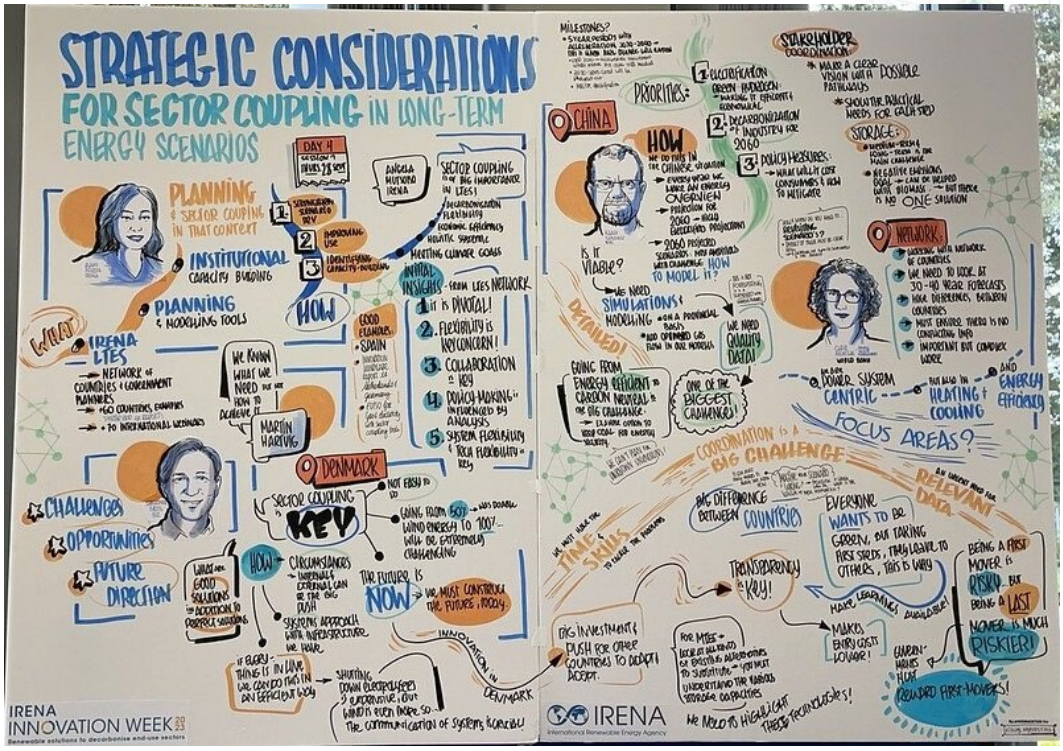
Session Proceedings

Table of Contents



Overview

As the first discussion of sector coupling under the LTES Network scope, this session mapped out the key considerations that scenario practitioners need to incorporate when including sector coupling aspects in long-term energy scenarios. The takeaways and outcomes of this session are anticipated to enhance the understanding of how to integrate sector coupling elements in the energy planning process. Moreover, these findings will shape future discussions within the LTES Network.

Key Takeaways

1. **Complexity and Importance of Sector Coupling**: The panelists emphasized the complexity of implementing sector coupling in energy systems. This approach is crucial for achieving a comprehensive and efficient transition to clean energy systems, particularly in integrating different energy sectors like electricity, transport, and heating.
2. **Challenges in Data and Modeling**: A significant challenge highlighted in the discussions is the need for quality data and robust modeling techniques. The ability to accurately forecast and plan for future energy needs and the integration of various energy sectors depends heavily on reliable data and advanced modeling capabilities.
3. **Role of Policy and Market Dynamics**: The importance of policy measures and market mechanisms in driving the energy transition was underscored. Policymakers need to create conducive environments for the adoption of sector coupling technologies, and market dynamics should be leveraged to encourage efficient energy use and investment in clean technologies.
4. **Innovation and Technological Advancements**: The panelists discussed the need for continuous innovation and the development of new technologies to facilitate sector coupling. This includes advancements in areas like hydrogen production, energy storage, and smart grid technologies.
5. **Stakeholder Coordination and Collaboration:** Effective stakeholder coordination and collaboration were highlighted as critical for successful sector coupling. This involves aligning the interests and actions of various actors, including government agencies, energy providers, technology developers, and consumers, to ensure a cohesive approach to energy transition.

Key Actions for Policy Makers

- **Prioritize intersectoral collaboration**: Encourage active collaboration between different sectors such as transportation, industry, and energy to ensure a cohesive approach to sector coupling. This collaboration is essential for realizing the full potential of integrated energy systems.
- **Focus on regulatory frameworks**: Develop and refine regulatory frameworks that support sector coupling and the integration of various energy sources. This includes creating policies that facilitate the adoption of innovative technologies and business models.
- **Invest in data infrastructure**: Allocate resources towards improving the quality and accessibility of energy data. High-quality data is crucial for accurate modeling and informed decision-making in energy planning.
- **Emphasize resilience and affordability**: In all energy planning and policy measures, prioritize the resilience of the energy system and the affordability of energy for consumers. This ensures that the transition to clean energy is sustainable and equitable.
- **Support innovation in energy technologies**: Foster an environment to drive technological innovation, particularly in areas like hydrogen production, electric vehicle integration, and renewable energy sources. This support can be through funding research, providing incentives for development, or facilitating public-private partnerships.

Scene Setting

Asami Miketa from IRENA welcomed participants and noted the need for an integrated approach to energy planning. Further, it was noted that innovation not only encompasses technology but also includes regulation and business models. Therefore, the current session will focus on sector coupling in energy planning.

It was noted that the sector-coupling dimension in long-term energy planning is presented differently in different countries, as some already incorporate all sectors in their energy planning. An inter-sectoral approach requires collaboration from multiple ministries and agencies.

Electrification of end-use sectors is one of the key solutions for climate-compatible growth. Power to Methanol (PtM), Power to Heat (PtH) and Power to Hydrogen (PtH2) are key aspects in the electrification discussion. In energy planning, direct and indirect electrification pathways and planning smartly to optimise infrastructure are necessary.

Sector coupling in LTES was identified as one of the priority areas by LTES members and partners. As the first discussion of sector coupling under the LTES Network, the outputs of this session will be used to map out key considerations that scenario practitioners need to incorporate when including sector coupling aspects in long-term energy scenarios and will shape future discussions within the LTES Network.

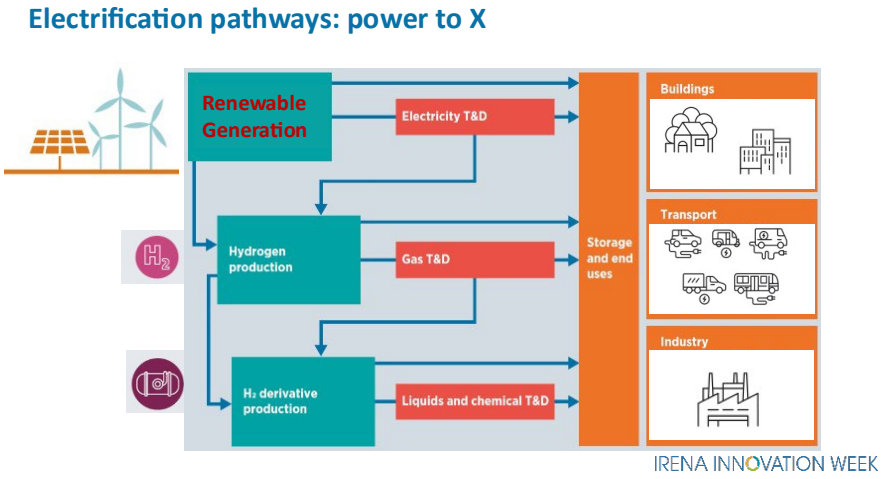


Figure 1: Illustration of electrification pathways: power to X

Angela Mutsotso from IRENA made a presentation where she noted that sector coupling in LTES is important for several reasons, including:

- Decarbonization of multiple sectors: Sector coupling in LTES ensues the integration of all sectors aside from only the power sector.
- Increased flexibility and system resilience: There is a need for more flexibility to handle fluctuations in the energy system. A sector coupling approach allows for the planning of energy storage and the incorporation of additional technologies aside from batteries.
- Economic efficiency: Integrating sectors can lead to better utilisation of infrastructure and energy resources, for instance, using renewable energy sources for hydrogen production.
- Holistic energy system planning: Sector coupling in LTES ensures that planners take a holistic approach, addressing interdependencies, synergies, and potential bottlenecks.
- Stimulating innovation: By linking traditionally isolated sectors, new solutions and business models can emerge, including vehicle-to-grid and demand-side response.
- Meeting climate goals: many hard-to-abate sectors cannot decarbonise without sector coupling.

It was noted that sector coupling is pivotal in connecting and electrifying all sectors, enhanced by power-to-X and hydrogen-to-X strategies. Flexibility remains a key concern in various aspects, including integrating hydrogen production, electric vehicle charging, demand side response, and thermal energy storage. Additionally, it was noted that collaboration with all players, especially Transmission System Operators (TSOs), is key to ensuring that the electricity infrastructure evolves in line with the changing energy landscape.

Scenarios heavily influence policymaking, and the inclusion of sector coupling in scenarios communicates the need for a holistic approach to policymaking. Various examples from the International LTES Forum 2022 and the 2023 Innovation Landscape Report were given to set the stage for the discussion, including an example from Spain on how they are incorporating global hydrogen insights into national LTES.

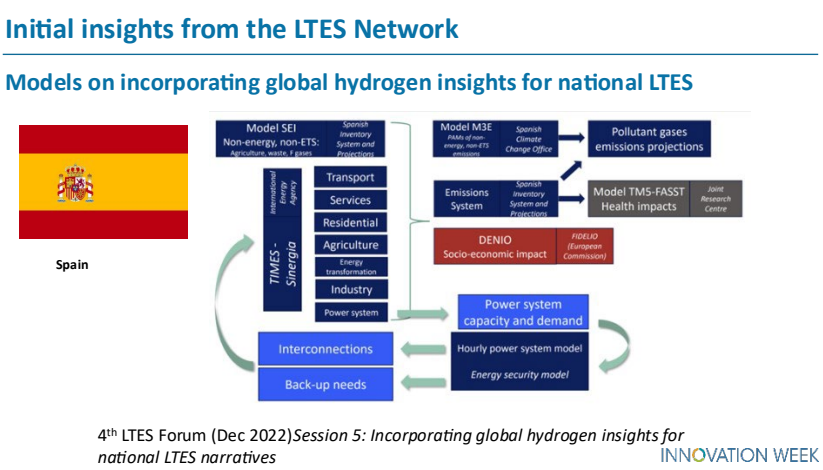


Figure 2: Incorporating global hydrogen insights for national LTES Narratives

Panel Discussion

Initial Remarks

Christopher Gross, *GET. Transform Team Lead, GIZ,* noted that GET. Transform as a technical partner to LTES Network and highlighted the relevance of the sector coupling discussion for the LTES Network.

Kaare Sandholt, *Chief International Expert China Energy Transformation Programme, Energy Research Institute of the Academy of Macroeconomic Research (ERI)* noted that ERI releases an annual energy outlook that considers the whole system. China's industrial sector is large and mainly dependent on fossil fuels. However, there are plans to incorporate hydrogen in the transport and industry by 2060. It was noted that there is a plan to ensure more efficiency in 2060 as the system will be mainly dominated by wind and solar.

The energy flow chart for the 2060 ambitious scenario shows that sector coupling is embedded in the system. The challenge, however, is how to model the 2060 flow chat (Figure 3). The major trends expected in the 2060 outlook include energy efficiency in end-use sectors, electrification in industry, transport and building sectors, the power system becoming the energy provider and a fossil fuel phase down and phase out. It was noted that it is necessary to use high-quality data and modelling tools while incorporating sector coupling to influence policy measures that will enable a smooth energy transition.

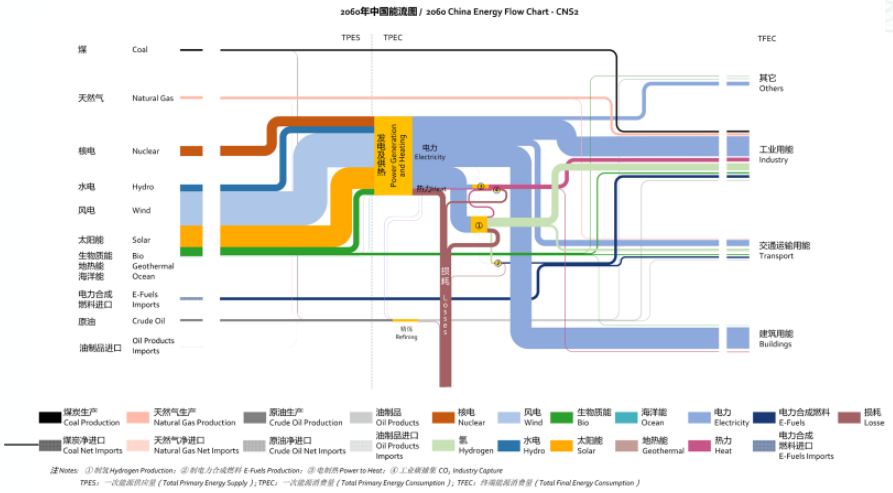


Figure 3: 2060 China Energy Flow Chart

Claire Nicolas, *Senior Energy Economist Energy Sector Management Assistance Program (ESMAP), World Bank* noted that the World Bank's work in sector coupling is fairly new. Until a few years ago, modelling focused on the short to medium term and in-house modelling tools only focused on the power sector but not the whole energy sector. There has been a move to explore the link between development and climate change, and incorporate 20-30-year forecasts.

It is important that sector coupling is incorporated into models, and to this end, there are several models, including the TIMES model used at the national level.

Martin Hartvig, *Senior Engineer, Energinet* noted that sector coupling is key as it involves planning for the future. Modelling is helpful, but there is a need to account for sudden large changes; for instance, moving to 50% wind in the Danish system was manageable, but moving to 100% is more taxing. Energinet has worked on modelling hydrogen into the energy system, which will be discussed further.

Highlights from Moderated Discussion

1. **Key Considerations for Sector Coupling**
   - Martin Hartvig noted that Energinet has taken a multisector approach to energy planning where the state-owned TSO incorporates gas into the power grid. It is necessary to make sure investments are in line with the entire energy system. Given the transition from gas to power for heating, an integrated system approach is necessary. It is vital to combine a system approach with a resource approach.
   - Claire Nicolas noted that the key considerations on sector coupling that the World Bank has incorporated have been focused on expanding energy planning from the power system to the whole energy system. The next step in expanding energy planning is to include the transport system, as fleet electrification is already ongoing, and electric vehicle demand will impact overall power demand massively. It was noted that there should be a focus on heating and cooling and its decarbonisation, mainly in Eastern European and Southeast Asian countries.

- In response to the question on the critical trade-offs addressed during planning and whether China weighed direct vs indirect electrification, Kaare Sandholt noted that for Least-Cost Optimisation, direct electrification is preferable; however, hydrogen will be incorporated into the energy system when direct electrification is not possible. China plans to make full investments in grids and to ensure energy and cost efficiency. Innovative technologies will play a key role in optimising China's energy system. Finally, it was noted that Denmark has more opportunities for creating demand flexibility as it is possible for consumers to choose their suppliers as compared to China.

2. Is the least cost option enough to induce behavioural changes on the demand side?

- In response to the question of whether a purely economic approach, specifically the least cost option, is enough to induce behavioural changes on the demand side. Kaare Sandholt noted that energy planning in China is not purely driven by economic considerations but by targets, including the Net Zero target. China is currently working with low-carbon targets and is not necessarily planning to accelerate the phase-out of coal capacity but to use it for hydrogen production. In this way, net zero will eventually be achieved.

- Martin Hartvig noted that the least cost metrics and other national goals drive energy planning in Denmark. Resource potential also plays a key role in shaping the results, and it is important to look into viable vs not-viable futures and select the best solution.

- Claire Nicolas noted that the least cost solution can be different from the absolute least cost, but both can achieve a lot in terms of decarbonisation. This is where modelling analysis shows its value as it allows for the testing of different pathways, identifying outliers and evaluating the consequences of different decisions in terms of climate impact.

3. How is cross-ministerial coordination and stakeholder engagement incorporated into the planning process?

- Kaare Sandholt noted that ERI is a think tank which informs policymakers on potential pathways. As such, it does not have a comprehensive stakeholder process, as the institute focuses on creating scenarios and making recommendations. Following the announcement of dual climate goals for China, ERI has created multiple scenarios for different sectors.

- Martin Hartvig noted that Energinet involves multiple stakeholders across the whole supply chain, including manufacturers and a consortium of wind power producers in Germany and the Netherlands. Energinet involves researchers and academia when considering where offshore cables should connect to land and health and safety specialists. Stakeholder involvement is vital when planning for the future deployment of hydrogen grids and the incorporation of future innovations and technologies.
    - In response to the question on how Energinet reaches a consensus with the different stakeholders, it was noted that they do not necessarily reach a consensus but choose the lowest cost option during the tendering process. Currently, tenders are assessed

based on the amount of electricity produced, but in future, they will focus on electricity production and transmission aspects.

4. **Possible challenges related to sector coupling in the future**
   - Claire Nicolas noted that coordination with stakeholders is one of the main challenges due to the differences in skills and understanding in different sectors, as the modelling and scenarios in the power, transport and heating sectors are not the same. As such, there is a need to educate all stakeholders to ensure uniformity of understanding.
     - Data collection is another challenge, as data quality is not the same across the entire economy. There is a need for better data collection and coordination with the changing political climate.
     - Markets play a key role, and it is vital to design markets to steer investment to where they are most needed.
   - Kaare Sandholt noted that lack of quality data is one of the biggest obstacles, given that the future is uncertain. The role of modellers is not to predict the future but to inform policymakers on different options and pathways. When modelling the future, it is vital to identify which measures and regulations are necessary, how to stimulate the market and identify the innovation pathways necessary for the desired future.
   - Martin Hartvig noted that Denmark has invested extensively in technology; and transparency around technology cost is vital. There is also a need for better and more accurate data to ensure more accurate models.

5. **What role does the LTES Network play in terms of knowledge exchange?**
   - Claire Nicolas noted that data collection and data sharing are important, and the LTES network plays a key role in sharing lessons on coordination and consultation.
   - Kaare Sandholt noted that the network's role of sharing experiences is important, and it is helpful to continue sharing lessons on the different ways of modelling and scenario design. The network should consider sharing lessons on how models are developed and used in light of the energy transition.

Question and Answer Segment

Would the first mover suffer from high costs? Would the nature of this change reward or penalise the first mover? What can we do to mitigate this?

- Martin Hartvig noted that very few people are willing to be the first mover. To remedy this issue, Denmark has an energy data hub which allows live tracking of prices. Transparency and data are vital in lowering costs and reducing the economic risks that first movers face.
- Kaare Sandholt noted that, in some cases, it is not risky to be the first mover, but it is often risky to be the last mover. He noted that with technologies that are scalable and have a steep learning curve, people gain more by being the first mover, and governments should reward the first movers.
- Claire Nicolas noted that developing countries often have a dilemma regarding whether to invest in renewable energy. As the energy industry is fast changing, some countries choose to

wait and take advantage of developments in one go as the affordability of energy is a key concern.

What is the role of Medium-Duration Energy Storage (MDES) and Long-Duration Energy Storage (LDES) in LTES?

Martin Hartvig noted that the role of MDES and LDES changes depending on the global location. In Denmark, there is more renewable energy than needed, and if there are enough electrolysers, then MDES will barely be needed as electrolysers function as LDES. It was noted that incorporating storage into modelling is complex as it is difficult to incentivise the entire value chain. More research in collaboration with other organisations is needed on this aspect.

How accurate should Long-Term modelling be? How often should they be updated?

- Claire Nicolas noted that the World Bank has been working on sector coupling for a few years; as such, when disruptions arise, adjustments will be necessary. Regarding modelling accuracy, the TIMES mode is used in the Balkans; however, if a country is particularly interested in trade, different models should be used. It is necessary to build interconnectors to ensure the accuracy of modelling results.

Given that every long-term scenario is not 100% accurate. What is the value of these scenarios?

- Martin Hartvig noted that scenarios help conceive pathways to a desirable future. Energinet is currently developing a study on the progress towards achieving net-zero goals.
- Claire Nicolas noted that the scenarios are about exploring different futures in consultation with different stakeholders. Key considerations such as resilience and affordability must be identified to aid the creation of useful scenarios.
- Kaare Sandholt noted that scenarios allow countries to explore different pathways and consider various risks and opportunities.

How is backcasting conducted to ensure that key milestones are identified and achieved?

- Kaare Sandholt noted that backcasting is vital when planning. He noted that China plans for 5-year periods and is currently incorporating aspects including investments in renewable energy sources, electrification, and reducing the reliance on coal. Between 2030-2040 the focus may be on massive electrification, decarbonisation, and renewable energy investment. Between 2050 and 2060, the focus will be on consolidated re-investments in the existing energy system.
- Martin Hartvig noted the need to build a hydrogen grid, plan for the hydrogen market and plan for proper regulation in preparation for 2050. Backcasting would play a vital role in planning for the emerging hydrogen market; it was noted that transformation and innovation in the energy system are vital.