

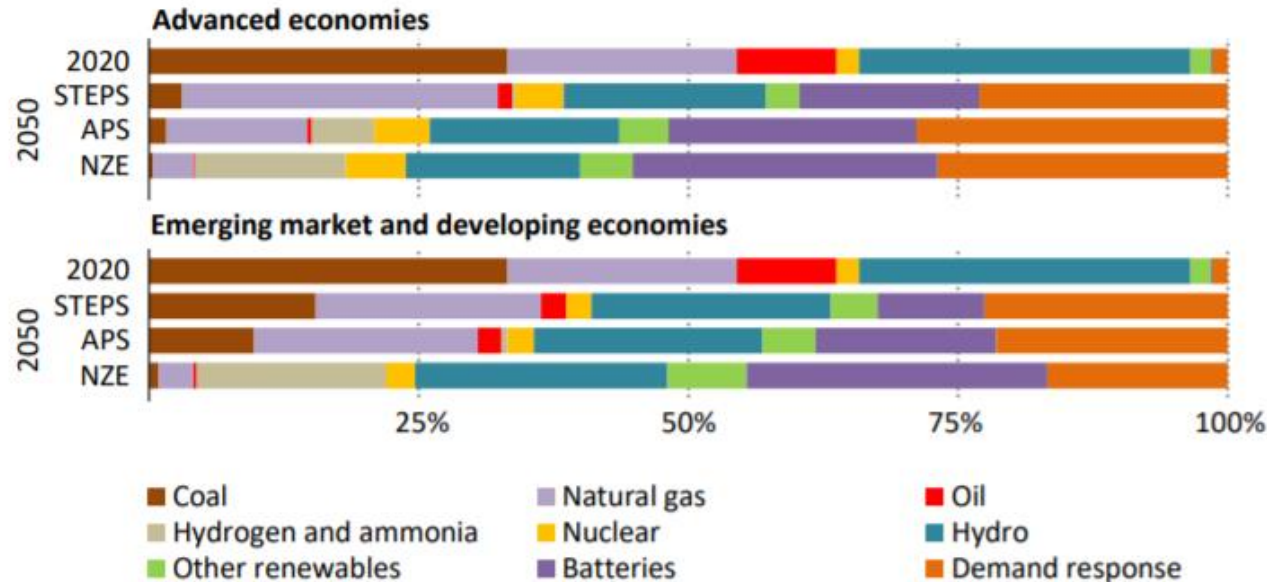


# **Contractual flexibility in power systems with solar and wind**

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# Flexibility is the cornerstone of VRE integration

Electricity system flexibility by source and scenario, 2020 and 2050

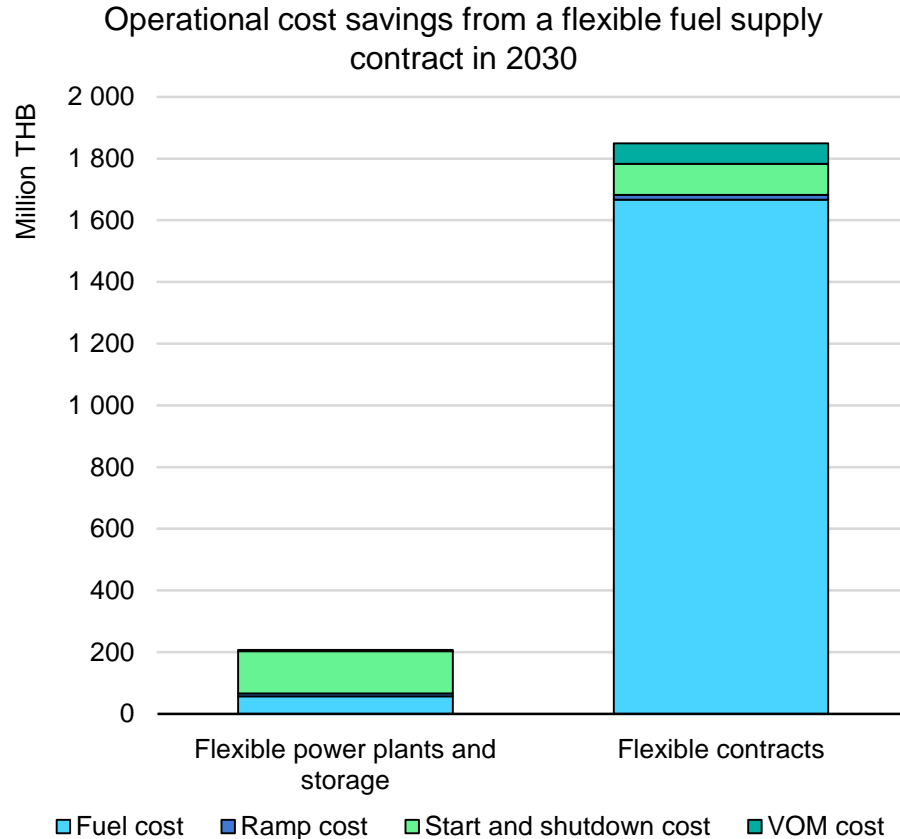


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**Coal and natural gas remain cornerstones of electricity flexibility in the STEPS, but the mix of flexibility sources shifts dramatically on the path to net zero emissions by 2050**

- The technical capability of the thermal fleet to ramp and operate flexibly can be very different from the overall ability since commercial and institutional structures also impact flexibility
- Examples of commercial and institutional structures that impact flexibility can be
  - Physical PPA's
  - Long term transfer agreements on transmission
  - Fuel supply contracts
  - Ownership requirements for assets in vertically integrated markets
  - Asset development process
  - Market structure

# Thailand is an important example of contractual inflexibility



- The operational cost savings from a flexible fuel supply contract are significantly greater than the savings from flexible power plants and storage options
  - Minimum take-or-pay obligations
- A significant reduction in operational costs as system operators can access a large amount of latent flexibility in the system and dispatch the system in a more cost-effective manner.

- In India spot markets have been introduced, but the utilisation of the short term markets is limited, which has been linked to long-term physical PPAs
- Cross-border transmission is often developed with long-term transmission contracts which can also be limiting for VRE integration
- In ASEAN hydro resources from e.g. Laos and Cambodia can contribute to integrating for example PV in for example Viet Nam or Thailand
- This however requires the needed institutional and commercial structures to facilitate flexible cross-border power trade
- In China inter-provincial trading can be key to lowering curtailment of VRE
- In short grids and commercial structures allowing utilisation of assets needs development to achieve clean energy transitions

- In order to make the clean energy transitions most affordable it's important to understand how to utilise current assets
- Can current coal plants change operational patterns and allow for integration of VRE?
- Can both national and cross-border grids be optimised to help increase flexibility?
- What type of flexibility should be invested in?
  - Would gas plants risk being stranded assets?
  - What contractual structures are appropriate?
  - Do any current structures need to be changed?

- Flexible contracts for thermal assets can include the following aspects
  - Separating physical production guarantees from budget stability
  - Lowering minimum take obligations
  - Relating minimum run rates to technical capabilities
  - Implementing differentiated price incentivising flexibility
  - Implementing budget security instruments like floors on settlement irrespective of generation
  - Providing financial incentives for retrofits for older plants to increase flexibility
- Flexible contracts for VRE can include the following aspects
  - Clear procedures for curtailment
  - Clear settlement for curtailment
  - Compensation mechanisms that incentivise system friendly deployment
  - Forecasting requirements

- A holistic approach to flexibility needed for VRE integration is needed
- To ensure affordability the flexibility of the current assets should be investigated and utilised
- For future flexibility a lot can be achieved with grids, hydro and other storage solutions
- If thermal power like gas is needed, ensure that contracts reflect utilisation of inherent flexibility to limit lock in effect



