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Sustainable Energy Connectivity in Central Asia

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THE ONLINE INITIAL TRAINING WORKSHOP ON ENERGY MODELLING

Online, 27 March 2025

What is strategic planning and scenario analysis?

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International Consultant in Energy Modelling, SECCA

Stantec | intec | ACTED | European University Institute | Robert Schuman Centre for Advanced Studies | FSR Energy Florence School of Regulation

Scenario analysis in policy development

Exploring the impacts of different factors

Supranational - elements

- International fossil fuel prices
- Behaviour of other players
- Technology costs
- International standards
- ….

National - elements

- Structure of the socio-economic sector
- Energy service demands
- Domestic energy resources
- Other factors and constraints (eg technologies, market, etc.)

National - objective and policies

- Targets (overall, sectoral, etc.)
- Measures (commodity, technology, etc.)
- …

Uncertainties

- *Controllability (Decision Makers)* +

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Modelling in policy development

National objectives and targets*

1 (what?)

Include “targets” which must be met in the scenarios

(e.g. EE target, RES target or Emission targets, etc.)

* **Targets** define specific quantitative “thresholds” that must be achieved

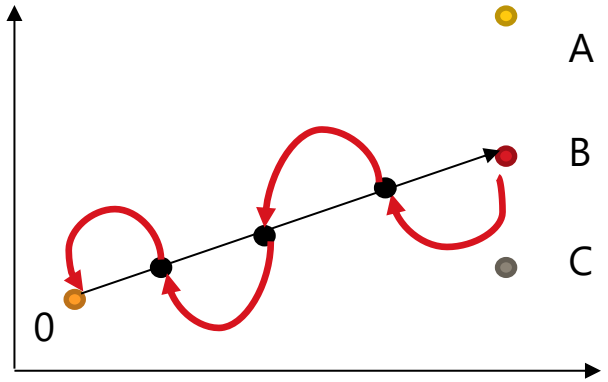
Policies and measures*

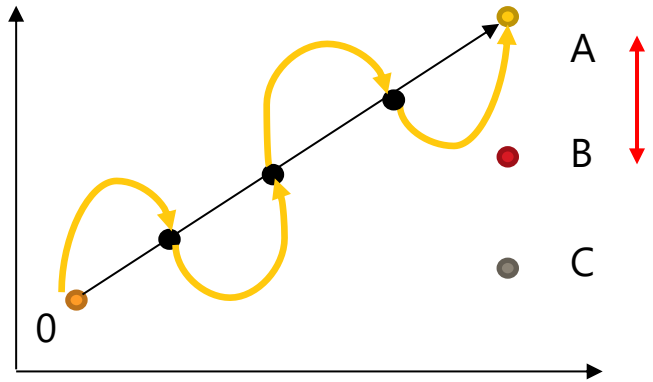
2 (How?)

Include a set of policy “mechanisms”

(e.g. CO2 tax, Feed-in tariffs, standards, etc.) and explore the effects on the energy- and environmental-related indicators

* **Measures** are instruments to implement the policies





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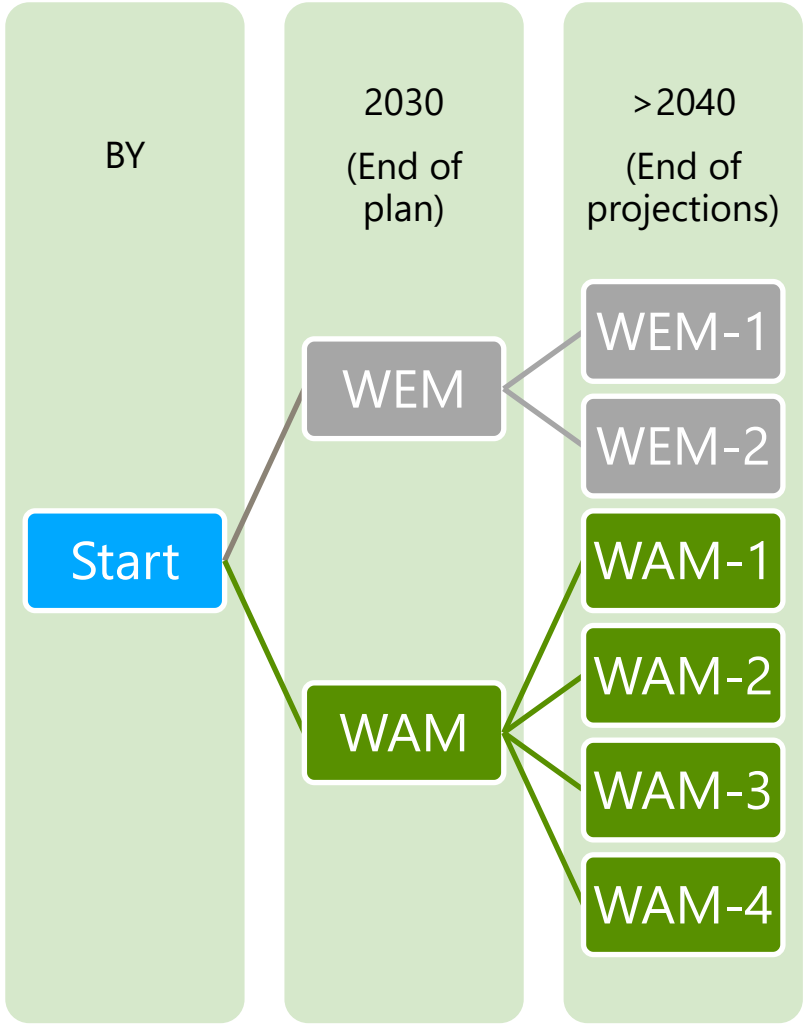
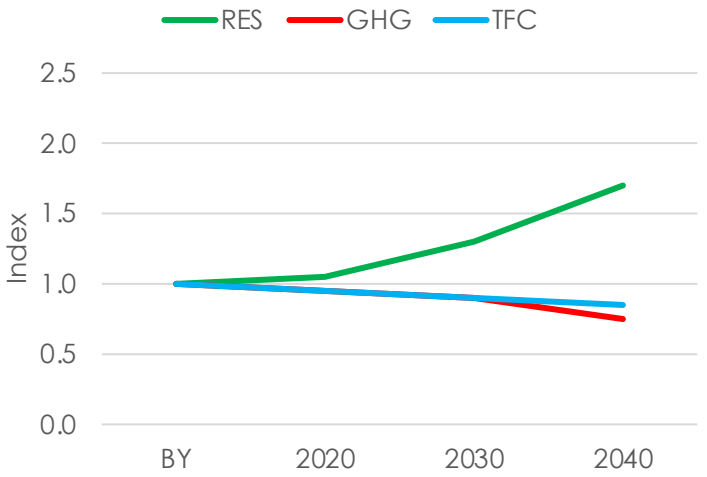
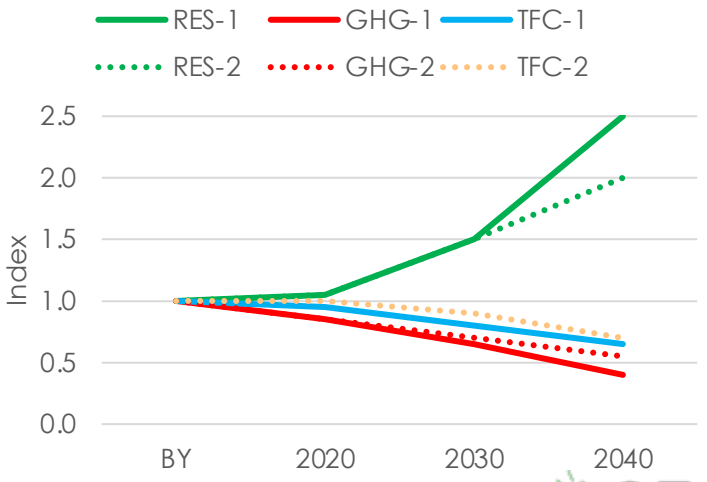
Model-based strategic analysis (EU-NECP)



"Outlook" of the WEM to > 2040



"Outlook" of the WAM to > 2040



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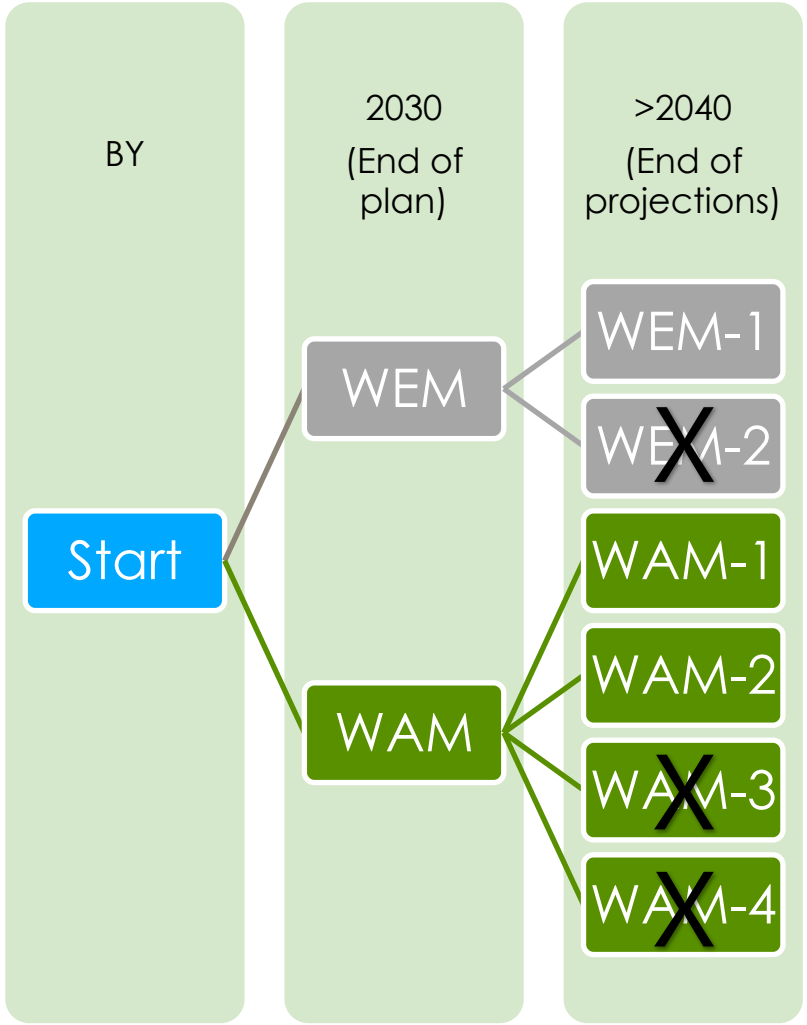
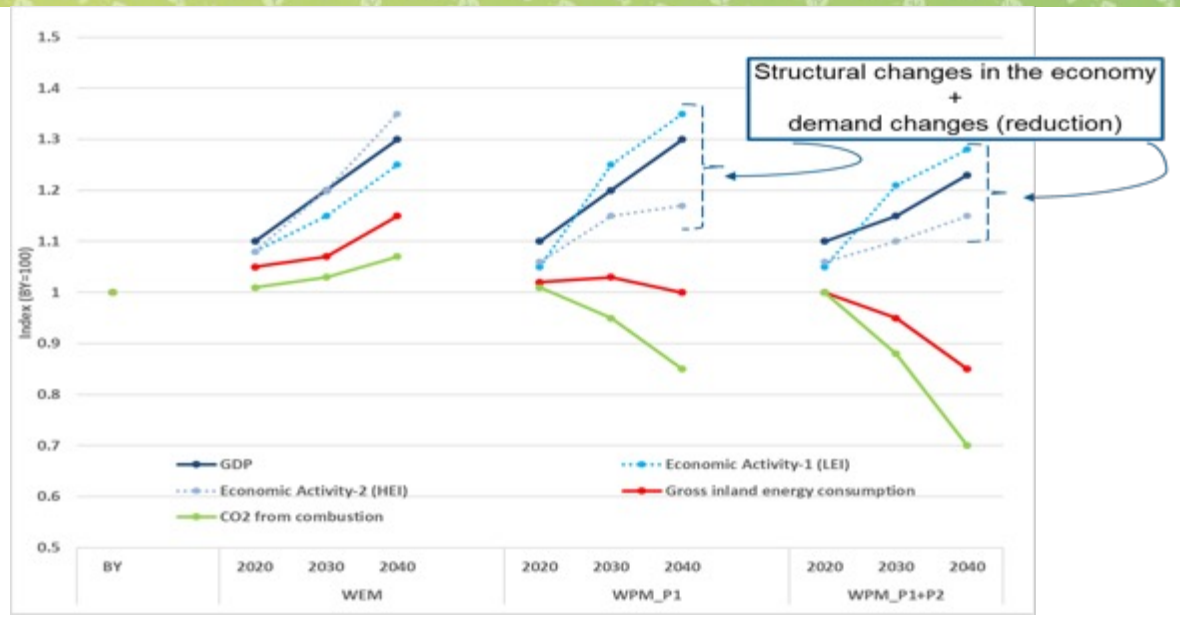
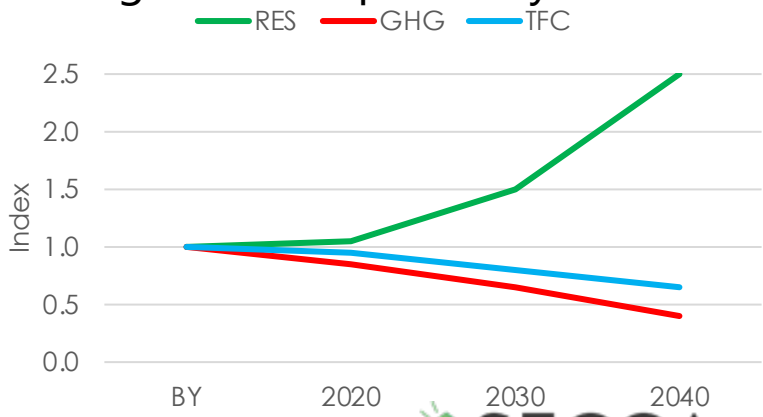




Multiple explorations / Continuous parsing of the "exploratory tree" until a "robust" path is found.

"Robust outlook" of the WAM > 2040 (against multiple criteria)



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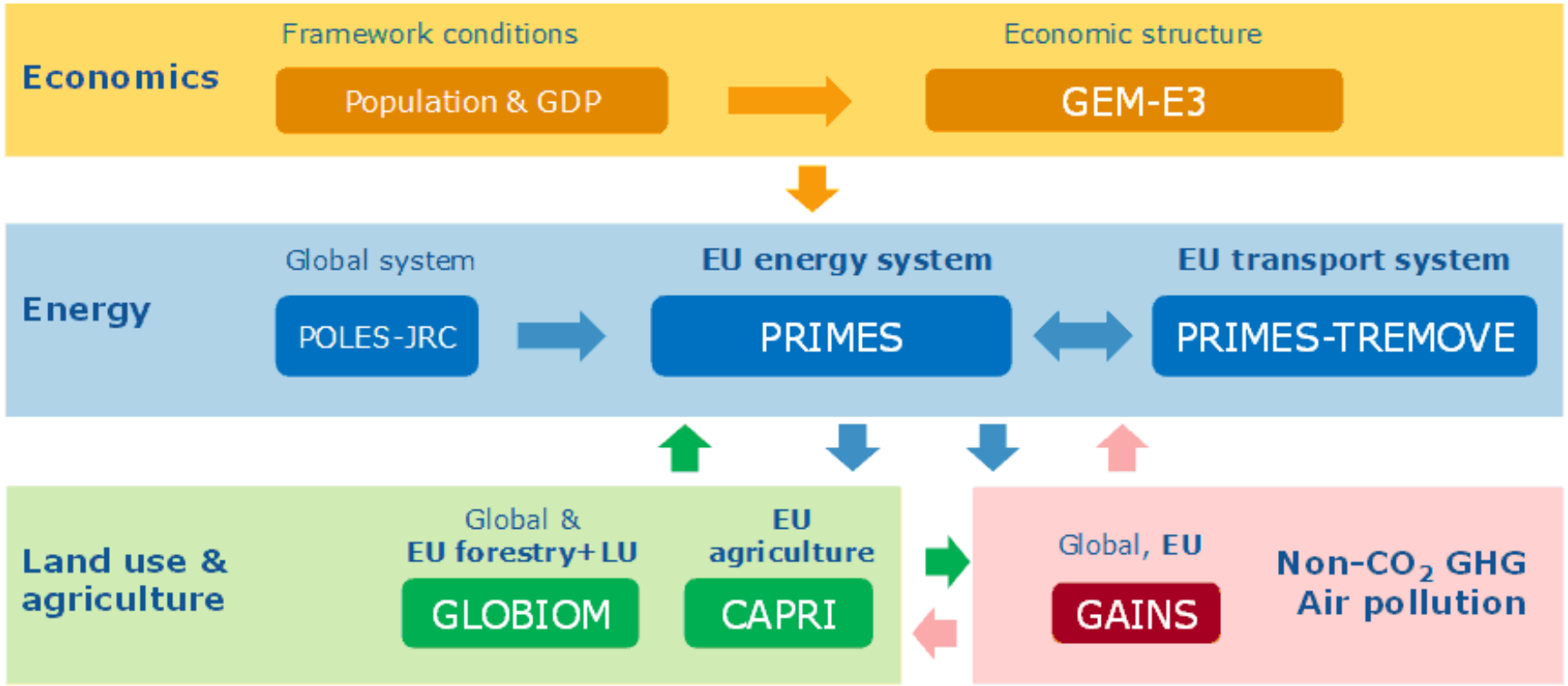
Modelling framework for energy-climate analyses - Example

Model-based scenario quantification supports the European Commission in impact assessments and analysis of "policy" options.

Tools are linked with each-other to ensure consistency ("integration")



https://climate.ec.europa.eu/eu-action/climate-strategies-targets/economic-analysis/modelling-tools-eu-analysis_en

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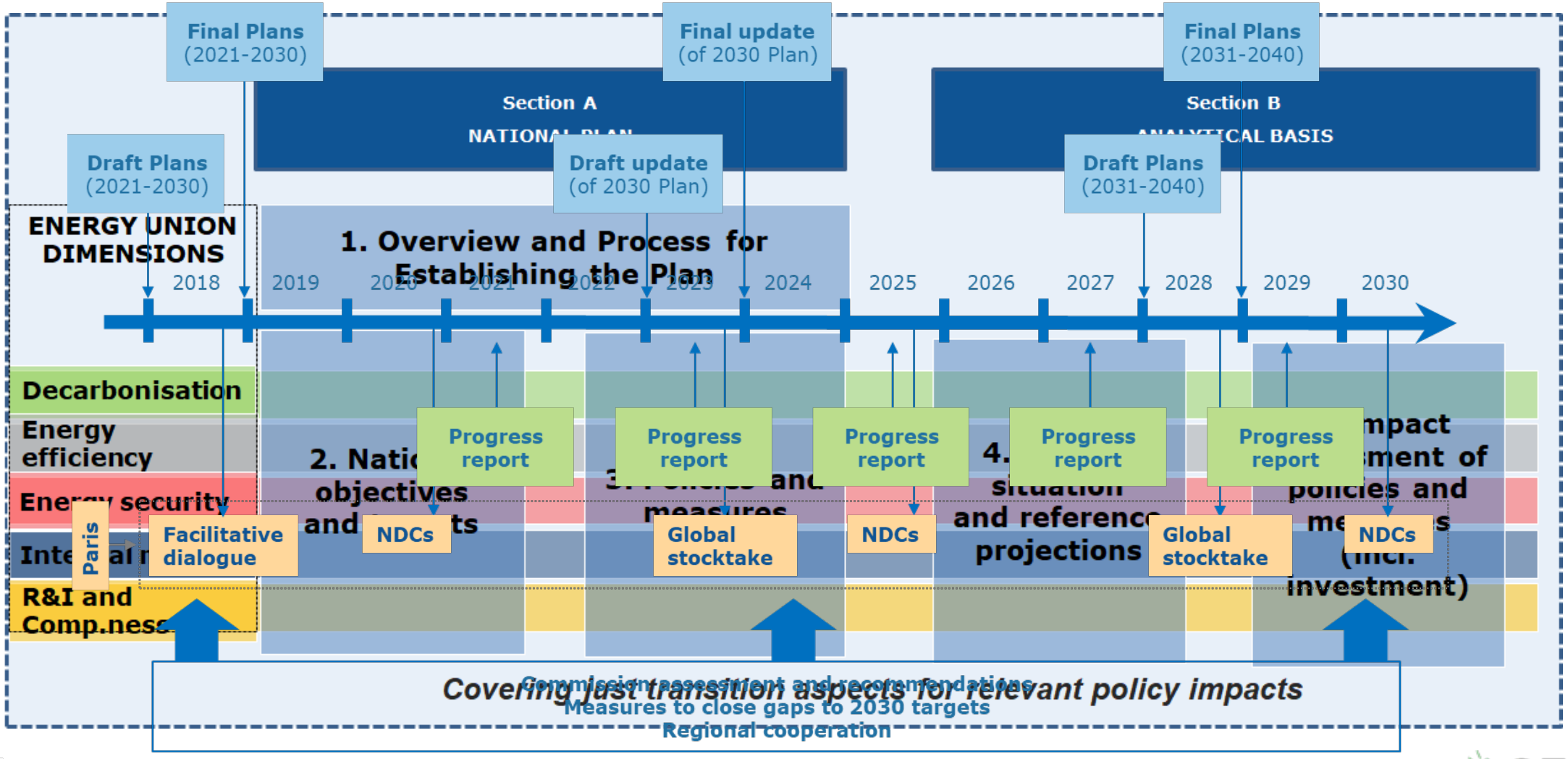
Model-based strategic analysis (EU-NECP)



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Defining Energy Efficiency Improvements - Indicators

Consume **LESS (-)** energy to provide **SAME (=)** service

Consume **SAME (=)** energy to provide **MORE (+)** service

Consume **LESS (-)** energy because of **CHANGE (≠)** in service

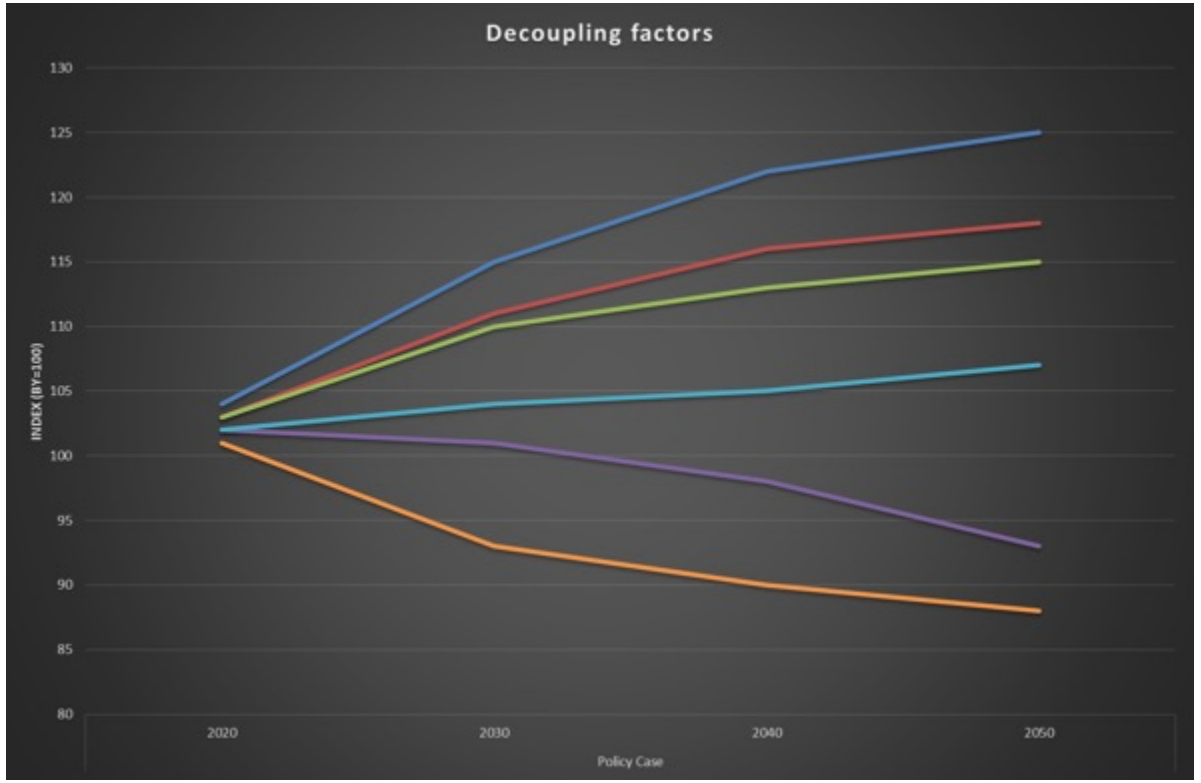
Consume **LESS (-)** energy and provide **LESS (-)** service

Are all the above energy efficiency improvements?

Generic energy efficiency indicator: $\frac{Energy\ Consumption\ (t)}{Activity\ (t)}$

Generic energy efficiency indicator: $Energy\ consumption\ (x,t)\ -\ Energy\ consumption\ (B,t)$

"Decoupling" is when two variables stop moving together:
- the correlation between them remains positive (relative)
- the correlation between them becomes zero, or negative (absolute)



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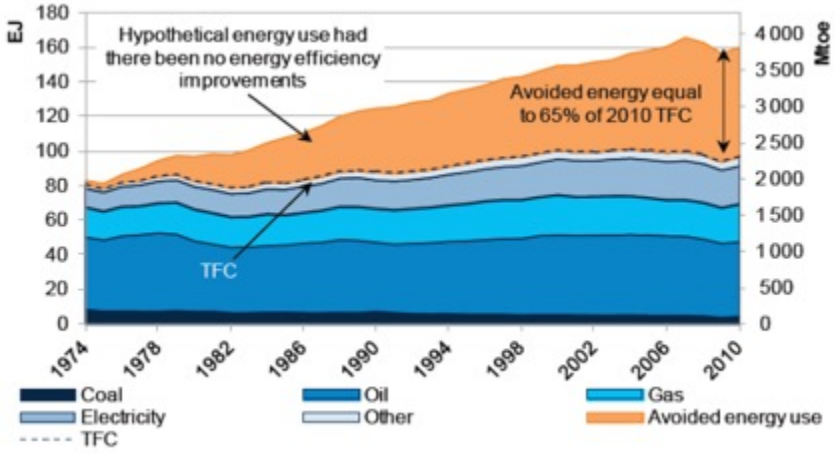
EE1st at the EU level

Article 2(18) of the Regulation on the Governance of the Energy Union and Climate Action

EE1st, as a horizontal "**guiding principle**" of the European climate and energy governance and beyond, should ensure, while taking full consideration of security of supply and market integration, that only the energy **needed** is produced and that investments in stranded assets are avoided in the pathway to achieve the climate goals.

Member States are required to take into account the principle in the integrated National Energy and Climate Plans (NECPs).

The principle aims to treat energy efficiency as the "**first fuel**", that is a source of energy in its own right
"save before you build/produce"



The EE1st principle implies adopting a holistic approach which takes into account the overall efficiency of the "integrated energy system" (holistic) and promotes the most efficient solutions for climate neutrality across the value chain (from energy production, network transport to final energy consumption) so that efficiencies are achieved both in primary and final energy consumption.

This includes giving **priority to "demand-side"** solutions whenever they are more cost-effective than investments in energy infrastructures.

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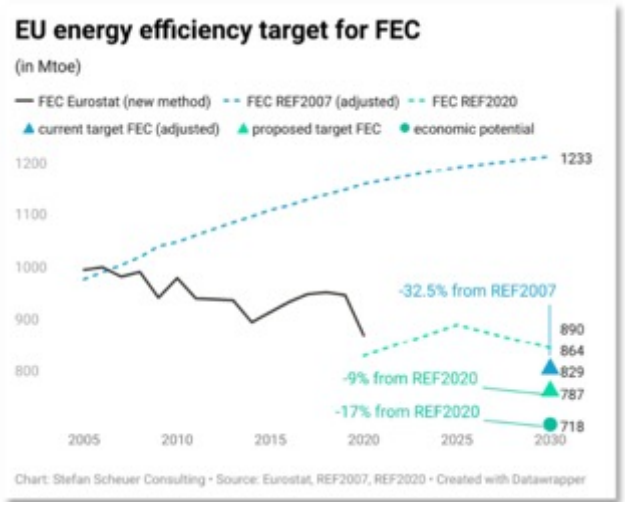
Overall energy efficiency target – Revision of the EED - EC

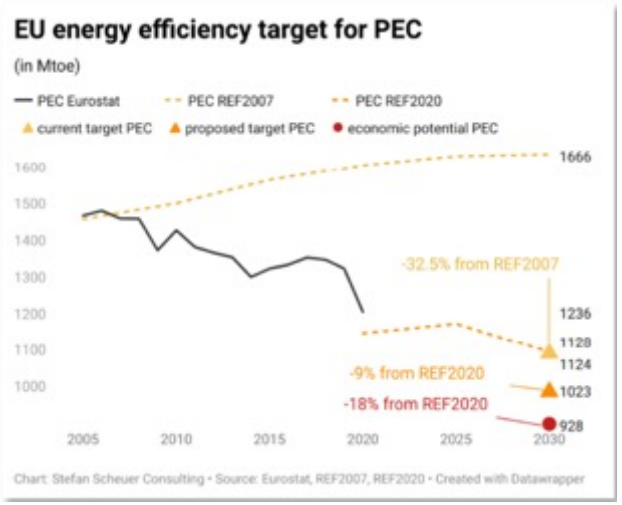
The EU has set ambitious energy efficiency targets for 2020 and 2030 to reduce **primary** and **final** energy consumption as part of its 2050 decarbonisation objectives.

Initial (2018): headline EU energy efficiency target for 2030 of at least 32.5% (compared to projections of the expected energy use in 2030). 32.5% target translates into a final energy consumption of 956 Mtoe and/or primary energy consumption of 1273 Mtoe in the EU by 2030.

More recently (2022, in the context of the REPowerEU plan)

	Modelling analysis for the EED recast	New modelling analysis	
	Full Package Scenario 9%EE/40%RES	REPowerEU 13%EE/45%RES	REPowerEU 19%EE/45%RES
Energy consumption			
EU FEC target (wrt. REF2020 scenario)	**9%**	**13%**	**19%**
Final energy consumption (Mtoe)	787	751	701
EU PEC target (wrt. REF2020 scenario)	8%	10%	13%
Primary energy consumption (Mtoe)	1,033	1,006	979





Model-based analyses

Target values: "absolute numbers"

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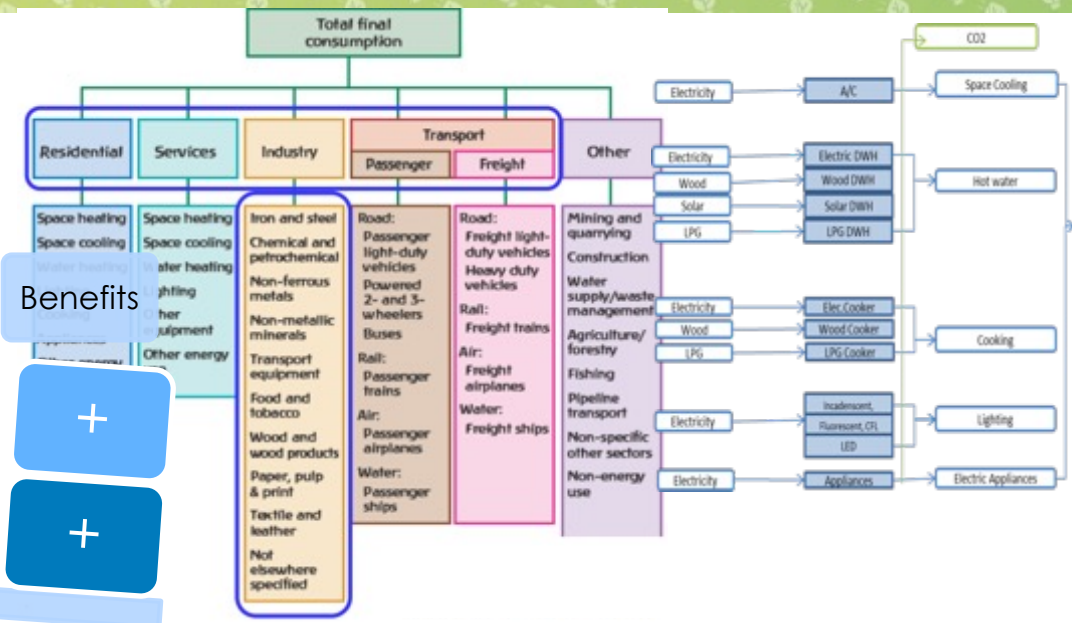
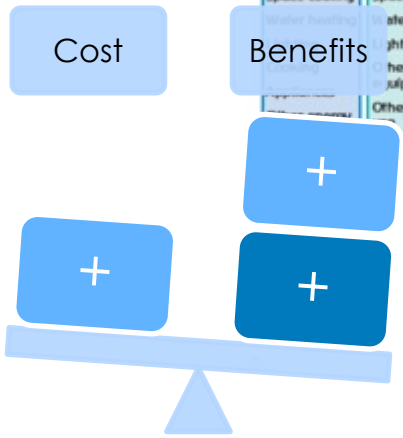
Understanding energy efficiency – Indicative steps

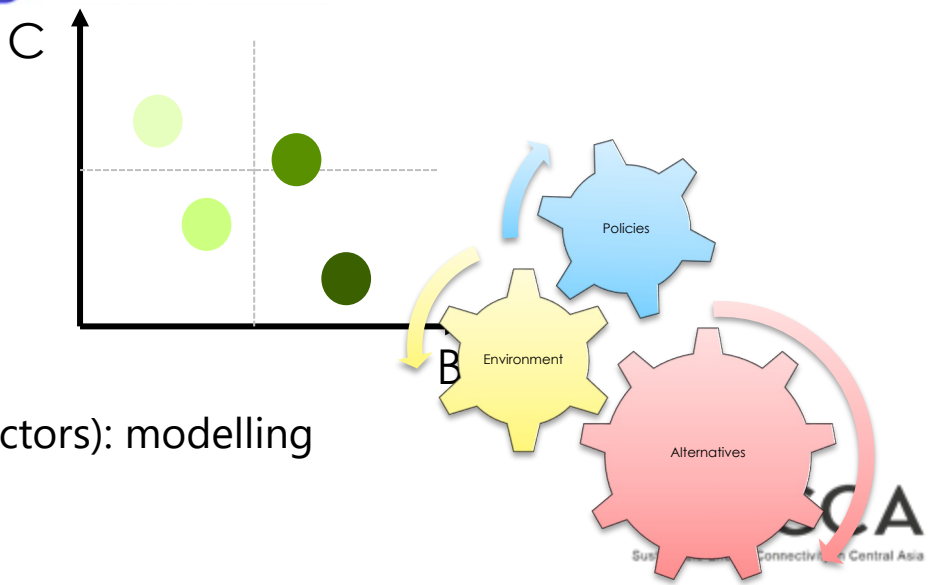
- Understand how energy is used across system/sectors
Need end-use information beyond the energy balance





- Define evaluation methodology/rationale

- Information collection (statistics/surveys/metering/databases,..)
Select and assess alternatives (technology explicitness is “key”)



- Explore and project energy variables (EE “triggers” and other factors): modelling

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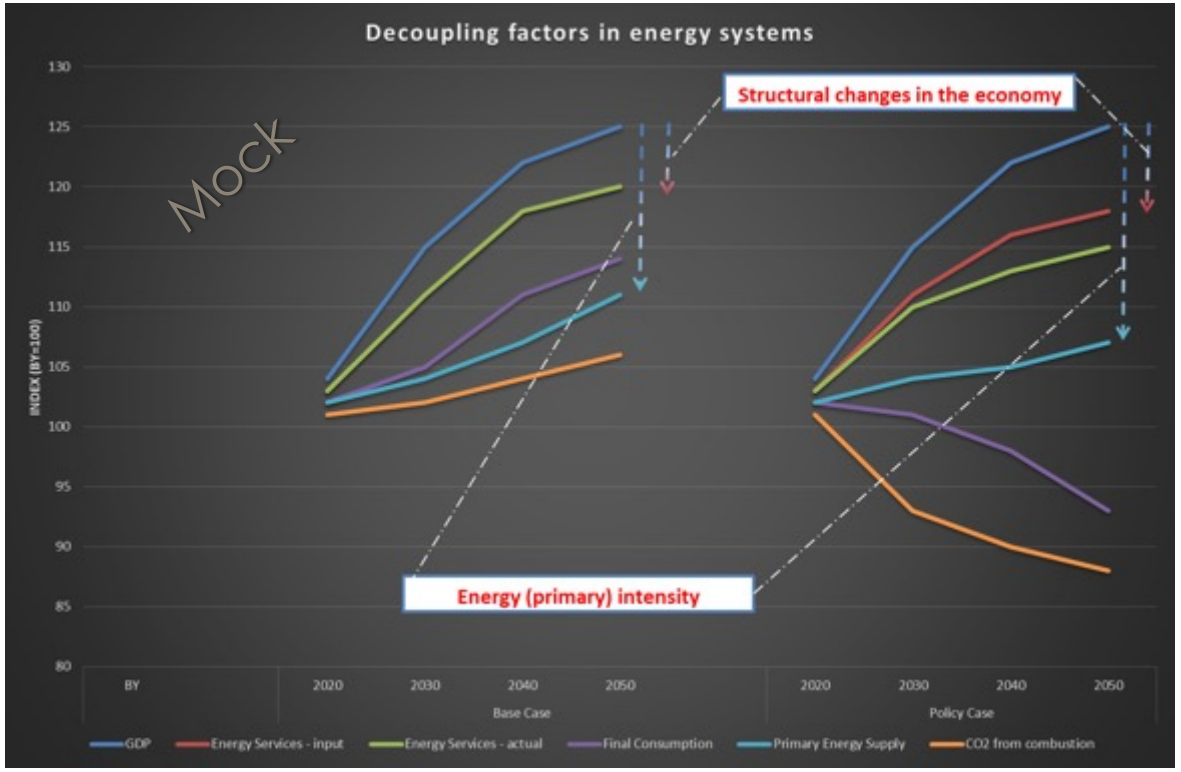
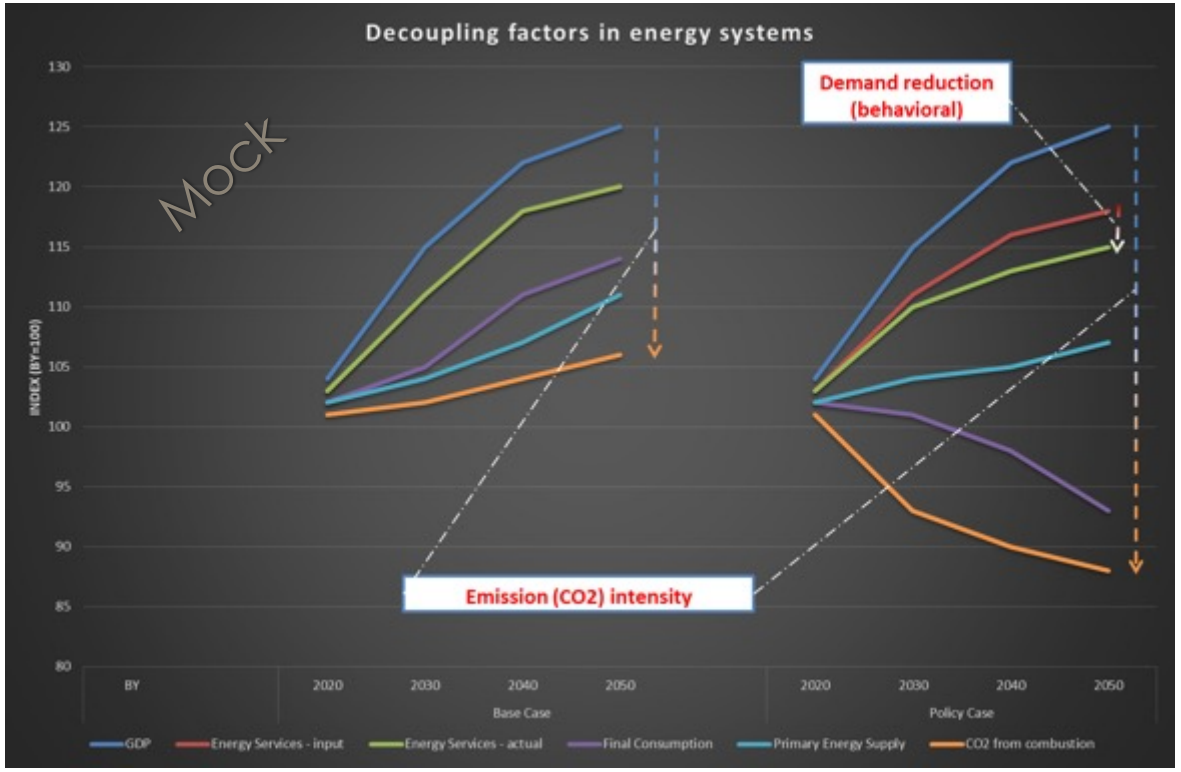
Unveiling and understanding energy efficiency indicators

The importance of disentangling “efficiency improvements” from “structural changes” of the economy and behavioural changes





Country’s economy and population is expected to grow at high rates of over 4% and 0.5%, respectively, Unmet demand is an issue!

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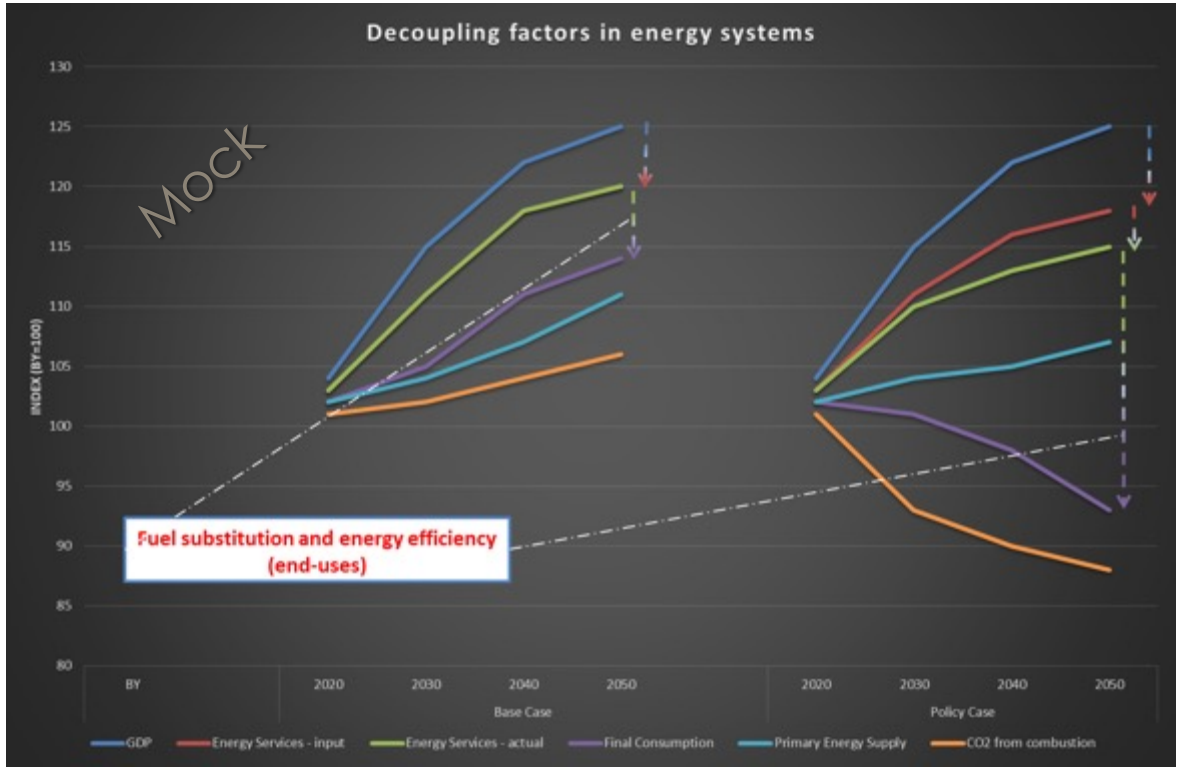
Unveiling and understanding energy efficiency indicators



Examples:

Final Energy per Inhabitant (toe/capita)	Energy use for Residential Space Heating (per sqm)	Energy Intensity Passenger Transport (per pass-km)
Final Energy per household (toe/household)	Energy use for Tertiary Space Heating (per sqm)	Energy Intensity Freights Transport (per t-km)
Final Energy per sectoral value added (toe/M$)	Energy use for Residential Lighting (per dwelling)	Energy use for Cement production (toe/t)
Electric vs bio-fuelled vehicles (over the chain)	Energy use for Public Lighting (per number)	Energy use for Iron&Steel production (toe/t)

Relative indicators need to be carefully interpreted!

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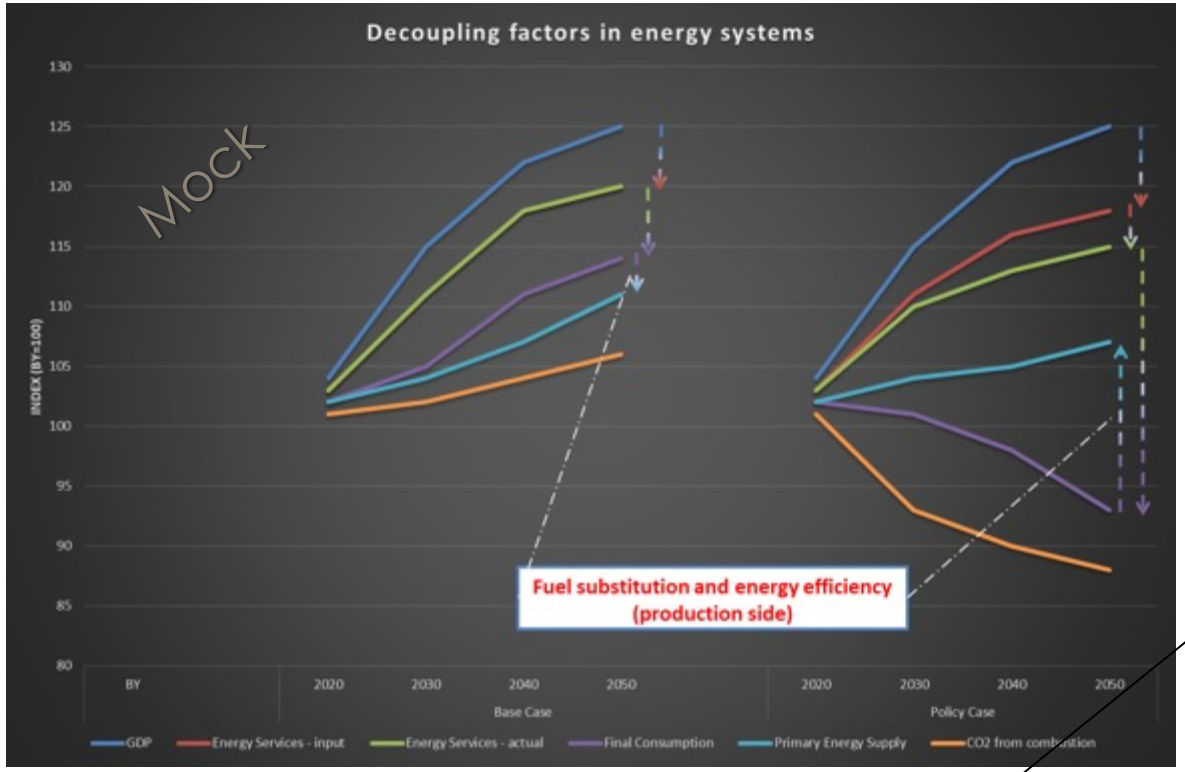
Unveiling and understanding energy efficiency indicators



EU (average): 1.35

Examples:

Primary Energy Supply per Inhabitant (toe/capita)	Efficiency of Thermal Electricity Generation	CO2 emissions from the power sector per unit of electricity produced (kgrCO2/kWh)
Primary Energy Intensity (toe/k$)	Electricity transmission and distribution efficiency	CO2 Emissions Intensity per unit of Primary Energy Supply (kg CO2 from Energy Sources / $ GDP)
Primary Energy over Final Energy (toe/toe) Best = 1	District Heat distribution efficiency	Per value added carbon intensity (kgCO2/$)
Electric vs bio-fuelled vehicles (over the chain)	Average Capacity Factor of Conventional Power Plants	H2 vs electricity in industry (over the chain)

Relative indicators need to be carefully interpreted!

Single indicators can be misleading!

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Model-based strategic analysis (EU-NECP)

GENERAL FRAMEWORK FOR INTEGRATED NATIONAL ENERGY AND CLIMATE PLANS

SECTION A: NATIONAL PLAN

1. OVERVIEW AND PROCESS FOR ESTABLISHING THE PLAN
2. NATIONAL OBJECTIVES AND TARGETS
3. POLICIES AND MEASURES

SECTION B: ANALYTICAL BASIS

4. CURRENT SITUATION AND PROJECTIONS WITH EXISTING POLICIES AND MEASURES
5. *IMPACT ASSESSMENT OF PLANNED POLICIES AND MEASURES*

List of parameters and variables, NEB, key indicators

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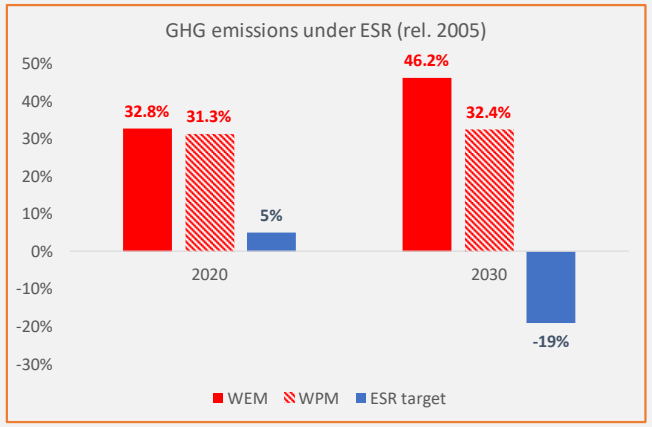
Model-based strategic analysis (EU-NECP)

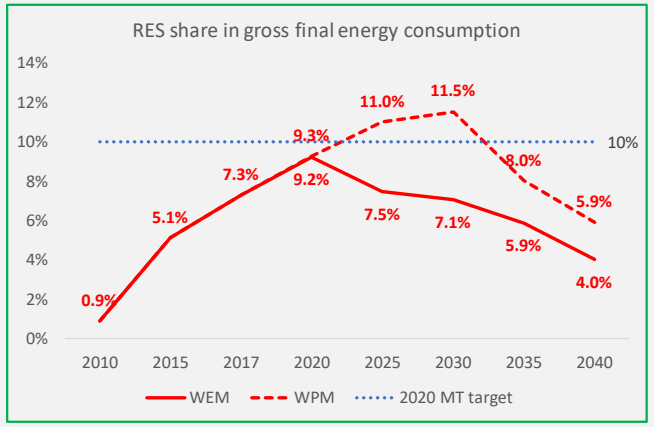
Sensitivity name

Central | EffSens | ElecSens

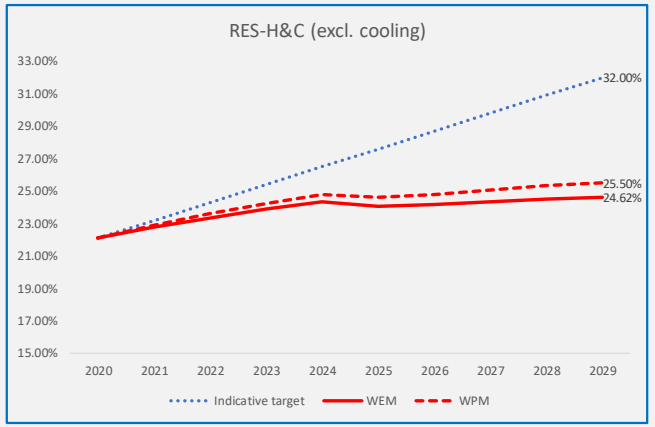
Decarbonisation



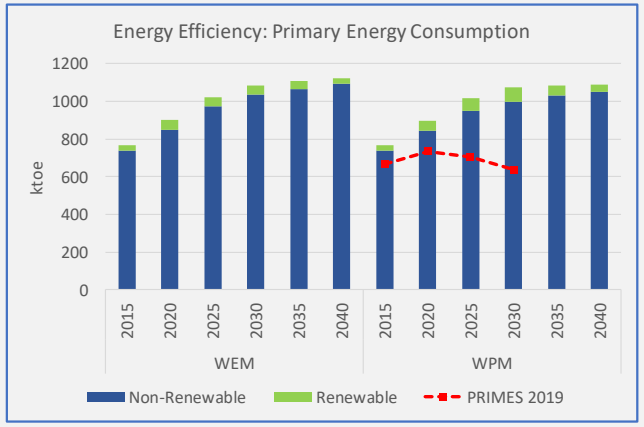
Renewable Energy Share



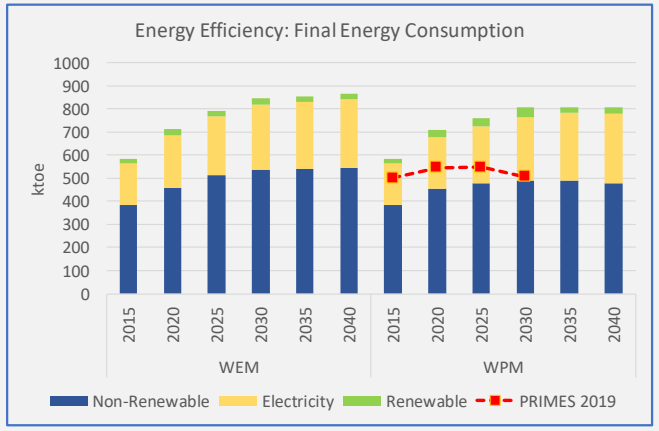
Renewable Heating



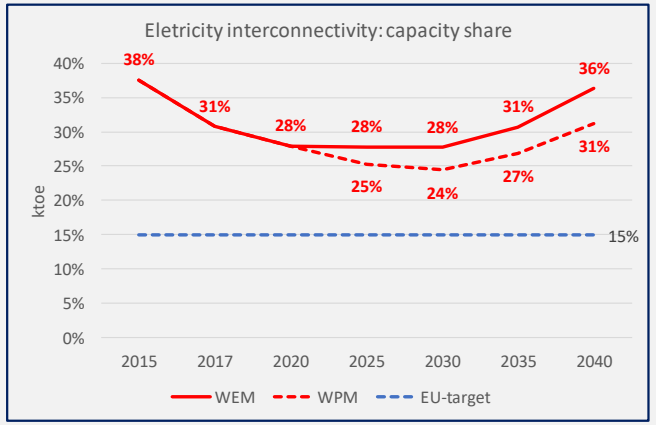
Energy Efficiency (1)



Energy Efficiency (2)



Electricity interconnectivity



https://energy.ec.europa.eu/topics/energy-strategy/national-energy-and-climate-plans-necps_en

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