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Energy Planning

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Energy Planning

Incorporating nuclear: Initial thoughts

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Introduction: Nuclear and Energy Systems Analysis

- Nuclear power planning begins with energy systems planning:
 - Only then can one be confident that nuclear has role to play (from a techno-economic perspective given other policy considerations (security, environment, reliability, etc))
 - Important for public information/stakeholder to demonstrate that all options have been explored etc.
- Energy analysis = rolling affair
 - hence capacity building is essential

Introduction: Energy Systems Analysis

- Energy Systems Analysis is multidimensional:
 - Can include “minute by minute balancing” to “hundred year” simulations
 - Can focus on a subset of the energy system
 - Can focus on a single or several fuels
 - Can include multi-resource integration
- Approaches vary depending on the question to be asked and information on hand
- Different actors (and their analysis) have different objectives



Typical Medium to Long Term Energy Systems Analysis

- A typical approach to energy planning / systems analysis is to minimize the economic cost while accounting for important technical physical constraints for energy system development over a 20-30 year period
- Beginning with as simple a representation as possible to account for constraints that may effect general conclusions
- Of interest is:
 - Broadly: what technologies or policies help meet the development objective in a techno-economically manner?
 - What (1) kind of investments need to take place, (2) when, (3) at what level of investment and (4) operation?
- This is then iterated in more detail (together with other studies) as more information/detail is required for the target investments/technologies/polices...

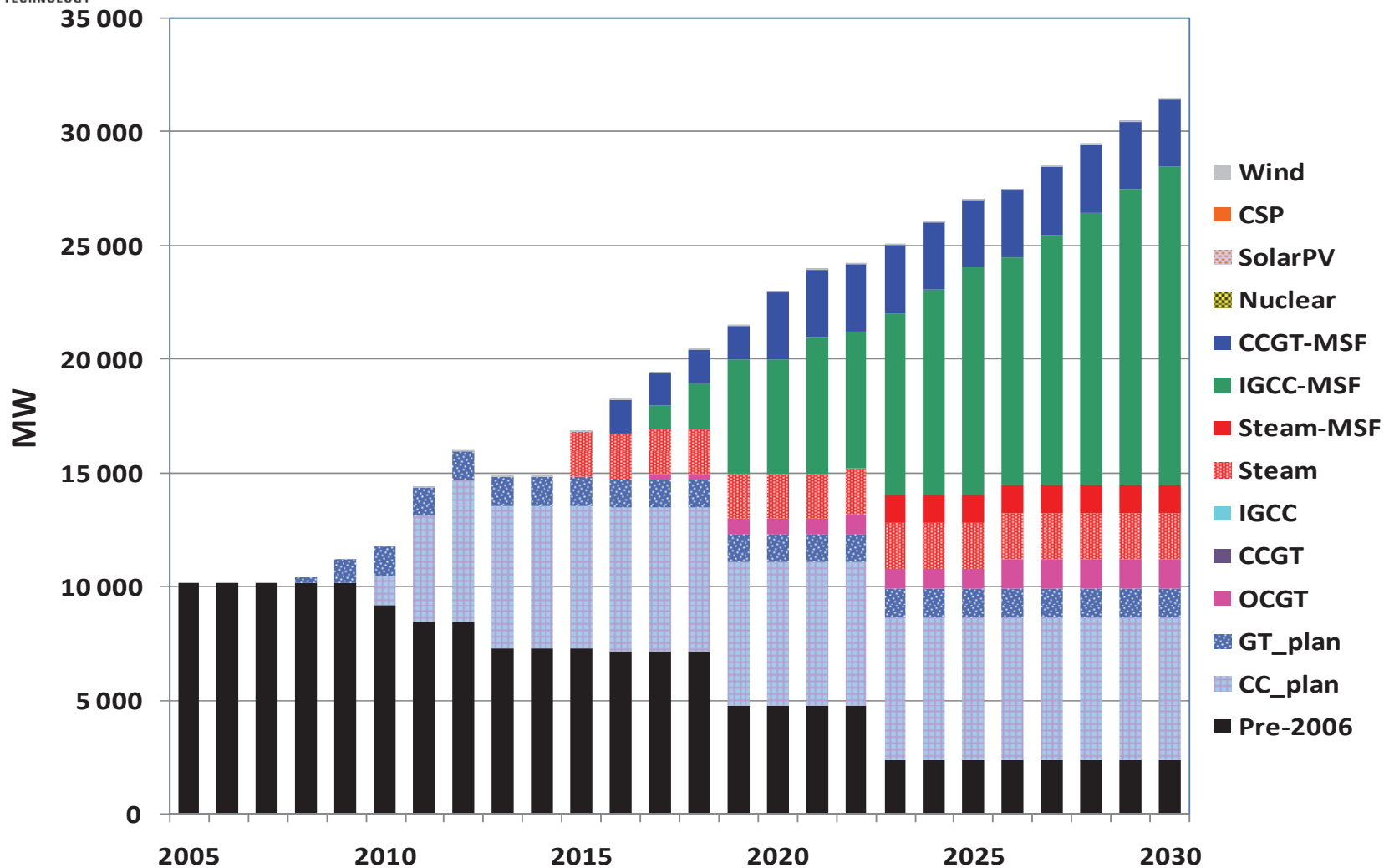
Incorporating nuclear power

- For Nuclear power plants the first iteration normally tries to answer: “Is it economically promising?” / “Do the potential benefits outweigh its costs?”
 - For several reasons: Energy security, lowering energy costs, freeing up domestic resource for export, reducing GHG emissions etc.
- These studies can include some simple heuristics to account for important short term constraints:
 - Largest unit should be $< 10\%$ of the transmission system
 - Restricted ramp rates
 - Various de-rating and capacity reserves
 - Unit loss tests etc.
- Typically many important criteria are not included during this first pass assessment
- They are, however, added during iterative, supplementary and more detailed studies



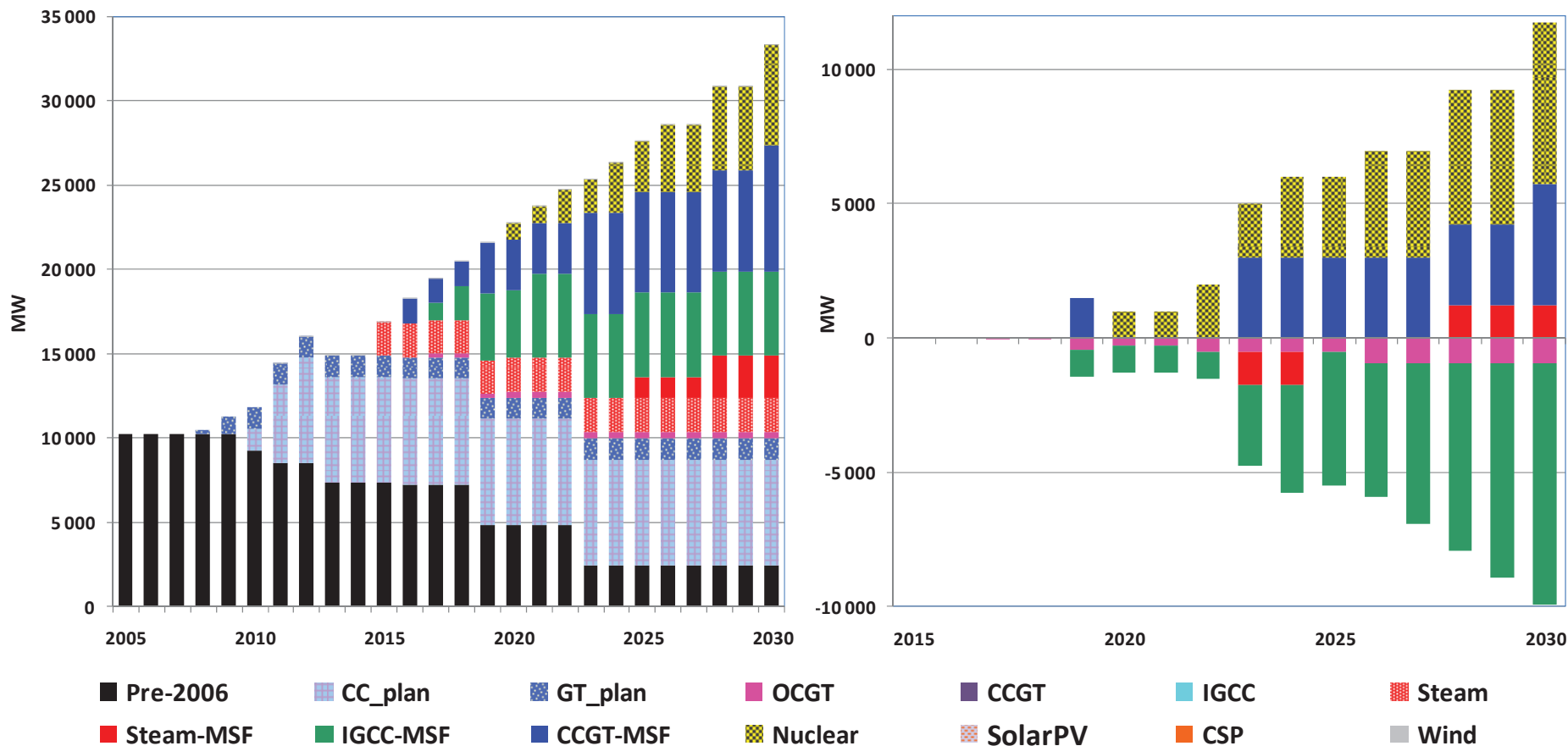
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An example: A system without nuclear

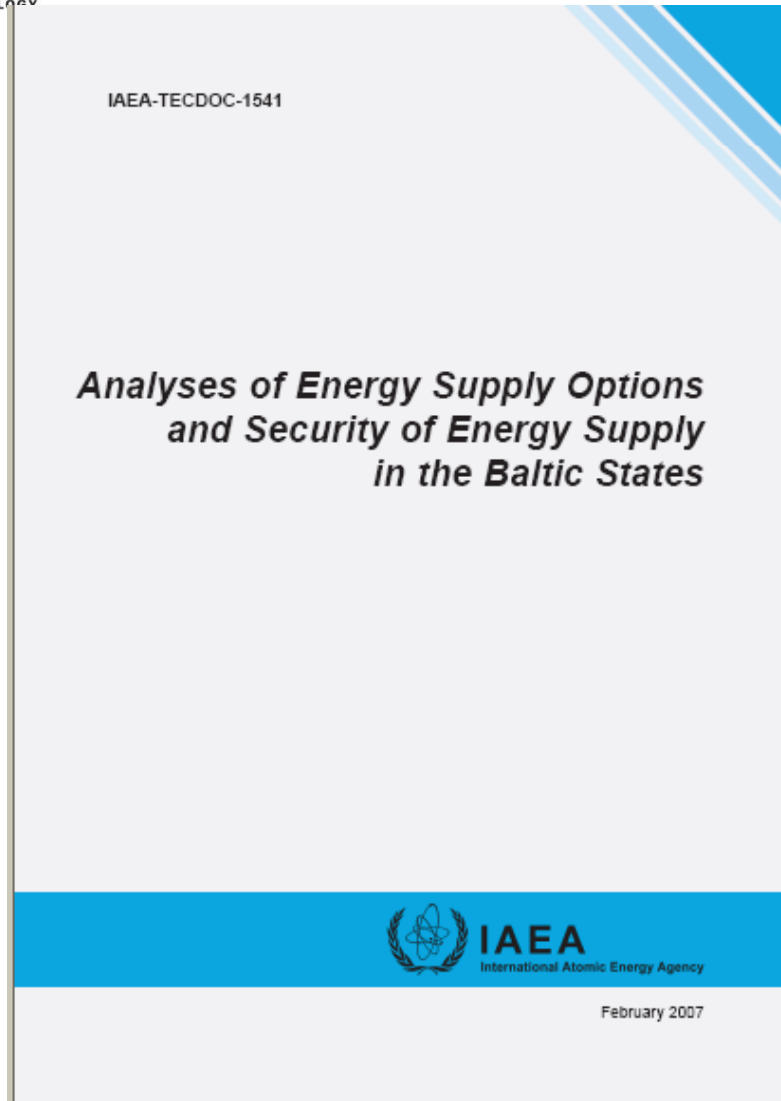




An example: Allowing nuclear in the solution



Another example



- In isolation each country is too small for a standard nuclear plant
- But in the region, power plants based on secure fuel (nuclear, shale-oil) are being decommissioned, increasing the need for imports
- A regional approach was needed

= > A series of interconnected energy models

IAEA energy analysis tools

Model for the **A**nalysis of **E**nergy **D**emand



Wien **A**utomatic **S**ystem **P**lanning Package



Model for **E**nergy **S**upply **S**ystem **A**lternatives
and their **G**eneral **E**nvironmental impacts



Financial Analysis of Electric Sector Expansion
Plans



Simplified Approach for Estimating **I**mpacts of
Electricity Generation



Energy **I**ndicators for **S**ustainable **D**evelopment



An iterative approach

- **Supplementary studies (amongst others...)**
 - Siting (Geology, environmental impact assessment, cooling requirements, accessibility, grid integration etc.)
 - Financing (Single NPP, fleet investments, risk sharing etc.)
 - Integration in the broader system (Electricity (various reserves and ancillary services), electricity and water, electricity and heat, all energy supply and demand, regional interconnection)
 - Temporal integration (Short term load flow and network issues, operational and real time dispatch issues)
- ...Detailed iteration and expansion of the Medium to Long term Energy Systems Planning and Analysis... back to the supplementary studies .. Etc.
- Fit within broader infrastructure (For examples see: INIR - integrated nuclear infrastructure review)



Conclusion

- Long to medium term energy systems analysis answers broad set of economic and strategic development questions in its first pass
- Needed for screening the nuclear option and building confidence with stakeholders
- Detailed supplementary studies are needed for all specific investments (such as nuclear)
- These often re-inform a new round of medium to long term systems planning and visa-versa.