Capacity Building through Energy Modelling and Systems Analysis

IEA Experts' Group on R&D Priority-Setting and Evaluation
Developments in Energy Education: Reducing Boundaries

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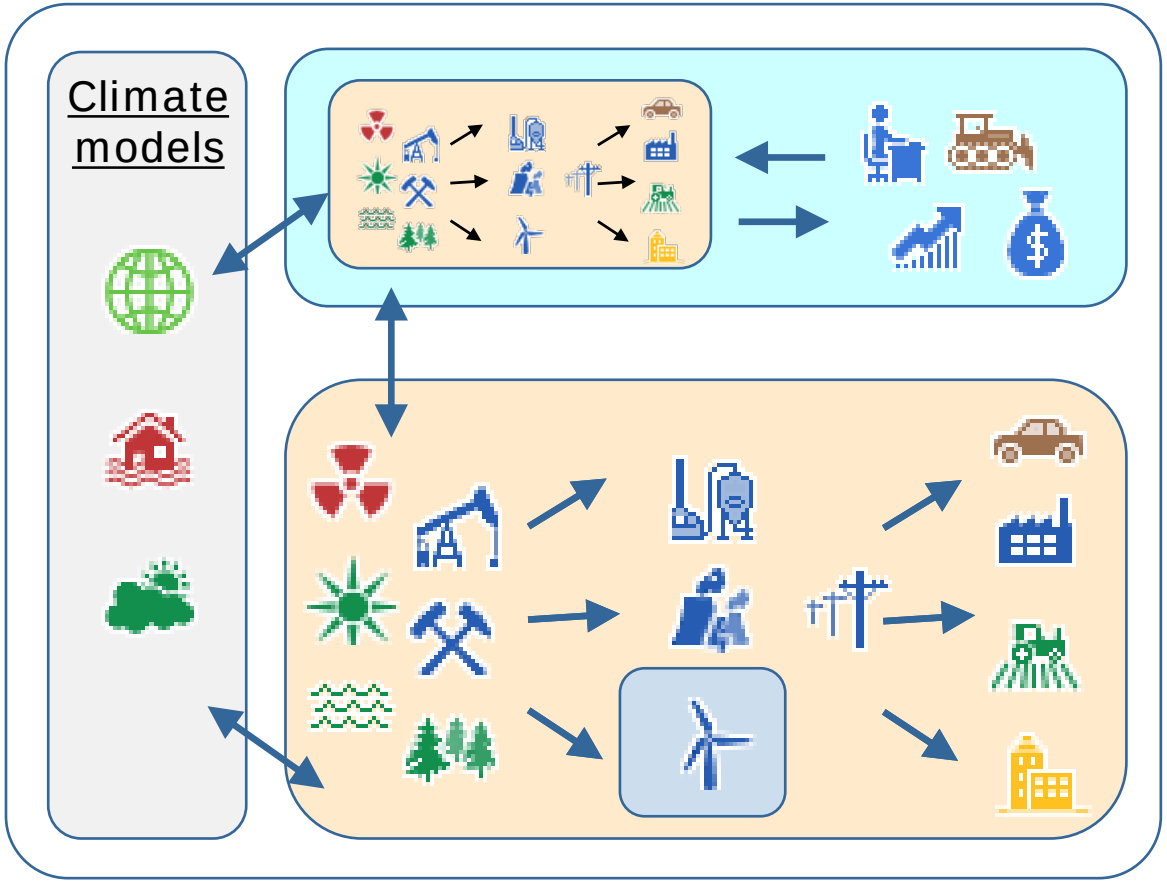
Outline

- Brief introduction to energy modeling:
  - Universe of energy models
  - Energy systems modeling with TIMES: Applications
- Barriers & opportunities in capacity development
- Training activities in energy modelling:
  - IEA training module & ETSAP training courses
  - Programmes by other institutions
- Key Messages

Universe of energy models

Integrated Assessment Models

e.g. AIM, REMIND-R, WITCH



Economic models

e.g. GEMINI-E3, E3MG, IMACLIM-R, OECD ENV-LINKAGES

Energy systems models

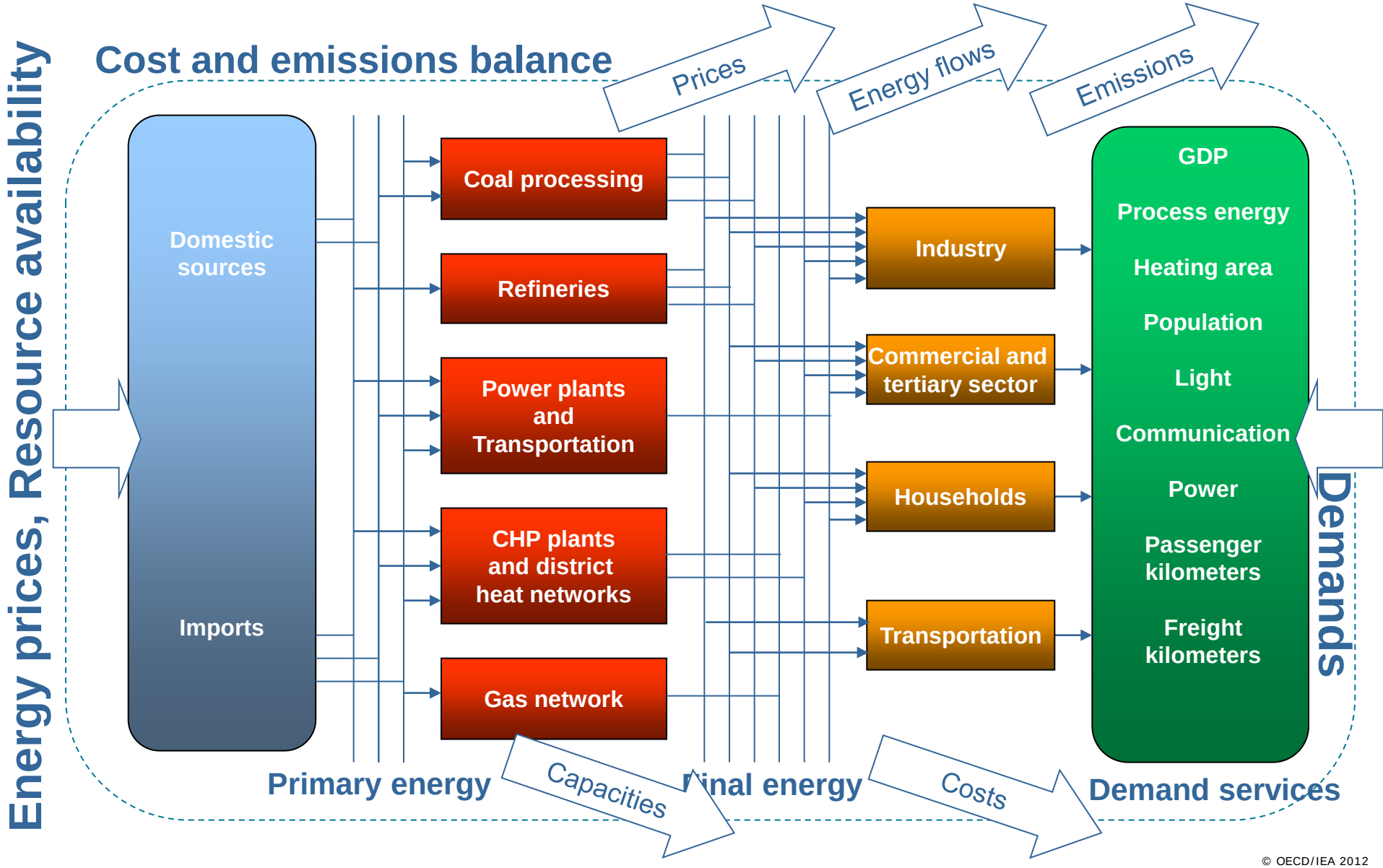
e.g. MARKAL, TIMES, MESSAGE, LEAP, PRIMES, NEMS

Engineering models

e.g. RETScreen

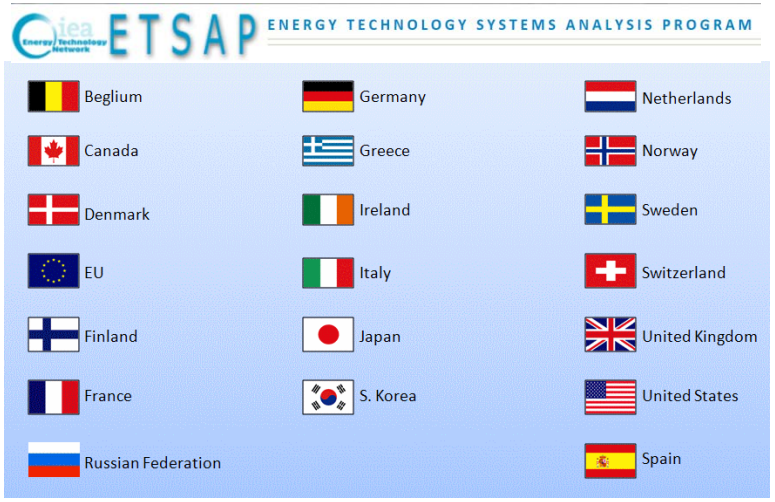
Model choice depends on the questions to be answered.

Energy system model (bottom-up model): TIMES

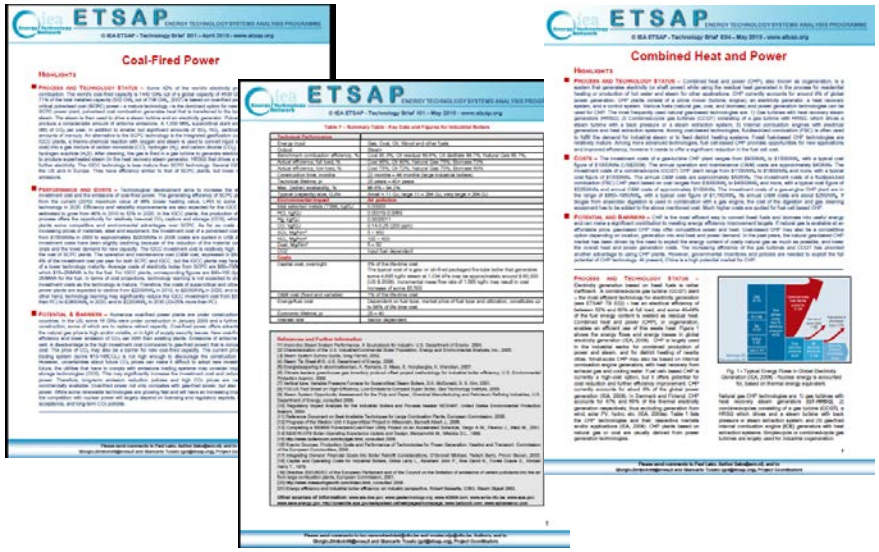


Energy Technology Systems Analysis Programme (ETSAP)

- Established in 1976
- To develop, maintain, and expand a consistent multi-country 4E (energy, economy, environment, engineering) analytical capability
- Common methodology: MARKAL/TIMES model generators
- Energy Technology Data Source: Consistent data set for more than 50 energy supply and demand technologies
- ETSAP workshops twice a year
- Training courses for TIMES

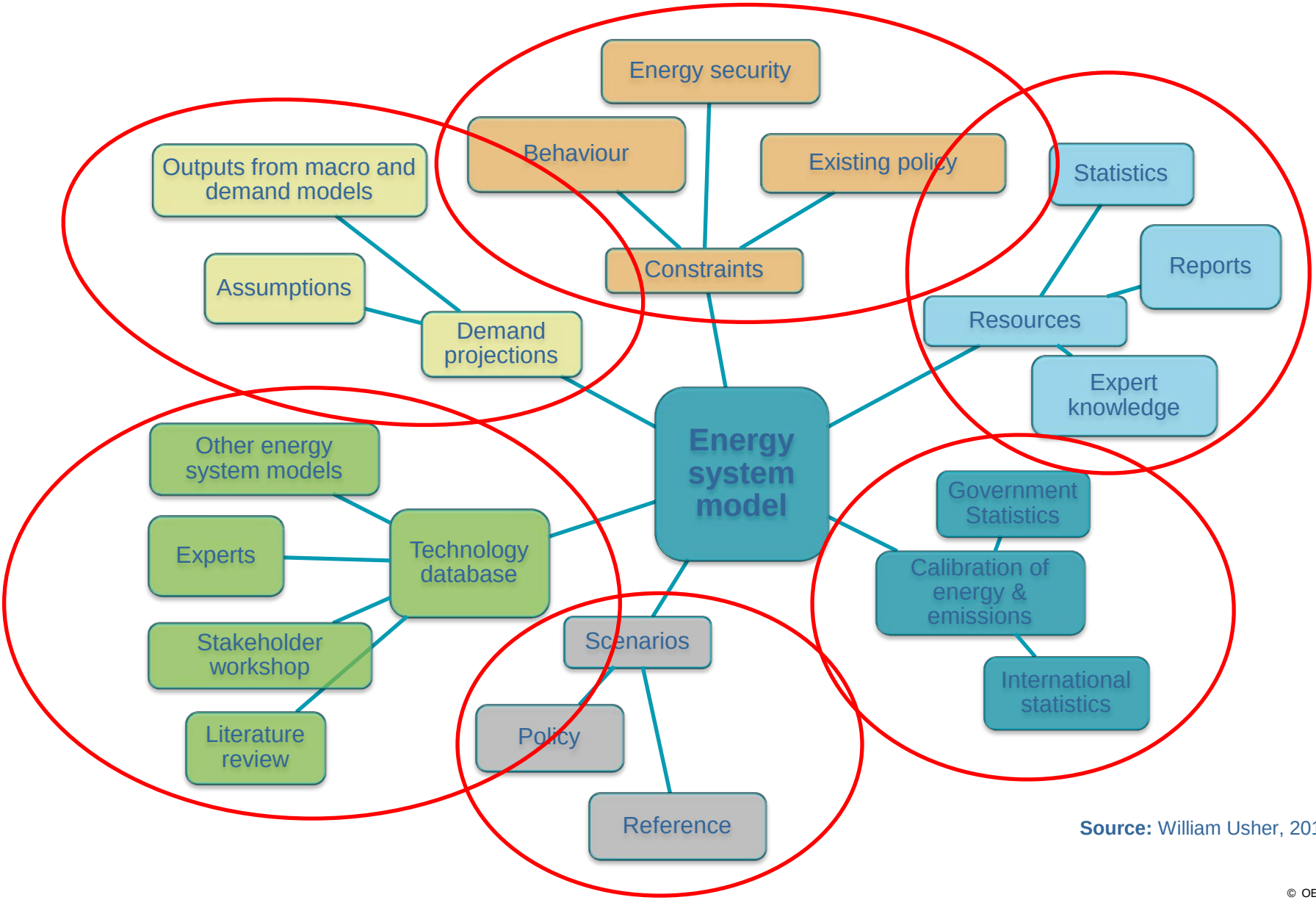


ETSAP Contracting Parties



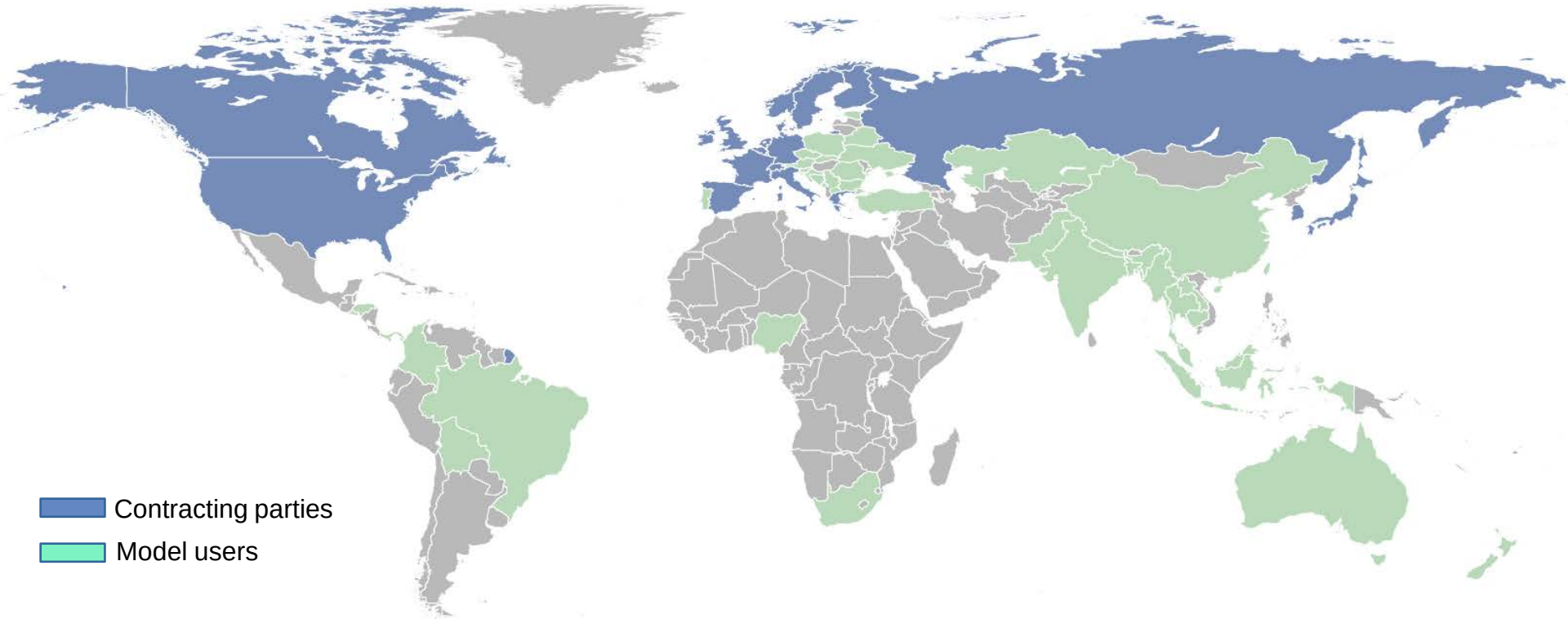
Energy Technology Data Source

Not only about modeling, but also data analysis



Source: William Usher, 2010

Application of MARKAL/TIMES around the world

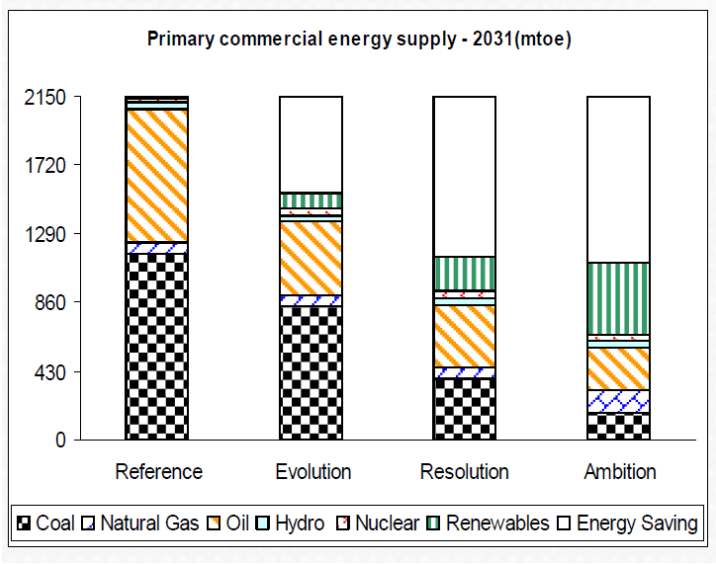


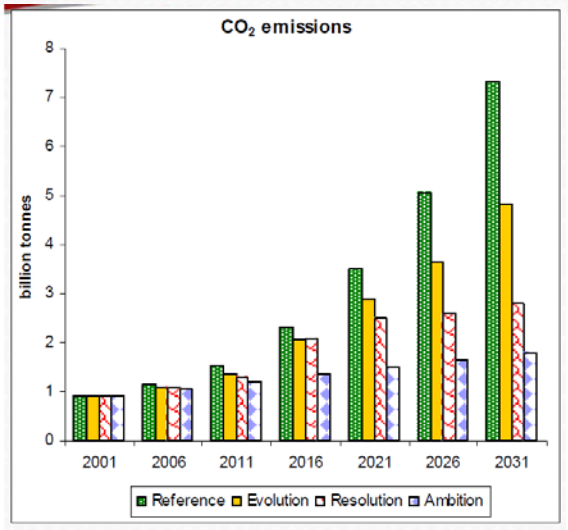
Used by more than 150 institutions in 63 countries

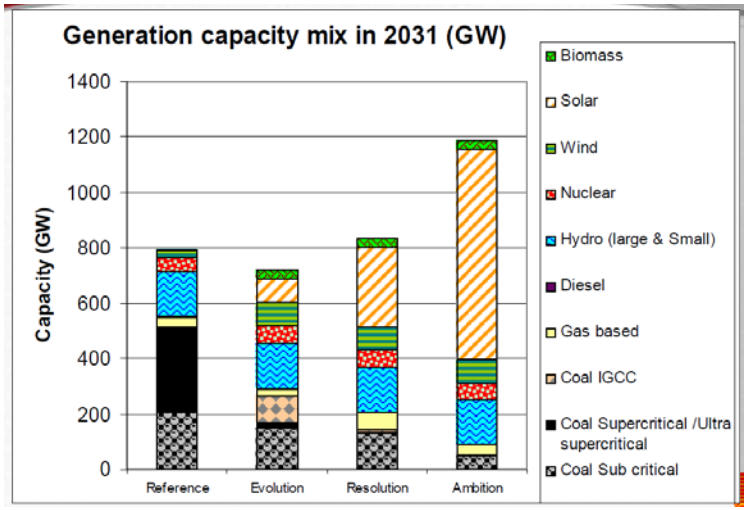
Applications: India (MARKAL)

So What Shape Can The Future Take?

Scenario names	*Storyline*
Reference	Life continues pretty much as we know it with autonomous efficiency improvements taking place where feasible. Increase in use of renewable energy carries on at the same pace. Defined policy priorities are implemented with no real sense of urgency
Evolution	A determined effort is provided for efficiency improvements both on the supply and demand sides. Considers an accelerated push for renewable energy, nuclear and new technologies such as CTL (Coal to liquids) and GTL (Gas to liquids). Energy Security concerns are paramount in this scenario.
Resolution	This scenario honors the Prime Minister of India's commitment that India's per capita carbon emissions would never exceed those of the developed world and it is optimistically assumed here that the developed world would be able to bring down its emissions to a level of 2 tonnes/capita. Carbon emissions for India in this case would be around 38% of Evolution levels in 2031 to fulfill this commitment.
Ambition	This scenario considers that India sets aside its legitimate arguments on "common but differentiated responsibilities" & equitable per capita rights, and takes on even more stringent emission reduction targets (reaching 1.3 tonnes / capita in 2031) towards influencing global response to the climate change challenge

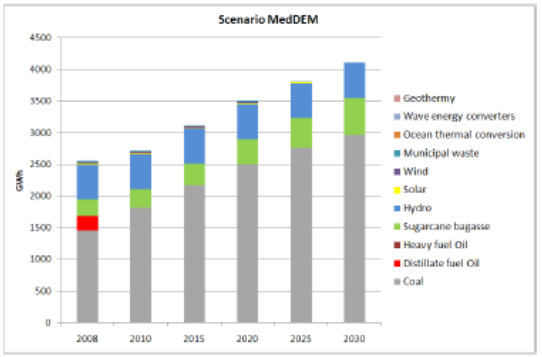




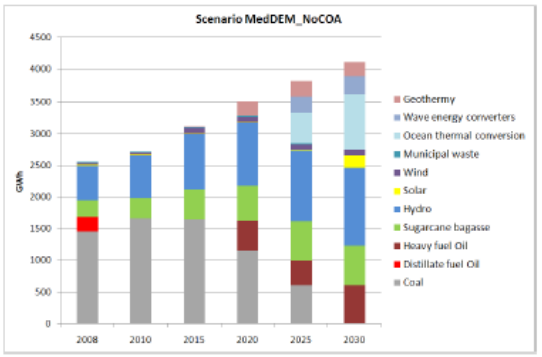


(Source: Srivastava L. et al., India's Energy Sector Options & Challenges, Joint TERI ETSAP Workshop, 21 January 2010)

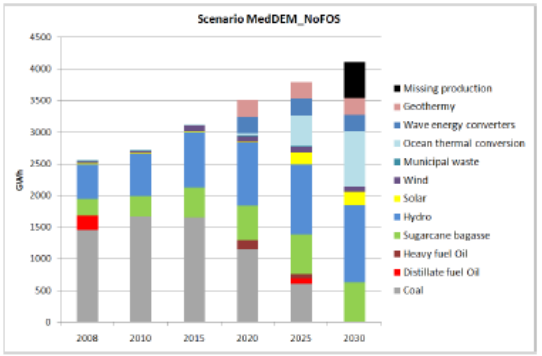
Applications: Island of Reunion (TIMES)



(a) Business as Usual.



(b) Without importation of coal in 2030.



(c) Without importation of fossil fuels in 2030.

(Source: Maïzi, N. et al., Flexibility and reliability in long-term planning exercises dedicated to the electricity sector, XXI World Energy Congress, Montreal, September 12-16, 2010)

Framing questions

- What are the barriers and opportunities to expanding university, training or capacity-building programmes across borders or regions?
- What does it take to influence education institutions to expand their programmes?

Barriers & Opportunities

International Energy Agency

Barriers

- Methodological level
  - Often relatively steep learning curve
  - Data-intensive analysis
  - Interdisciplinary (expertise/experts from different areas required)
- Institutional level
  - Model development is a long-term and continuous process
  - Change in staff
  - Initial costs for software can be a hurdle

Opportunities

- Training workshops: introduction to energy modelling, but also in-depth training
- Networks of modelers, but also with energy sector and technology experts
- University education and research (course curriculum, master & PhD programmes, graduate schools, exchange programmes, industry projects)

IEA Training Module: Energy Technology Modelling

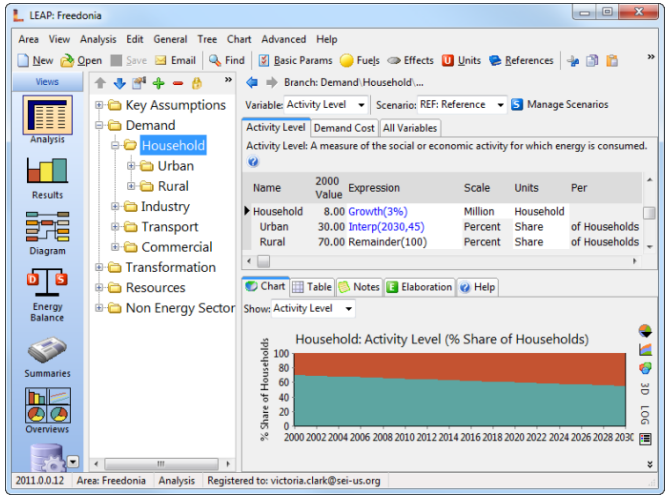
- Introductory course within IEA Energy Training Week:
  - Duration: 2 days
  - Basic concepts of energy modelling combined with practical exercises (power and transport sectors)
  - Linked with training modules on statistics and energy indicators
  - Participants: around 15, mainly from non-OECD countries
- In-depth courses:
  - Duration: 4-5 days
  - Content depending on participants' prior modelling experience (e.g. initial basic training followed by more advanced training a few months later)

ETSAP training activities

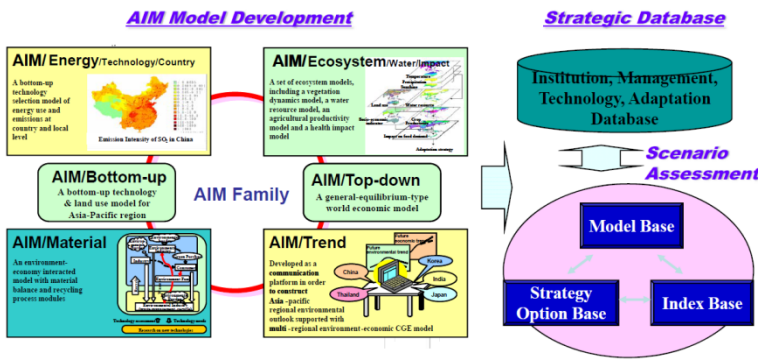
- Training courses:
  - Duration: 3 days
  - Offered on different levels
  - Twice a year linked to ETSAP workshops
- In addition, courses on request
- Website forum

Activities by other institutions (1)

- LEAP (Long range Energy Alternatives Planning System)
  - Integrated energy planning tool for an economy
  - Used in more than 150 countries
  - Lower initial data requirements, relying on simpler accounting principles
  - www.energycommunity.org

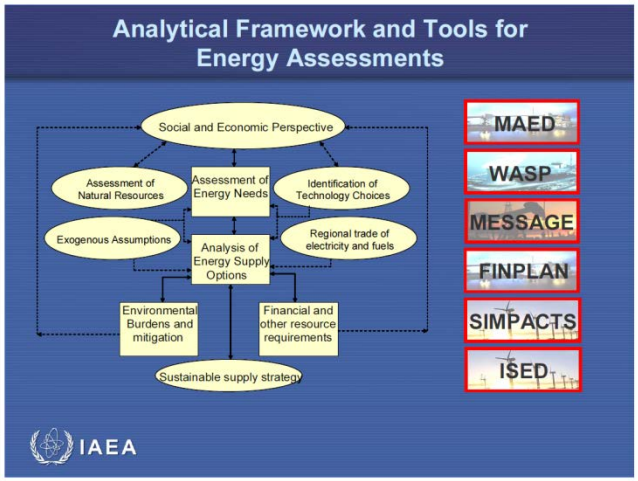


- AIM (Asia-Pacific Integrated Energy Model)
  - Model integrates emissions, climate and impact models
  - Combines bottom-up and top-down models
  - Applied on local level, countries within the Asia-Pacific region up to the global level
  - Training courses and annual workshops

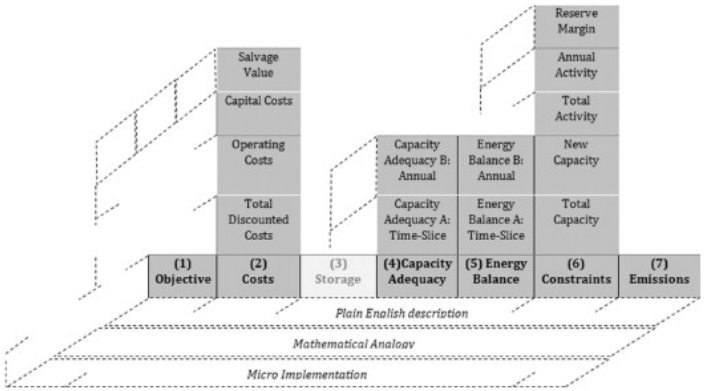


Activities by other institutions (2)

- IAEA: suite of tools for integrated energy planning
  - Assisting member states to build-up capacity
  - Training courses, distance learning, tele support
  - www.iaea.org/OurWork/ST/NE/Pess/index.html



- OSEMOSYS
  - Open-Source Energy Modelling System
  - Reducing barriers to use optimisation models for energy planning
  - Simple and transparent tool to develop new model formulations
  - http://osmosys.yolasite.com/



Activities by other institutions (3)

- ENPEP-BALANCE (Energy and Power Evaluation Program)
  - Argonne National Laboratory
  - Market share algorithm to determine equilibrium between supply and demand as well as to capture different objectives of various decision makers in energy system
  - Available for free
  - Used in more than 80 countries
  - Training courses offered
  - www.dis.anl.gov/projects/Enpepwin.html#balance

University programmes

…by no means exhaustive.

Key messages

- Growing need for energy modelling and systems analysis
- Capacity building is a long-term development: universities or research institutes good candidates for developing modelling capability
- International and national networks can help in this process
- Energy modelling and scenario analysis relies on many other disciplines → interdisciplinary exchange is important

Thank you!

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