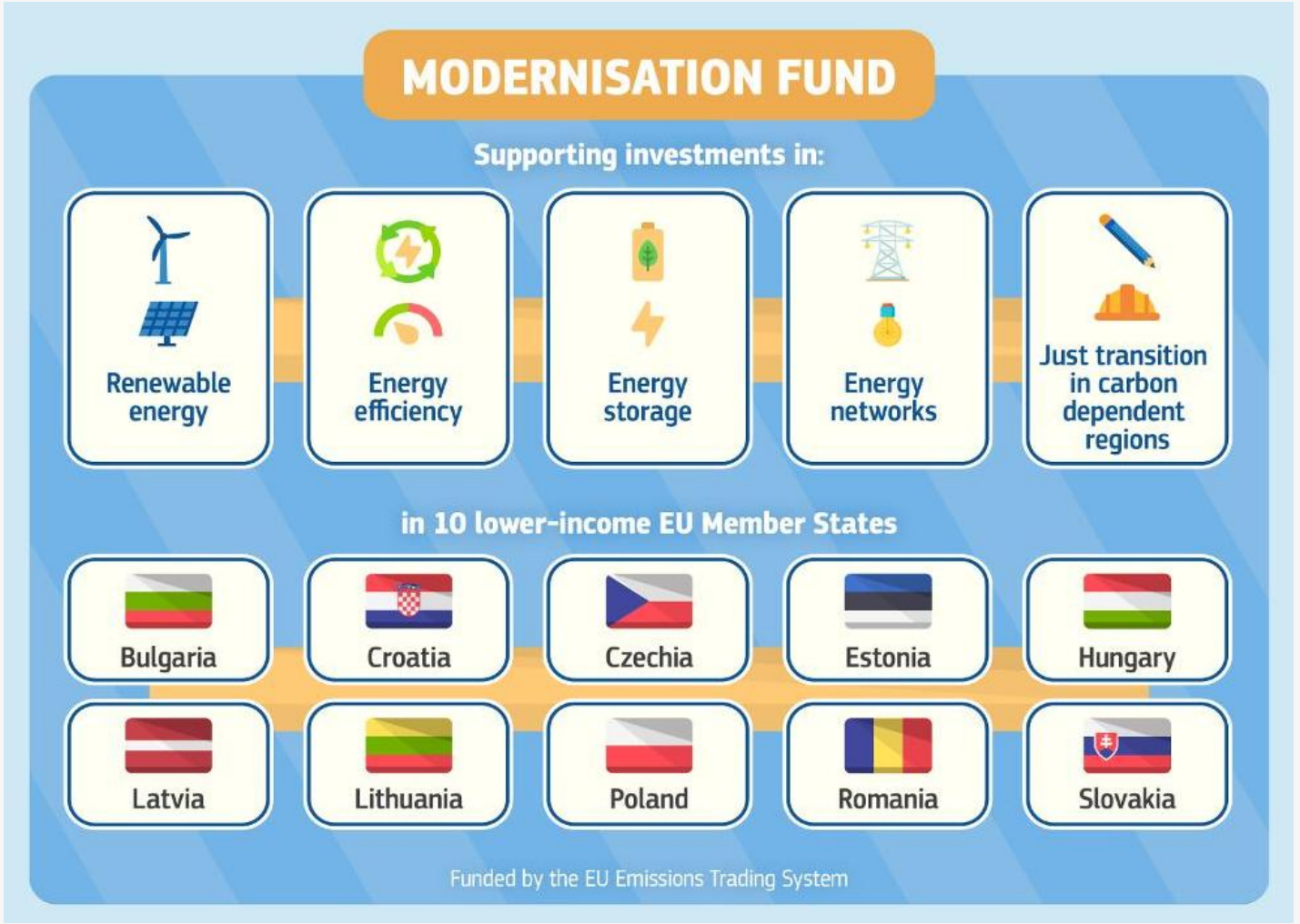
The Modernisation Fund



Source: https://ec.europa.eu/clima/policies/budget/modernisation-fund_en

Project co-funded by the Europen Union (ERDF, IPA).

Literature

- European Commission > Energy, Climate change, Environment > Climate Action > Policies; URL: https://ec.europa.eu/clima/index_en

Project co-funded by the Europen Union (ERDF, IPA).