Energy transition: interaction of policy making and energy system analysis incl. modelling

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Topics

- Energy and climate policy context: worldwide and EU
- How are laws prepared in EU, in the field of energy and climate?
- How/Why are energy system models used for policy making?
- What kind of energy system models exist, for what scope?
- Who uses energy system models?

Climate change negotiations

Paris Agreement

Key points of the Paris Agreement

196 signatories, will take effect from 2020

2.0°C/1.5°C Temperatures

The agreement aims to keep the global temperature rise this century below 2.0°C above pre-industrial levels, and "pursue efforts" to limit the rise to 1.5°C.

2050 Emissions

Parties aim to reach a global peak of greenhouse gas emissions as soon as possible, and achieve zero net emissions in the second half of the century.

$100 bln Financing

The agreement affirms the obligations of developed countries to maintain a $100bln per year funding pledge from 2020, with the amount to be updated by 2025.

2018 Review mechanism

Parties are to make the first assessment of their efforts to cut emissions in 2018, with further reviews every five years. First world review is 2023.

CGTN

UNFCCC?

COP?

IPCC?

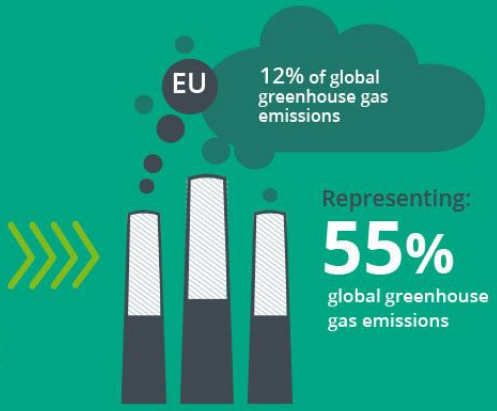
The Paris Agreement: entry into force

Requirements

Ratification by:

55 parties

of 197 Parties to the Convention



Representing:

55%

global greenhouse gas emissions

EU Ratification

ember 2015	Adoption of new agreement on climate change (Paris Agreement)
22 April 2016	Paris Agreement open for signature: EU and 175 other countries sign
30 September 2016	Council agrees to go ahead with ratification at EU level
4 October 2016	European Parliament votes to give consent
4 October 2016	Council formally adopts decision on ratification
5 October 2016	EU deposits its ratification instruments with the UN
7-18 November 2016	COP22 meeting in Marrakesh

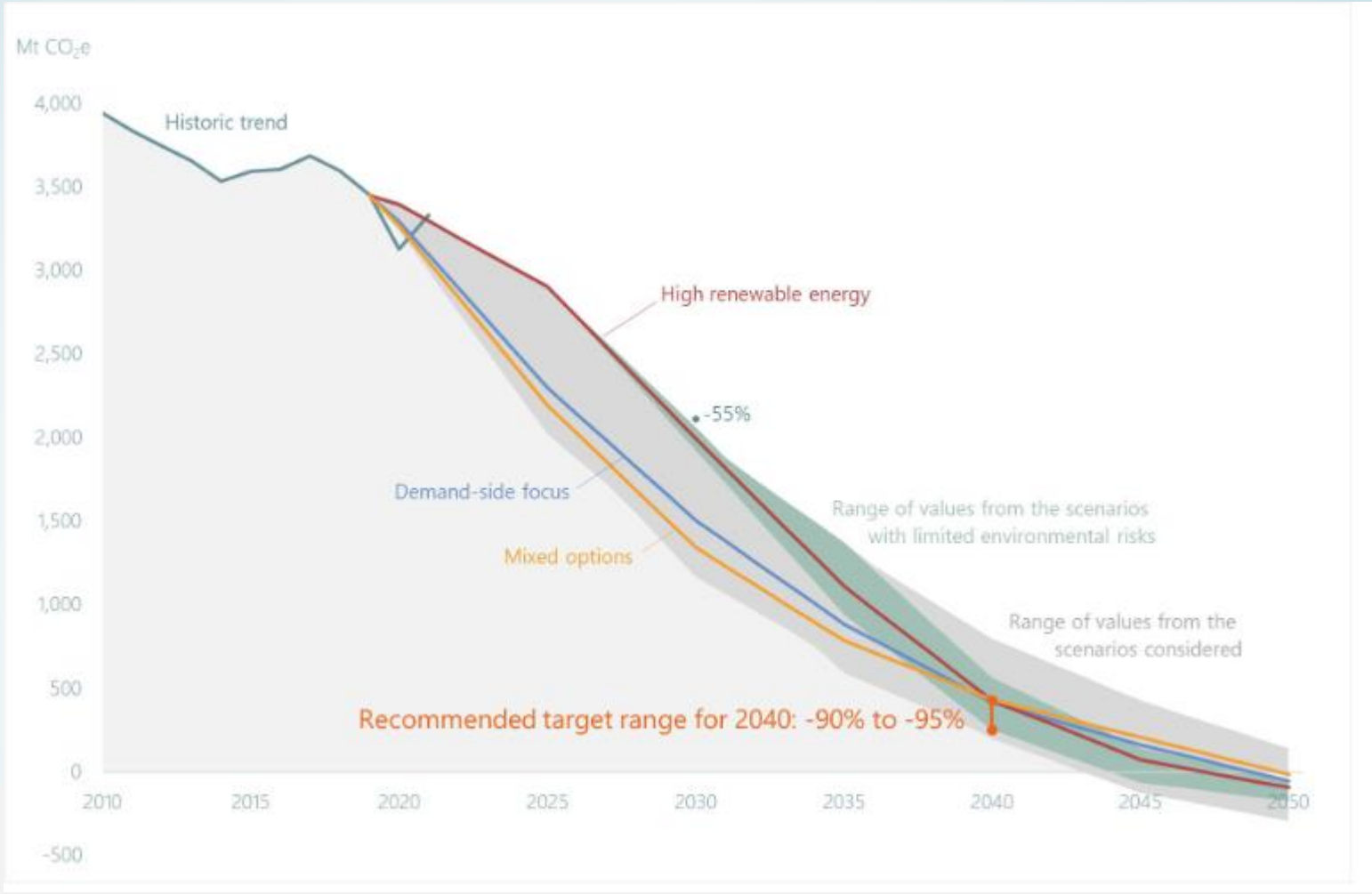
Council of the European Union
General Secretariat

EU Climate Law

EU Emissions reduction targets:

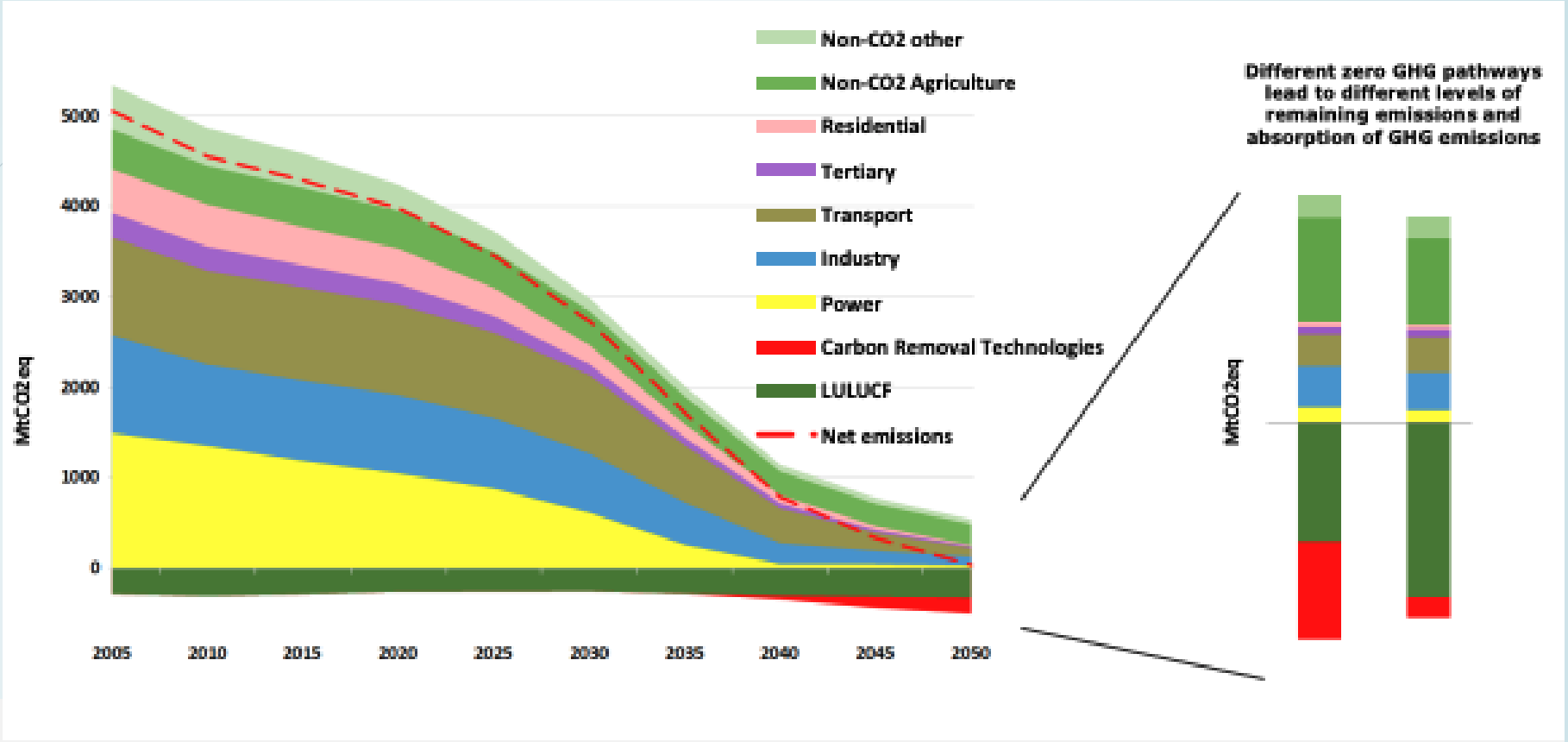
- -55% Emission reduction by 2030 compared to 1990 incl. LULUCF
- **Net zero by 2050**
- *Proposal for 2040 Target in 2024*

European Commission, Directorate-General for Communication, *The European climate law*, Publications Office, 2020, https://data.europa.eu/doi/10.2775/790913



EU Emission profiles over time

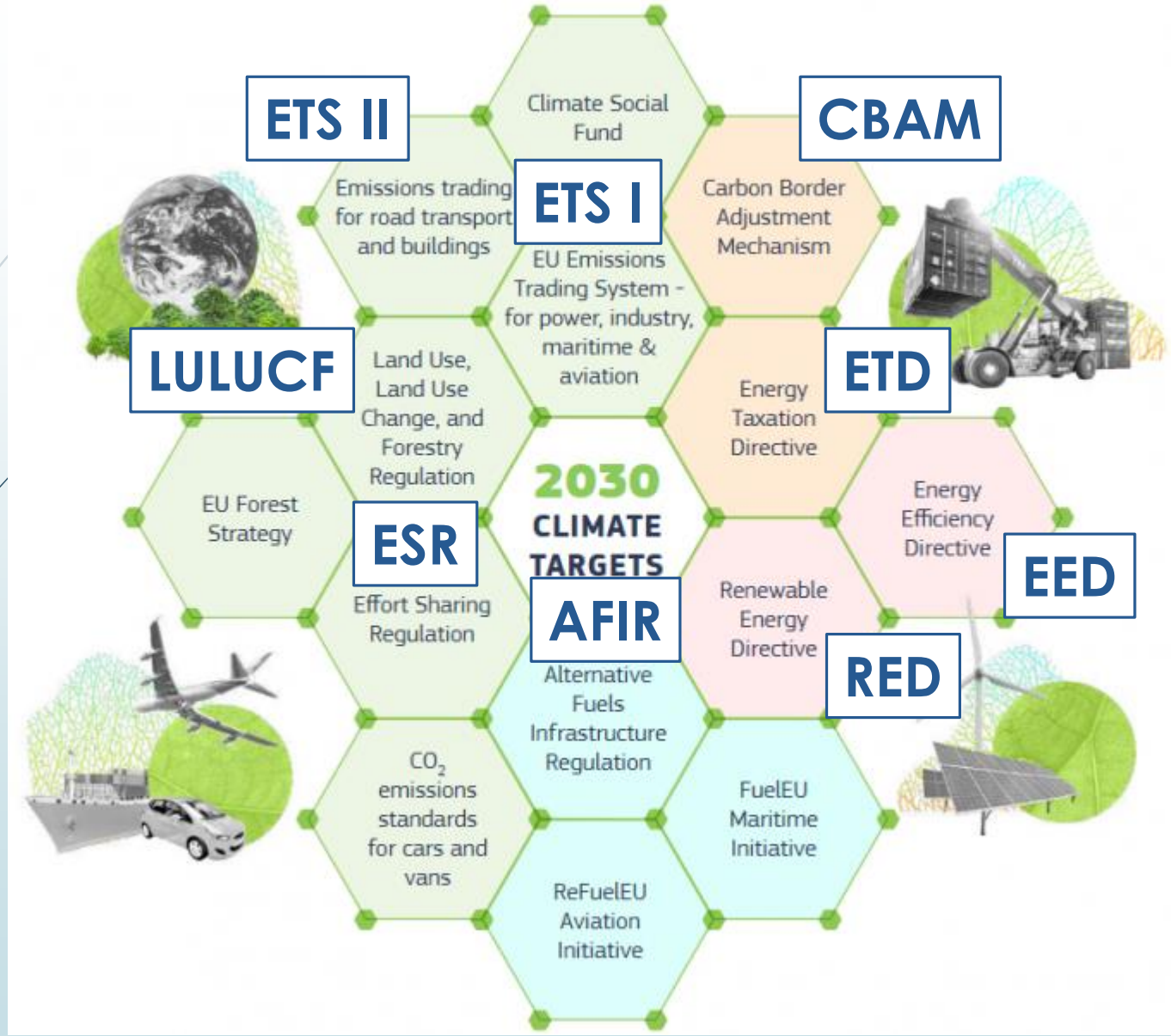
EU Climate Advisory Board
https://climate-advisory-board.europa.eu/reports-and-publications/scientific-advice-for-the-determination-of-an-eu-wide-2040/esabcc_advice_eu_2040_target.pdf/@@display-file/file



EU Emission profiles over time

A Clean Planet for all, COM(2018) 773 final
https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52018DC0773

EU Green Deal



Fit for 55 Climate and Energy package:

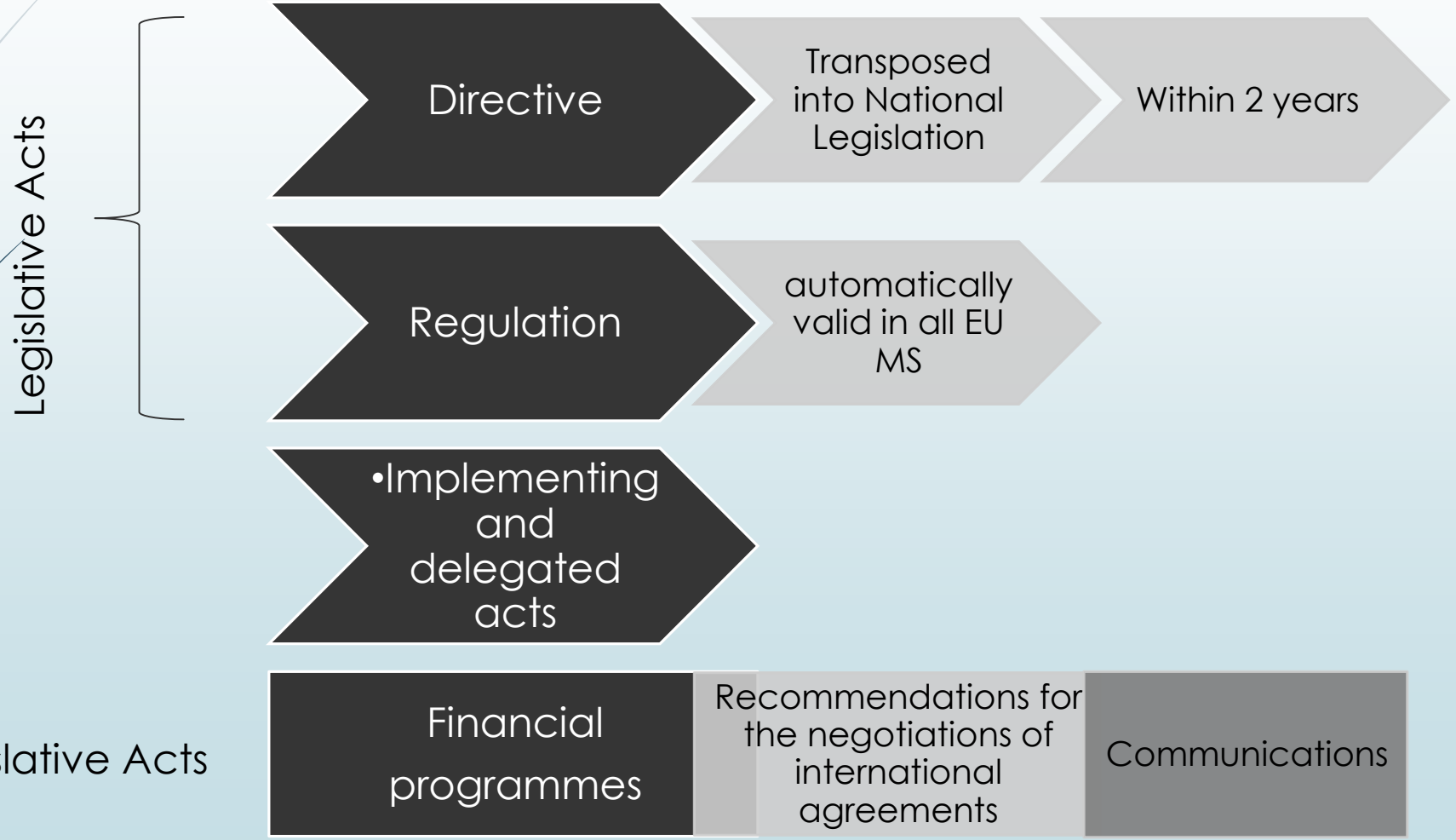
- 13 legislative proposals
  +
- Establishing a Climate Social Fund

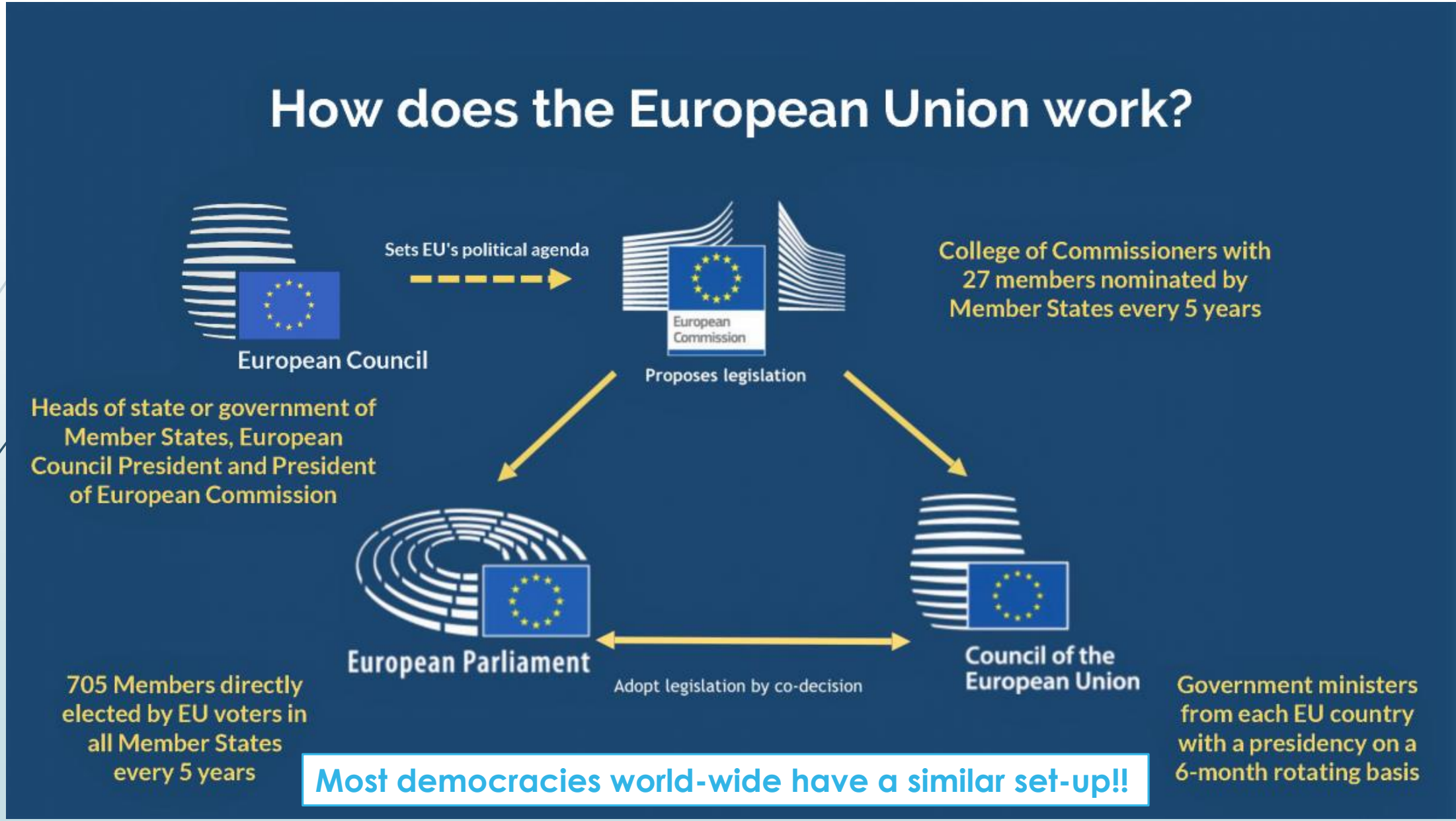
Additional initiatives: Farm to Fork, Nature Restoration Law

EPBD (GEG)
IED
…

https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52019DC0640&from=EN
https://www.citiesforum.org/news/green-deal-2/

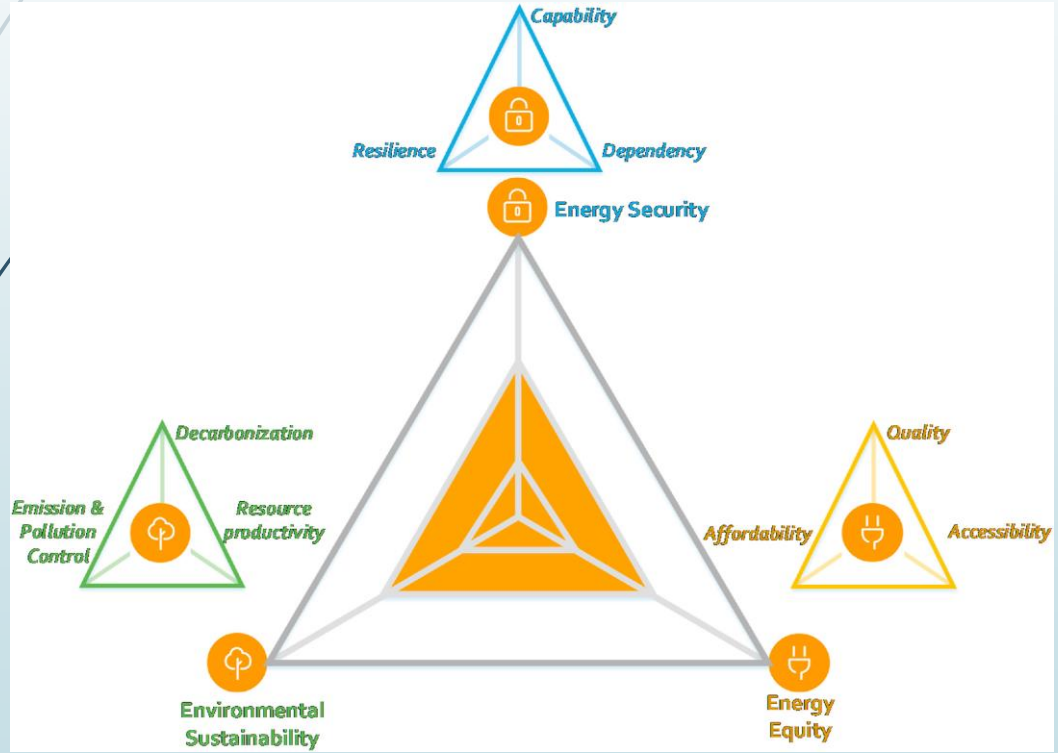
What kind of elements does the EU Commission propose




How does the European Union work?
Sets EU's political agenda
European Council
Heads of state or government of Member States, European Council President and President of European Commission
European Commission
Proposes legislation
College of Commissioners with 27 members nominated by Member States every 5 years
European Parliament
705 Members directly elected by EU voters in all Member States every 5 years
Adopt legislation by co-decision
Council of the European Union
Government ministers from each EU country with a presidency on a 6-month rotating basis
Most democracies world-wide have a similar set-up!!

Where does the modelling come in?

Energy Trilemma



Modelling use

- Simultaneous computation of indicators to understand the effect of a specific scenario on the energy trilemma components
- Depending on the system configuration and policy priorities different elements gain importance

Syed Ahsan Ali Shah, Cheng Longsheng, Yasir Ahmed Solangi, Munir Ahmad, Sharafat Ali,
Energy trilemma based prioritization of waste-to-energy technologies: Implications for post-COVID-19 green economic recovery in Pakistan,
Journal of Cleaner Production, Volume 284, 2021, https://doi.org/10.1016/j.jclepro.2020.124729

Where does the modelling come in?

- **How will the energy system develop? And what do changes imply?**

- Initiatives require **Impact assessments** *if* initiatives are expected to have **significant economic, social or environmental impacts**.
- "The impact assessment report must include a description of:
  - the environmental, social and economic impacts, including impacts on small and medium enterprises and competitiveness, and an explicit statement if any of these are not considered significant
  - who will be affected by the initiative and how
  - the consultation strategy and the results obtained from it
- Impact assessment reports are published with the proposals or with acts adopted by the Commission. They are also sent to the EU lawmakers, the Parliament and Council, to consider as they decide on whether to adopt the proposed law."*
- The Regulatory Scrutiny Board (RSB) assesses the quality of the Impact Assessments

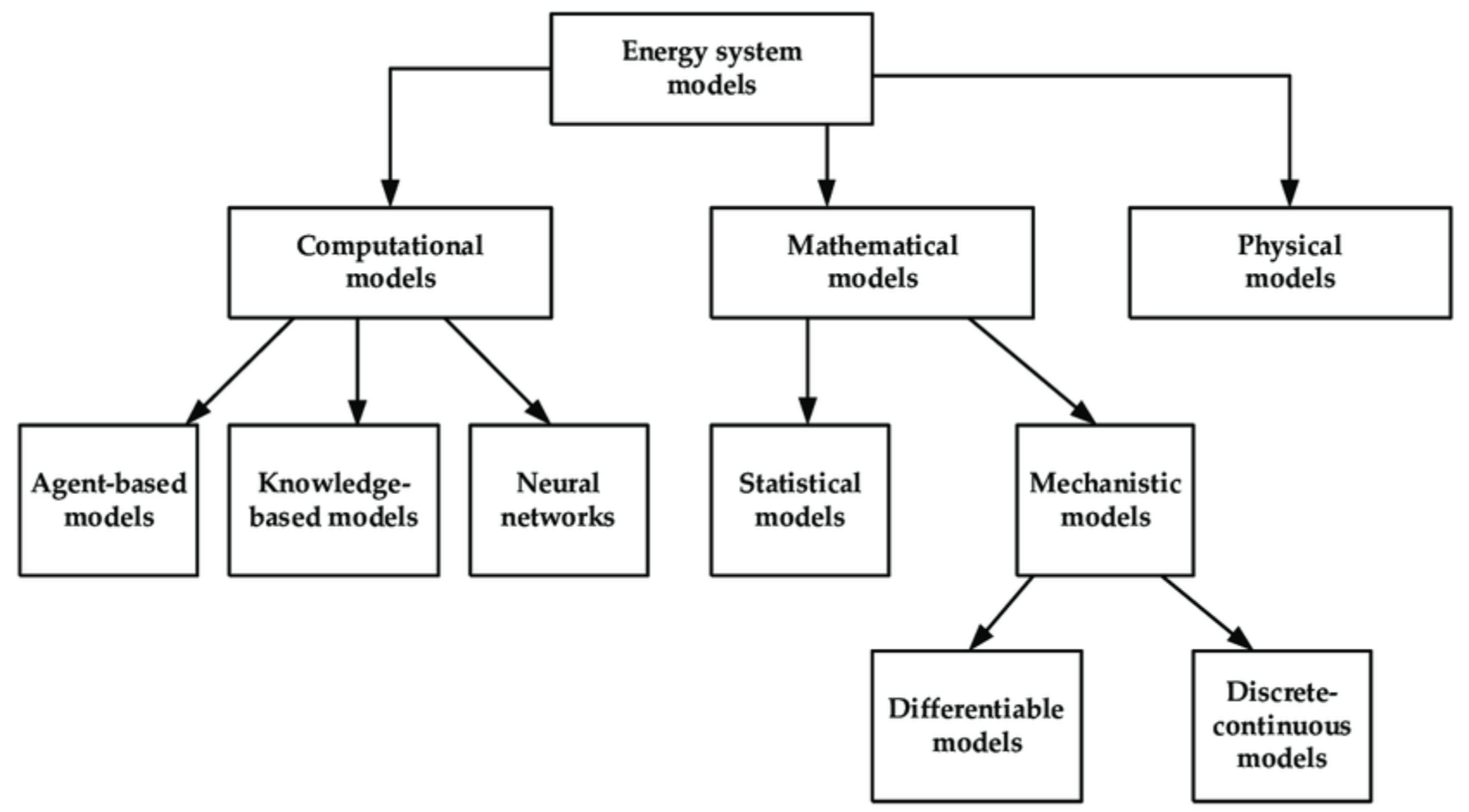
*Quoted from: https://commission.europa.eu/law/law-making-process/planning-and-proposing-law/impact-assessments_en

Why is modelling needed?

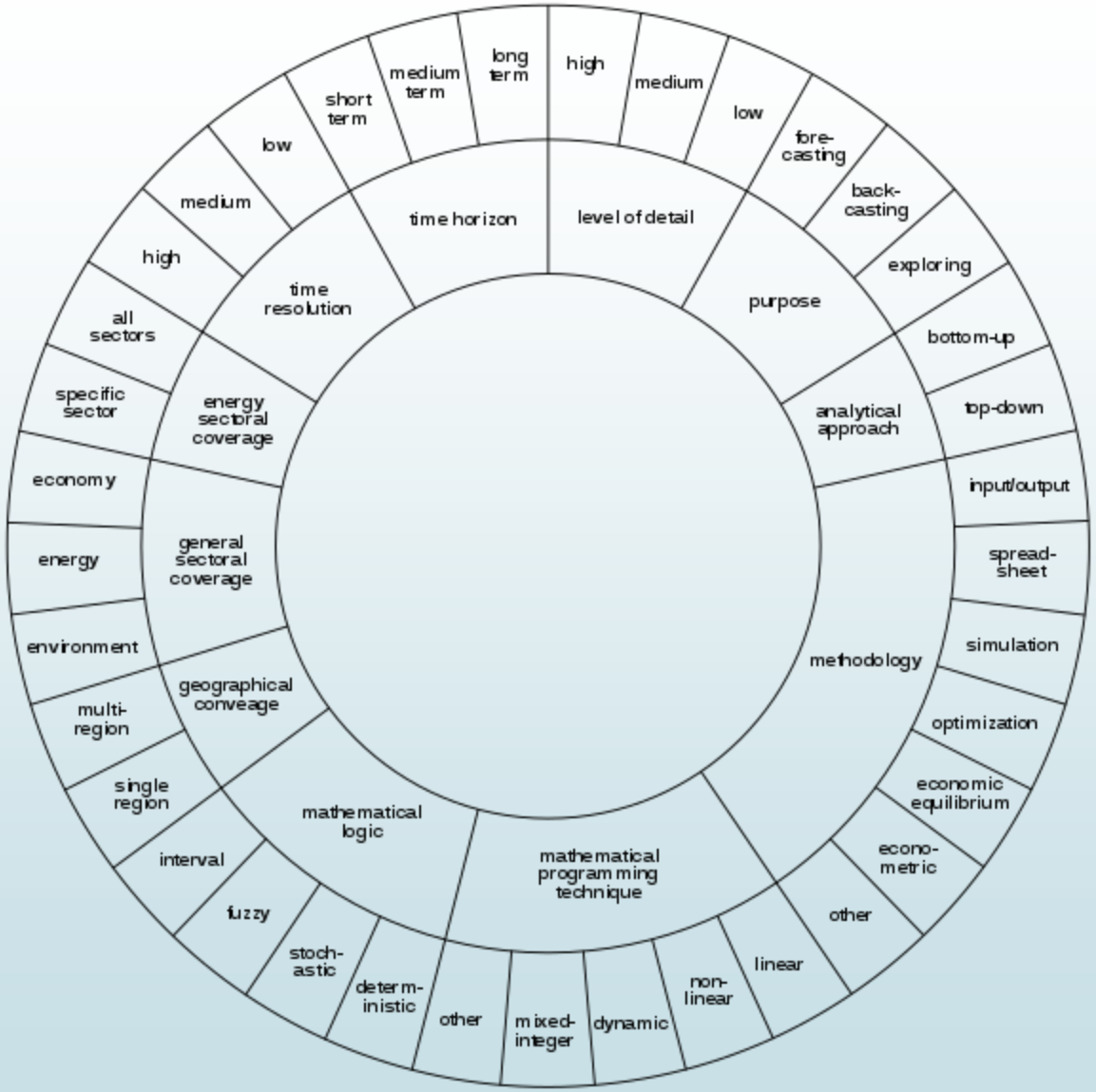
- Guidelines for preparing Impact Assessments include:
  - Better regulation guidelines: https://commission.europa.eu/law/law-making-process/planning-and-proposing-law/better-regulation/better-regulation-guidelines-and-toolbox_en
- Impact assessments need quantified assessment:
  - How much will it cost in monetary terms? And who will pay for what?
  - What investments are required?
  - Effect on SMEs?
  - Are there employment effects? Other social effects?
  - What are the relations to OTHER policy targets/initiatives/national legislation?

Model	Name of model
11. The Analytical Approach	Top-Down Bottom-Up Hybrid Other
12. The Underlying Methodology	Econometric Macro-Economic Micro-Economic Economic Equilibrium Optimization Simulation Stochastic/Monte-Carlo Spatial (GIS) Spreadsheet/Toolbox Backcasting Multi-Criteria Accounting
13. The Mathematical Approach	Linear programming Mixed-integer programming Dynamic programming Fuzzy logic Agent based programming
14. Data Requirements	Qualitative Quantitative Monetary Aggregated Disaggregated

Hall, Lisa & Buckley, Alastair. (2016). A review of energy systems models in the UK: Prevalent usage and categorisation. Applied Energy. 169. 607-628. 10.1016/j.apenergy.2016.02.044.



Subramanian, Avinash & Gundersen, Truls & Adams, Thomas. (2018). Modeling and Simulation of Energy Systems: A Review. Processes. 6. 238. 10.3390/pr6120238.



https://commons.wikimedia.org/wiki/File:Classification_of_energy_system_models.svg

Many kinds of energy system analysis…

Different types of models have different scopes and uses, each with its own merits

- System simulation: Engineering issues
- What-if questions, impact assessment: policy analysis, investment evaluation
- Normative analysis, optimization: policy and investment recommendation
- Forecasting-projections of demand prices, technology penetration, etc.
- Scenario construction and comparison of scenarios: exploratory pathways of uncertain futures and policy analysis

However:

"… all models are approximations. Essentially, **all models are wrong, but some are useful**. However, the approximate nature of the model must always be borne in mind…."

Box, G. E. P.; Draper, N. R. (1987), Empirical Model-Building and Response Surfaces, John Wiley & Sons.

What kind of people work with modelling and policy making?

Model developers:

- Who: (often) engineers, physicists, mathematicians, economists, …
- What: create models for policy use

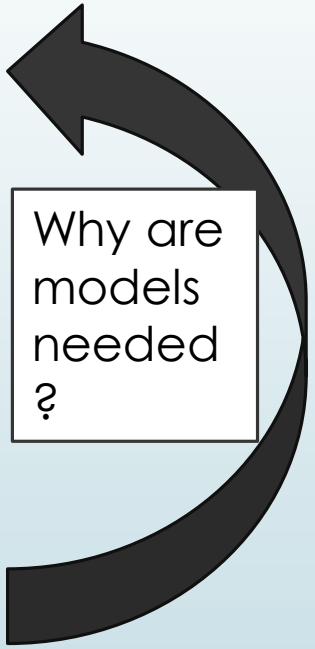
Analysts:

- Who: (often) engineers, physicists, mathematicians, economists, …
- What: Analyse data from statistics (ex-post) or model results (ex-ante)

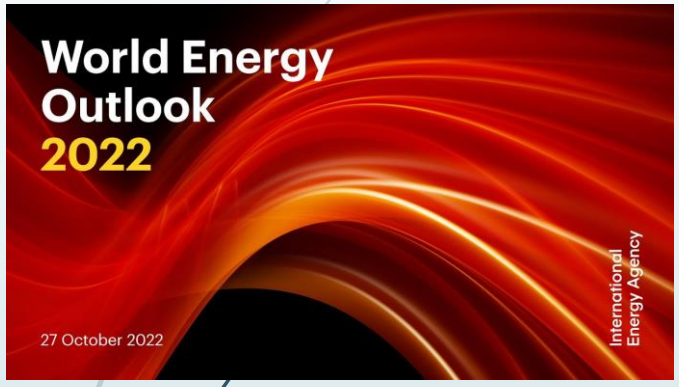
Policy makers:

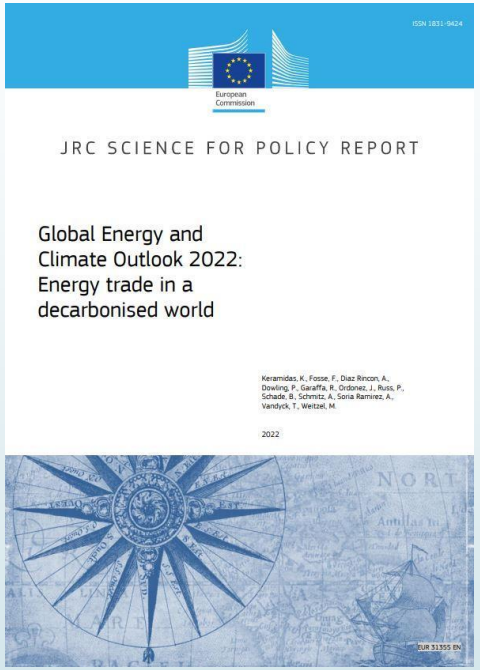
- Who: Ministerial employees (economists, lawyers, political scientists,…)
- What: prepare the legislative proposals

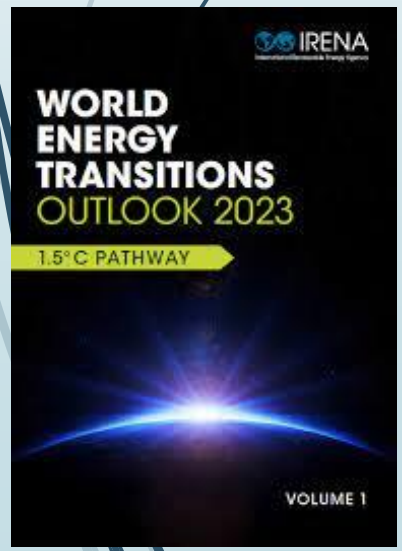
Politicians

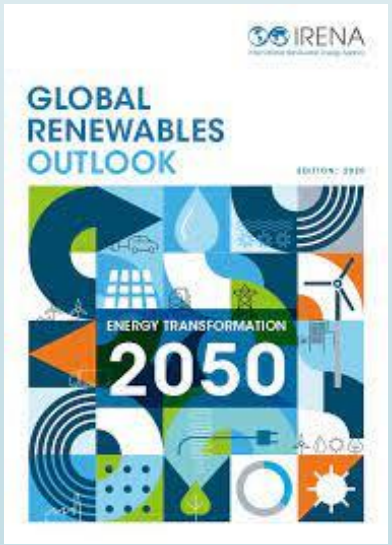


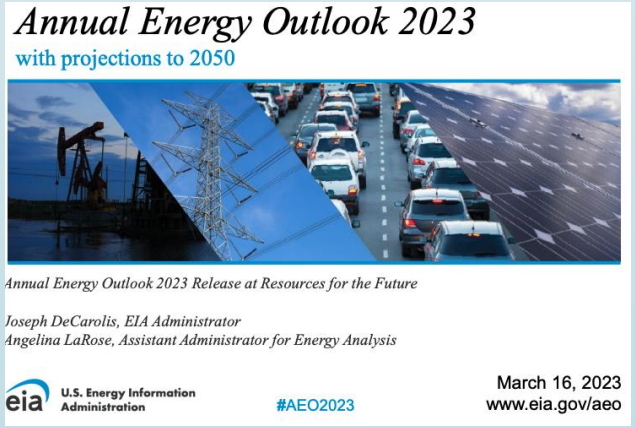
Where are energy system models used

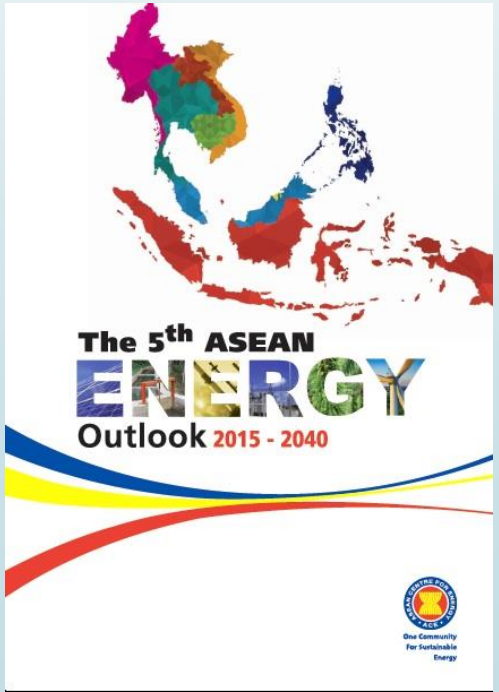












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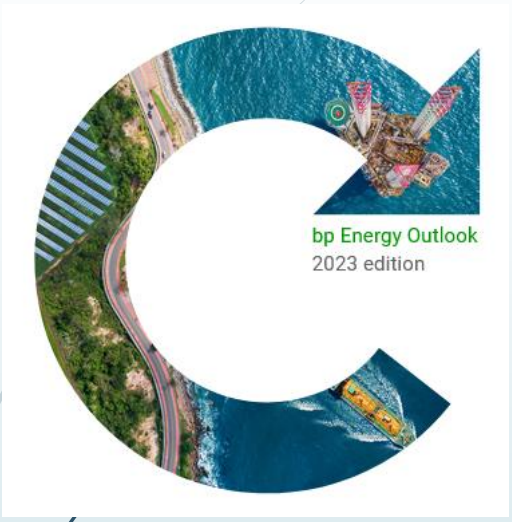
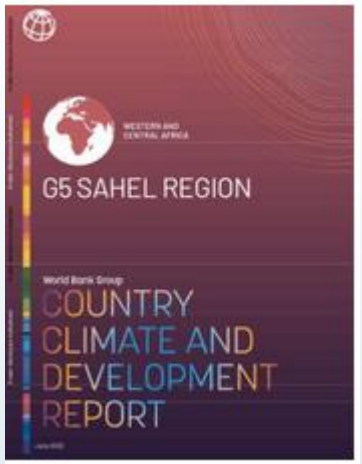




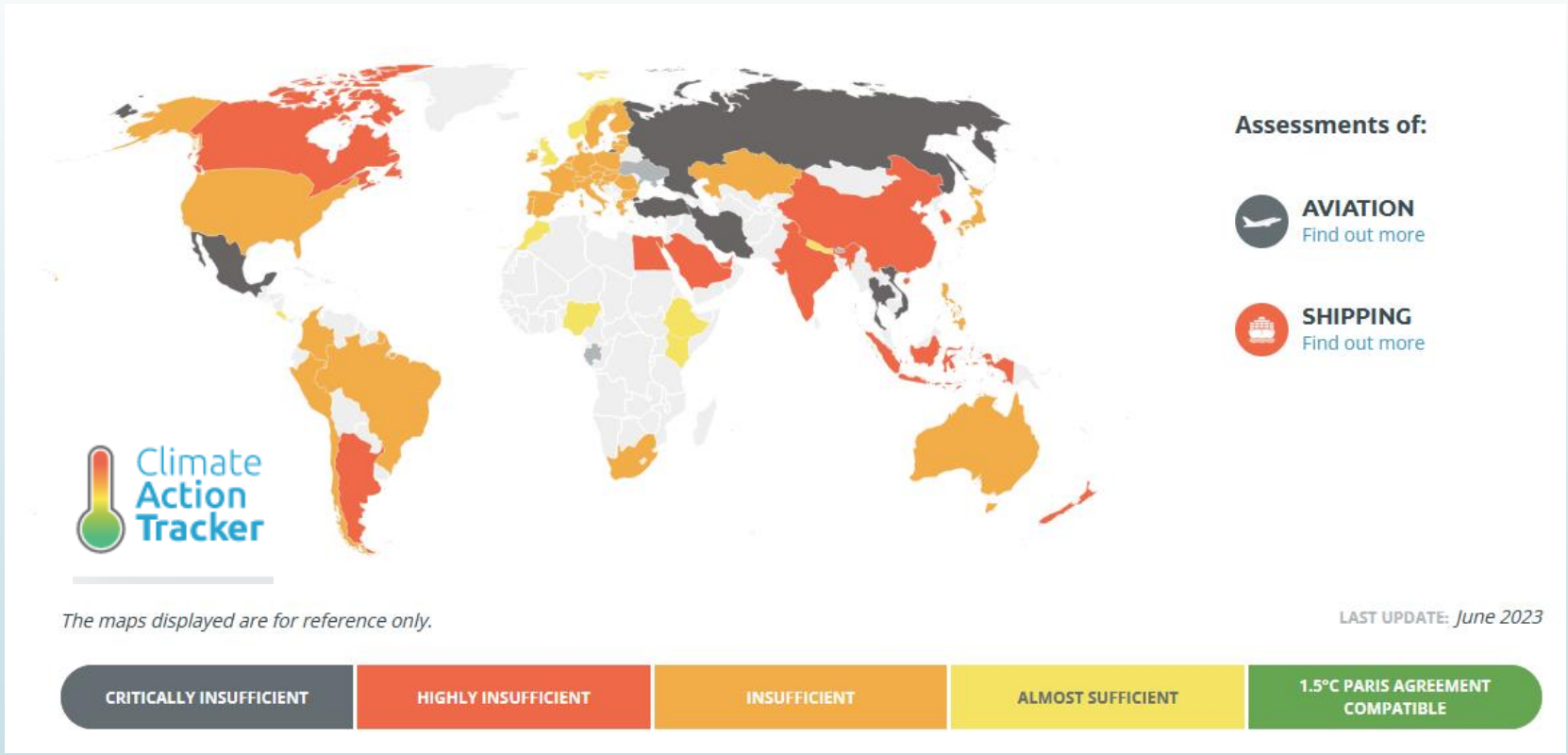
UNFCCC: Nationally Determined Contributions (NDCs)

UNFCCC: Long-term Low Emissions and Development Strategies (LT-LEDS)

Just Energy Transition Partnerships (JETP)

EU: National Energy and Climate Plans (NECPs)

Are countries on track to achieve the 1.5C goal?



https://climateactiontracker.org/

Still a lot to do!

What is it like to work with energy modelling and policy-making?

Cons

- Impossible deadlines
- Slow progress
- Frustration

Pros (or why I do it anyway)

- We need the energy transition to progress to avoid dangerous climate change
- Improved understanding at all levels from CEOs and government heads to simple citizens
- Allows decision making to progress