IAM COMPACT

Expanding Integrated Assessment Modelling:
Comprehensive and Comprehensible Science
for Sustainable, Co-Created Climate Action

IAM COMPACT Modelling Seminars

Model Presentation: PROMETHEUS

E3 Modelling

The IAM COMPACT project has received funding from the European Union's Horizon Europe Research and Innovation Programme under grant agreement No 101056306.

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- Developed by E3MLab of NTUA in early/mid 2000's
- The origins of PROMETHEUS are from similar global energy system simulation models like the IEA's World Energy Model and POLES
- It is a partial-equilibrium multisector energy system model designed to explore the interactions of energy system with the environment, economy and policy.
- PROMETHEUS analyses the interdependencies between energy, economy and emissions within a single computational platform from now to 2050 (expansion to 2100)
- The model has been widely used for IPCC scenarios, EC energy roadmaps, and several multisector multiscale studies and reports

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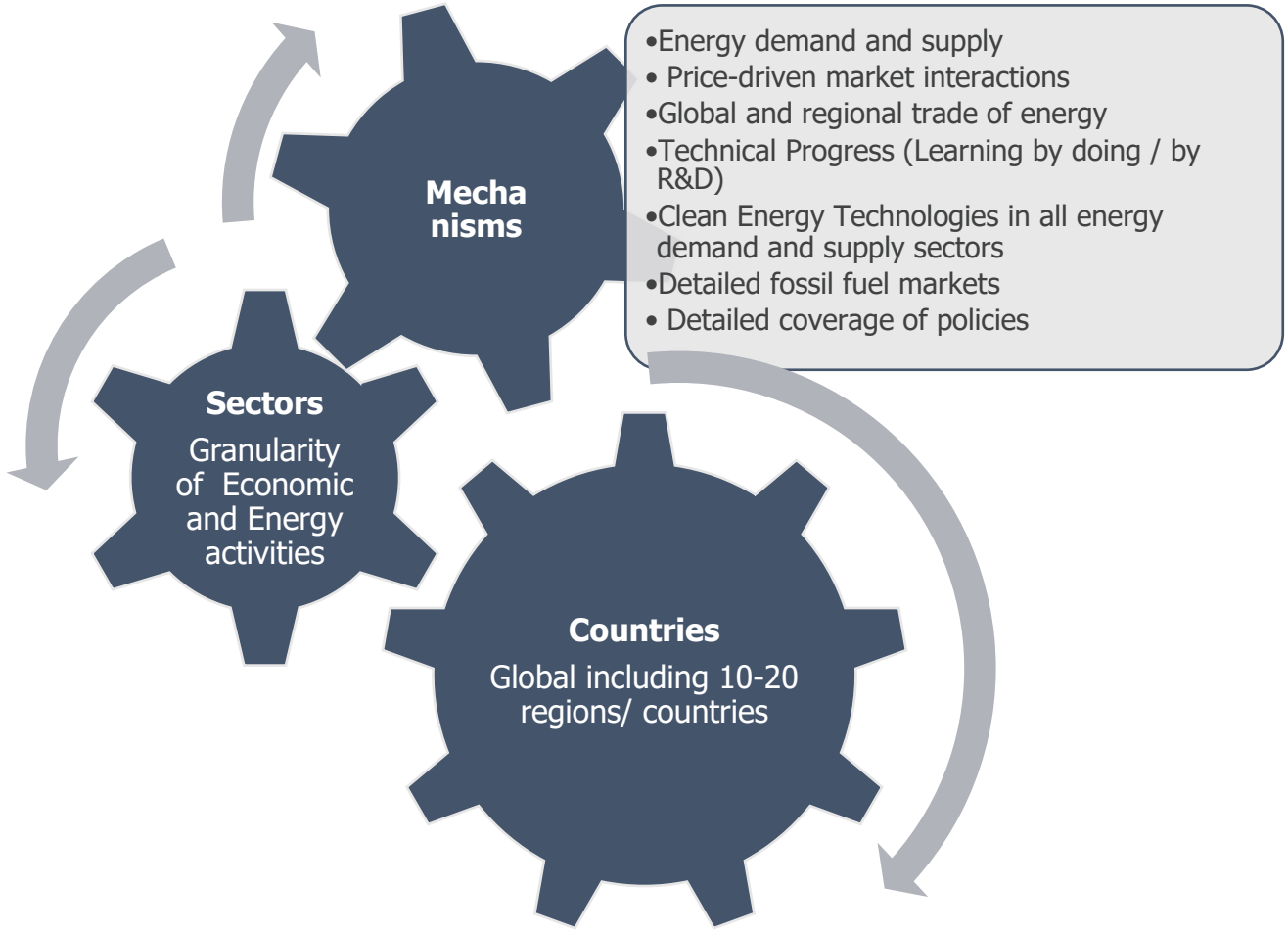
What does PROMETHEUS do?



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Regions and sectoral coverage

- 14 regions currently: to be expanded to more: Focus on major emitters
- OPEC/non-OPEC oil production and pricing
- 5 main end-use sectors. Each one is split into specific sub-sectors and uses
  - Agriculture
  - Industry (EITE industries are covered separately)
  - Commercial
  - Residential
  - Transport (by mode)
- Energy supply sectors:
  - Fossil fuel extraction
  - Fuel transformation
  - Electricity production
  - Hydrogen production
  - Heat, co-generation
- Inter-regional trade in:
  - All energy commodities (oil, gas, coal, electricity, hydrogen, biofuels)
  - Carbon permits

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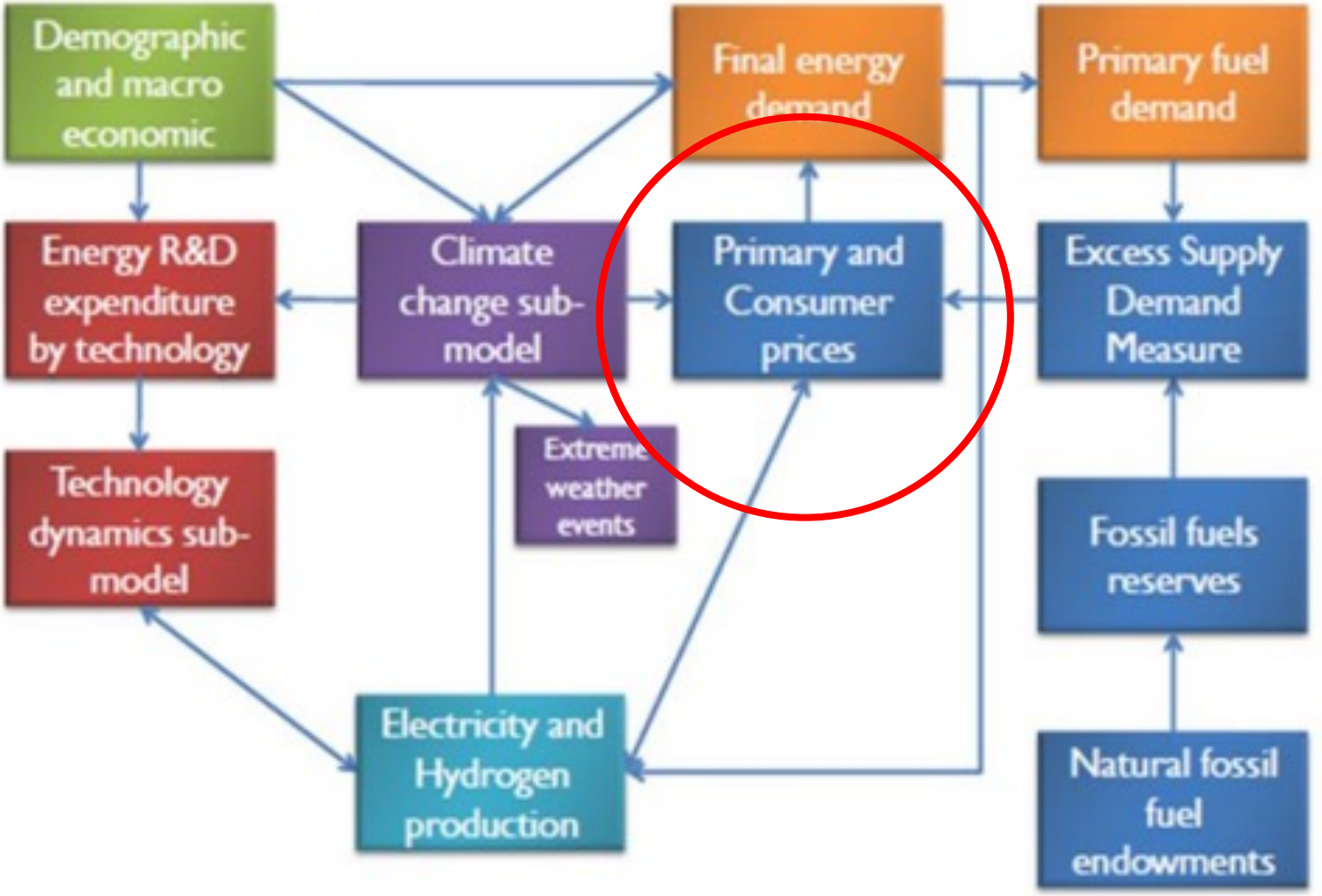
PROMETHEUS Simplified Flow Chart



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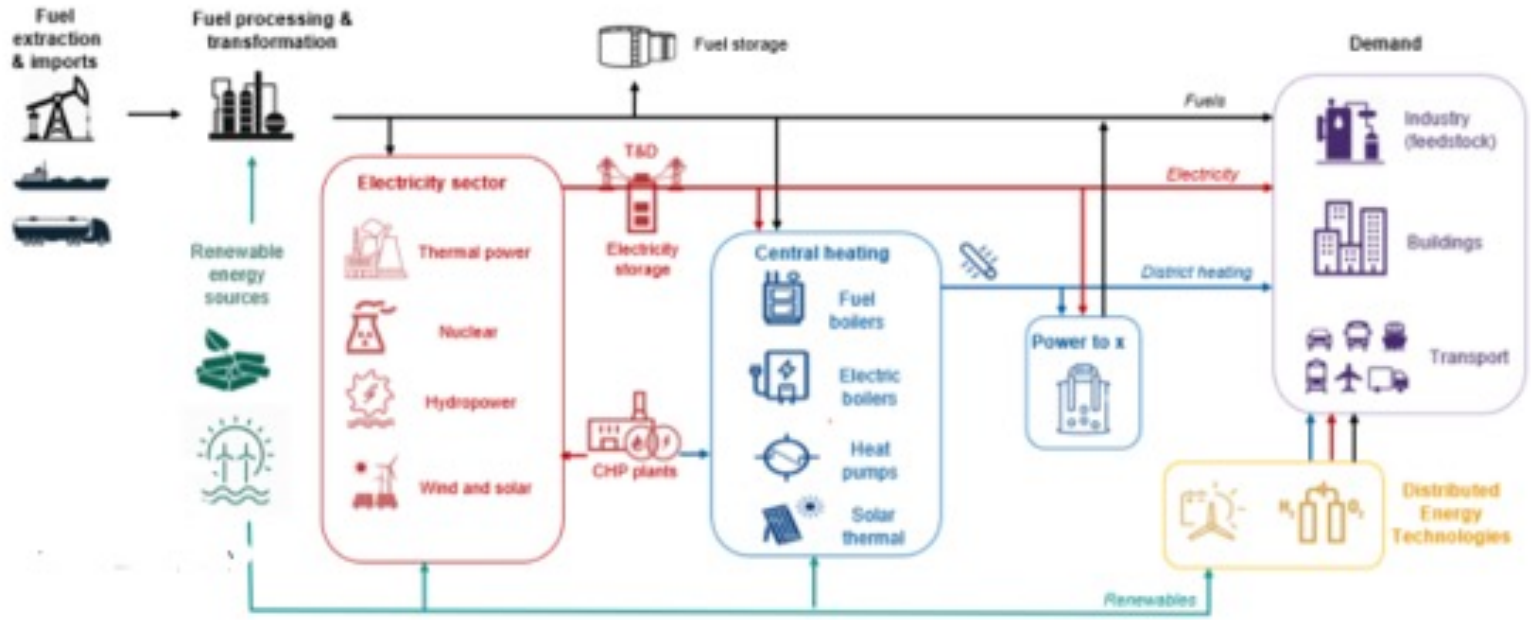

The model represents the links between energy resources, conversion/processing, grids T&D, technologies and end-uses

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Model Input and Output

Input	Process	Output
Population, GDP and economic growth per sector Taxes and subsidies for energy products Interest rates, risk premiums, etc. Environmental policies and constraints Technical and economic characteristics of future energy technologies (both for energy supply and demand) Energy consumption habits, comfort, efficiency potential Potential supply curves for primary energy by resource type, etc.	Energy System Model Performs iterations of demand and supply through calculated prices	Detailed energy balances Detailed demand projections by sector Detailed balance for electricity Production of conventional & new fuels Investment in all sectors, demand and supply, technology developments Transport activity, modes and vehicles Energy costs, prices and investment CO_2 Emissions from energy combustion and industrial processes Policy Assessment Indicators (e.g. imports, RES shares, costs etc.)

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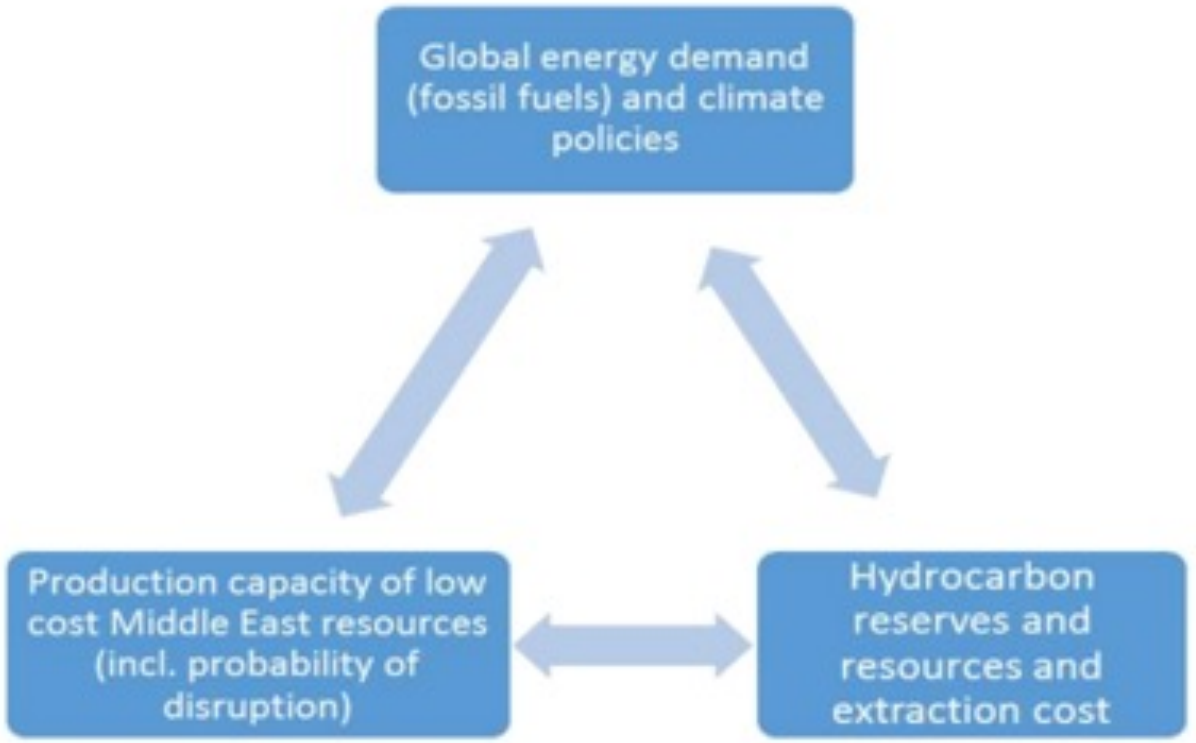
Modeling of fossil fuel markets



- Detailed modelling of international fossil markets
- One global pool for crude oil (brent price) influencing spot prices of oil products
- Three regional pools for natural gas (EU, USA, Asia) and coal
- Prices are a result of complex demand and supply interactions, capturing also potential cartel behaviour of producers (OPEC)
- Regionally differentiated production cost influence the regional production rates and global market dynamics

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PROMETHEUS predominantly works by specifying either a **carbon price** (imposed as a tax on CO_2 emissions) or a **carbon emissions constraint** in each region, or alternatively all regions simultaneously (global carbon budget).

The following further policies can be implemented:

- Subsidies on particular technologies (through adjusting their costs) or fuels;
- Constraints on the availability of particular technologies (e.g. no nuclear, no CCS);
- Constraints on the growth rates of particular technologies
- Inter-regional emissions trading (or no trading);
- Energy intensity and carbon intensity standards
- Promotion of renewable energy or energy efficiency
- Limitations in bioenergy or in BECCS (and other CDR options)
- Push for larger uptake of specific mitigation options (e.g. electrification, efficiency, hydrogen, power-to-X etc)

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- The impacts of global hydrocarbon resources on the EU energy system and emissions
- Global emission and energy impacts of NDCs
- The contribution of global upscale of Good Practice Policies towards meeting the Paris Agreement goals
- Implications of unavailable technologies – the role of CCS in developing countries
- Energy and emission impacts of the revised IPCC AR6 carbon budgets
- The role of demand-side mitigation options towards the 1.5 Paris goal
- Probabilistic assessment of pathways towards the 1.5 goal
- The impact of green recovery packages in global mitigation pathways
- Exploring the role of fossil fuel supply policies towards decarbonisation (e.g. fossil fuel extraction cuts) combined with demand-side policies (carbon pricing)
- Diagnosing the behaviour of global IAMs

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SDGs	Details
SDG3. Health (e.g., air-pollution related mortality)	The use of solid fuels in buildings can form the basis of local air pollution calculations.
SDG 7. Affordable and clean energy	Availability and costs of low-carbon energy by region is a central set of PROMETHEUS output.
SDG 8. Decent work & economic growth	Using employment multipliers by technology and fuel, combined with PROMETHEUS output on energy system structure (technology capacities, fuel supply etc) we can estimate the direct employment created in the energy sector
SDG 13: Climate action	Reduction of GHG emissions
SDG 15: Life on land	RES potential/exploitation and investment decisions (e.g. energy infrastructures) can be subject to land-specific constraints (natural and regulatory).

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