Modelling Net-Zero Scenarios -
Progress and Methodological Challenges

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IRENA Side Event - Insights from net-zero LTES for national energy planning

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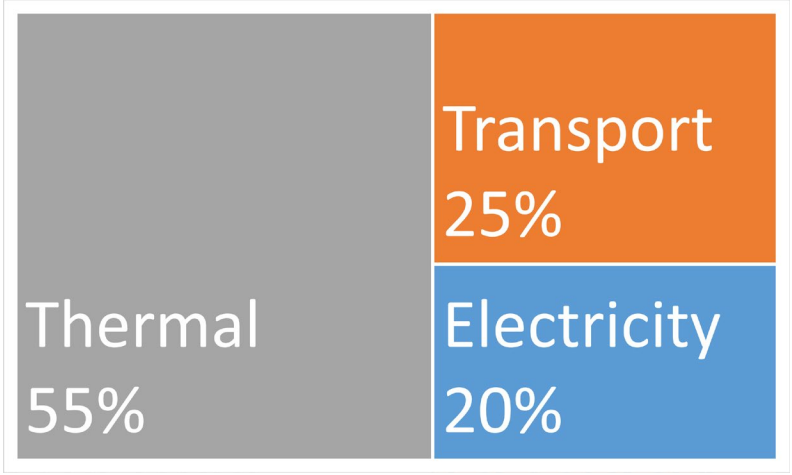
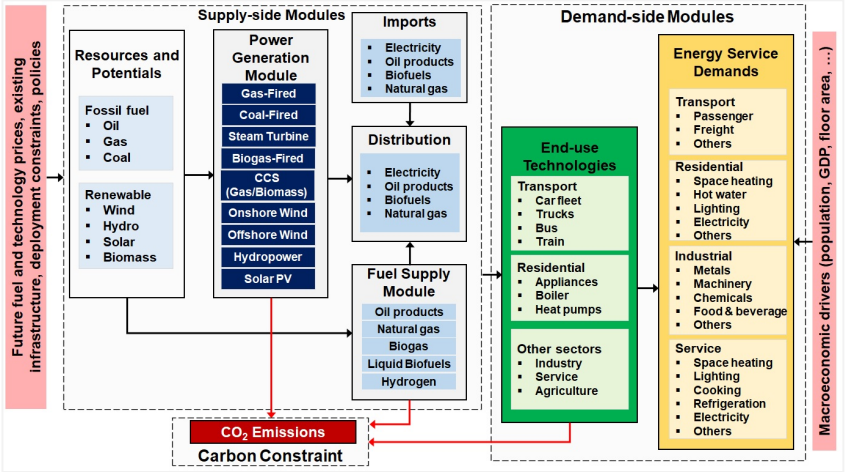
Energy systems modelling for decision making

- Energy policy and planning is more and more complex and uncertain (urgency of climate action, security of supply, impacts on economy and society).
- Energy systems **optimisation** modelling seeks least cost evolution of **whole** energy system using **TIMES –** technology rich (i.e. > 1,300 technologies).



Global Energy Use

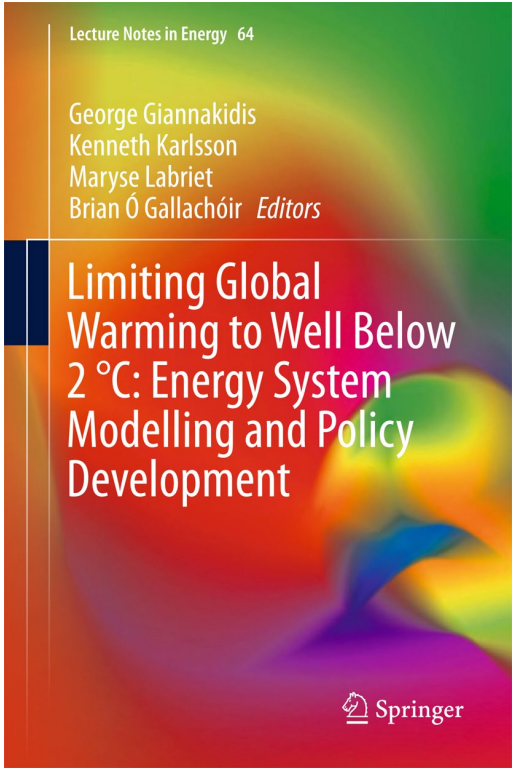


TIMES reference energy system

Modelling Net Zero Scenarios – National and Global

- explores feasibility of a *well-below-2°C* world
- energy system pathways and technology innovations
- behaviour change and the macro-economic impacts
- chapters directly related to the NDCs

>20,000 downloads



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CLIMATE POLICY
2019, VOL. 19, NO. 1, 30–42
https://doi.org/10.1080/14693062.2018.1464893

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RESEARCH ARTICLE

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Zero carbon energy system pathways for Ireland consistent with the Paris Agreement

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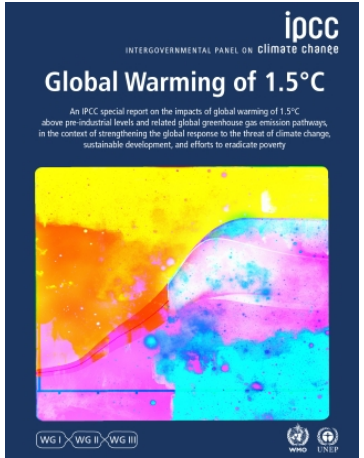
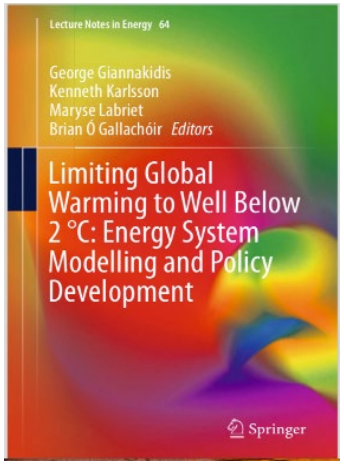
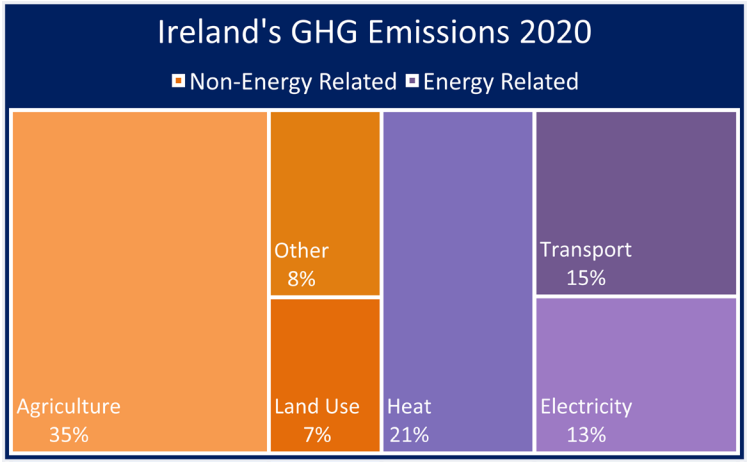
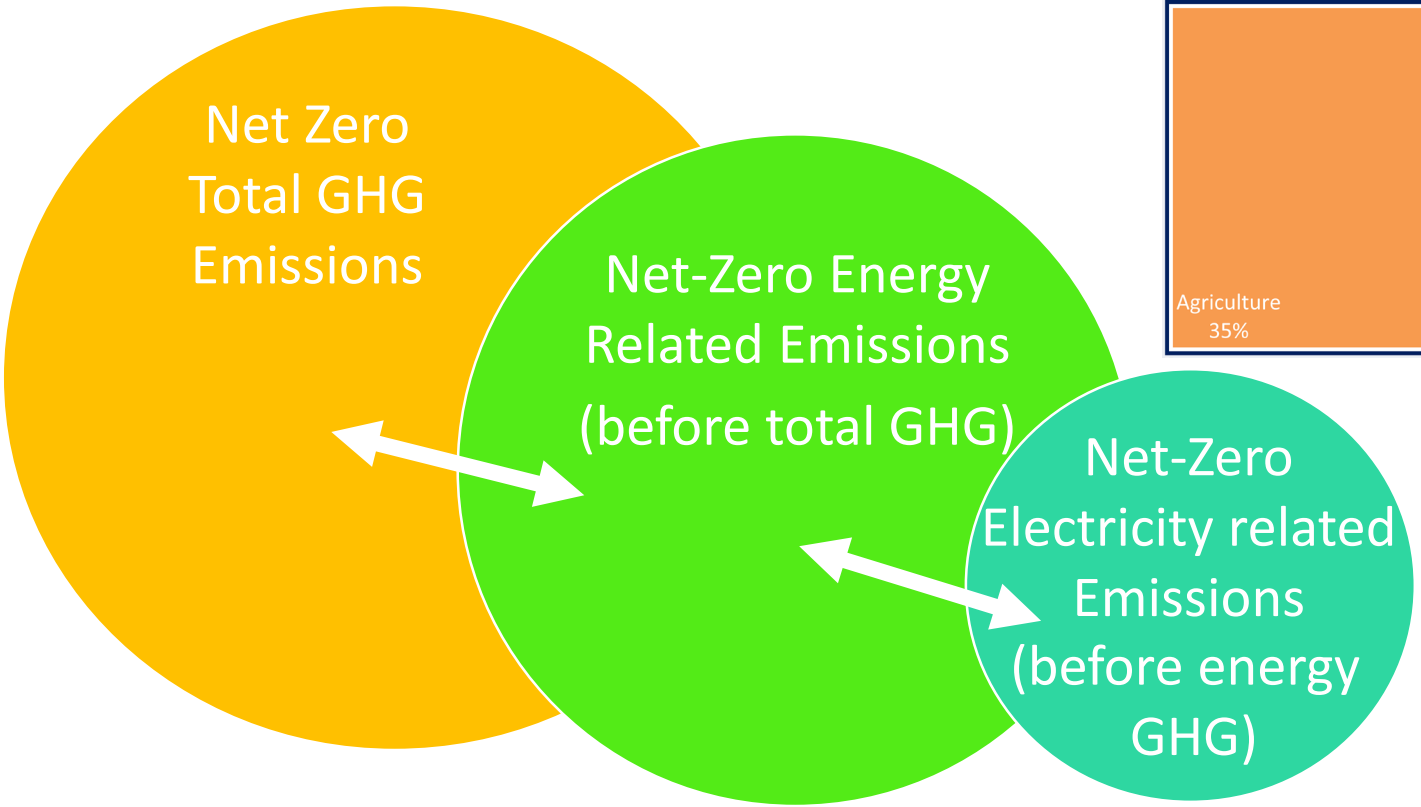




Net Zero Emissions





Key Learnings Net Zero Scenarios

- **immediate mitigation** action is absolutely required.
- negative emissions technologies (NETs) have a **crucial role**
- delaying action makes pursuing the **1.5 °C goals unachievable without** extremely high levels of NETs
- greater focus on emission reductions in the **demand sectors** is essential
- that focusing only on technological development is **likely not to be sufficient**
- reducing **energy-service demands** is also essential

Key Insights National Net Zero Scenarios I

- **Sweden -** Electricity, district heating and space heating can be close-to-zero emissions by as early as 2025.
- **Denmark** - ban on the sale of the internal combustion engines in 2025 would enable the largest cut in cumulative GHG emissions
- **Switzerland** - electrification and efficiency the key pillars in achieving decarbonisation, and new business models for smart grids, storage and power-to-gas
- **France -** policymakers must ensure consistency between the evolving lifestyles and the need to decar-bonize the economy

Key Insights National Net Zero Scenarios II

- **Ireland** - A 1.5^{o} compatible carbon budget is technically feasible, but extremely challenging with the current technology assumptions and can only be achieved through much stronger near-term mitigation
- **Portugal -** electrification of final energy consumption, especially through EVs, heat pumps (buildings) and dryers and kilns in industry
- **Canada** - efficiency, electrification, bioenergy, and the rapid decarbonisation of electricity production. Canada would benefit from greater cooperation between Canadian jurisdictions
- **Australia -** electricity and transport sectors can achieve the greatest emissions reductions of 70–80% by 2050.

Methodological Strengths

1. **Whole energy system** – rates of electrification and other sector coupling endogenous within TIMES models
2. **Technology richness** – detailed technical, economic and environmental information on (>1,300 technologies)
3. **TIMES modelling community** – IEA TCP ETSAP tools are used by approx. 200 modelling teams in 70 countries providing a significant resource for learning, updating and improving methods
4. **Variable renewables –** significant progress in integrating short term operational power systems constraints into long term energy planning

Methodological Limitations

1. **Societal aspects** – while our understanding of technology and economics of transitions improves, significant gaps remain on societal dimensions
2. **Energy security** – the decision to phase out imports of fuels from Russia has significant implications and methods to ensure energy security in scenarios requires further attention
3. **Mission oriented decarbonisation** – as we fail to reduce emissions and climate action urgency grows, new methods are required to understand mission oriented decarbonisation (learning from COVID-19 responses)

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