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Energy Systems Modelling Analytics Ltd

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Experience in integrating supply chain uncertainties in energy planning/LTES

Open TIMES USA (OTUS)
Open TIMES All Island (OTAI)

Dr James Glynn

2025.10.30 | IRENA | Bonn, GERMANY

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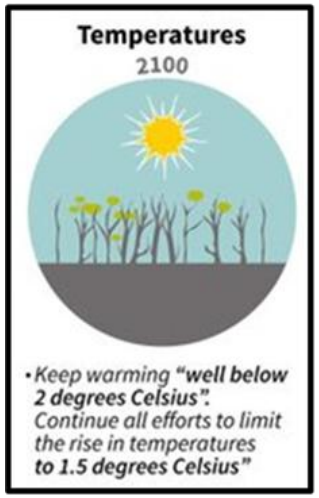
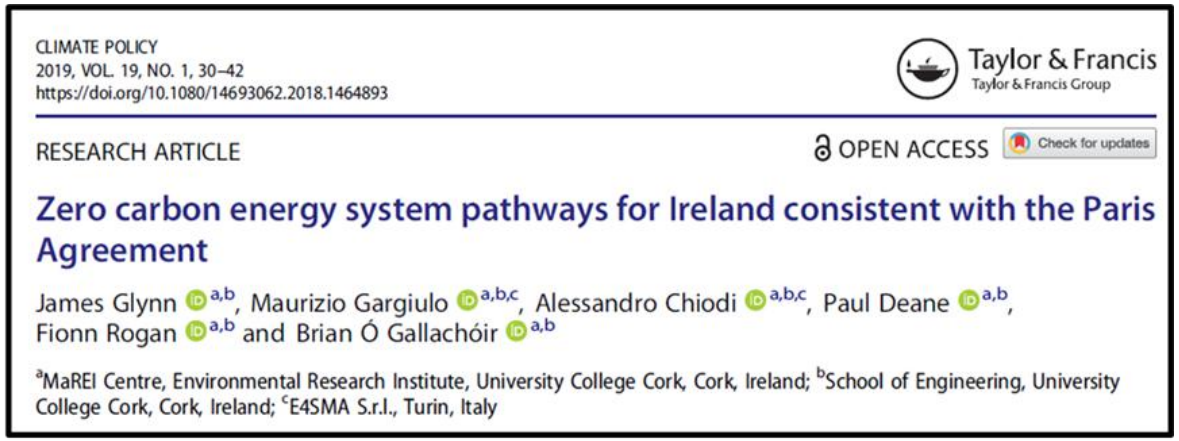
Outline

- Critical Minerals in TIMES Reference Energy Systems
- Open TIMES USA (OTUS)
  - Fossil Mineral Energy as a Weapon
  - Critical Minerals the new Energy Weapon
  - Geopolitics of Energy Technologies Trade & Impacts
- Open TIMES All Island (OTAI)
  - High Shares of VRES
  - Highest Share of DC as % of ELC TFC.

Open Modelling Research Informing Engineering planning, Science, & Law




CLIMATE POLICY
2019, VOL. 19, NO. 1, 30–42
https://doi.org/10.1080/14693062.2018.1464893
Taylor & Francis
Taylor & Francis Group
RESEARCH ARTICLE
OPEN ACCESS
Check for updates

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

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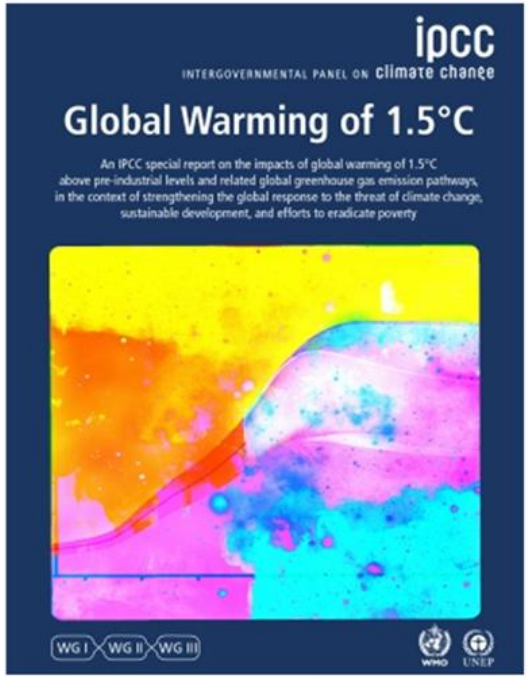



Home > Acts > 2021 > Climate Action and Low Carbon Development (Amendment) Act 2021

Climate Action and Low Carbon Development (Amendment) Act 2021

View by Section | View Full Act | Bill History | Commencement, Amendments, SIs made under the Act | Open PDF | Print Full Act

Previous Section | Next Section | Print Section

Climate reporting

15. (1) The Principal Act is amended by the insertion of the following section after section 14:

"**Climate Reporting**

14A. (1) The Minister shall, in each year after the publication of the annual report and the Agency's reports, at the written request of a joint committee, attend before it to give an account, for the period of the annual report, of the following matters:

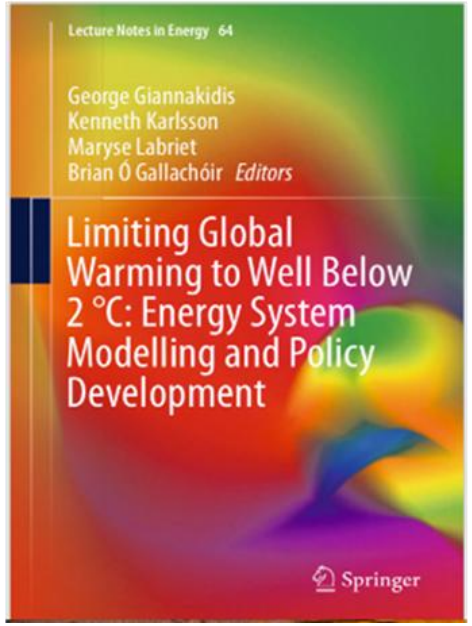
(b) whether there has been a reduction or increase in greenhouse gas emissions based on the Agency's reports;

(d) the implementation of adaptation policy measures under the most recent approved national adaptation framework.

(2) Each Minister of the Government shall, in each year after the publication of the annual report and the Agency's reports, at the written request of a joint committee, attend before it to give an account, for the period of the annual report, of the following matters:

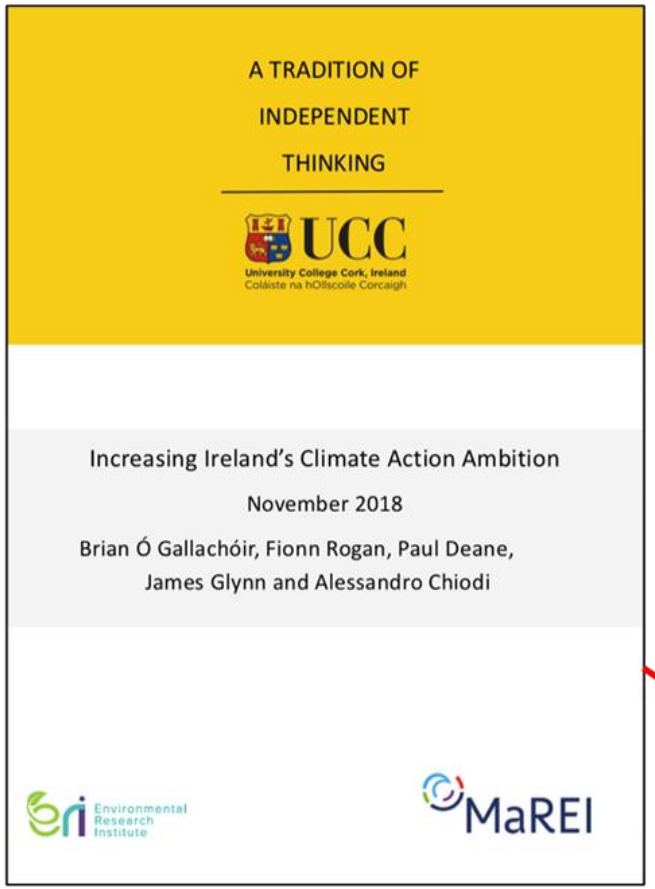
(3) For the purposes of subsection (2), each Minister of the Government shall, in relation to the sector for which the Minister of the Government has responsibility, give an account, for the period of the annual report, of the following matters:

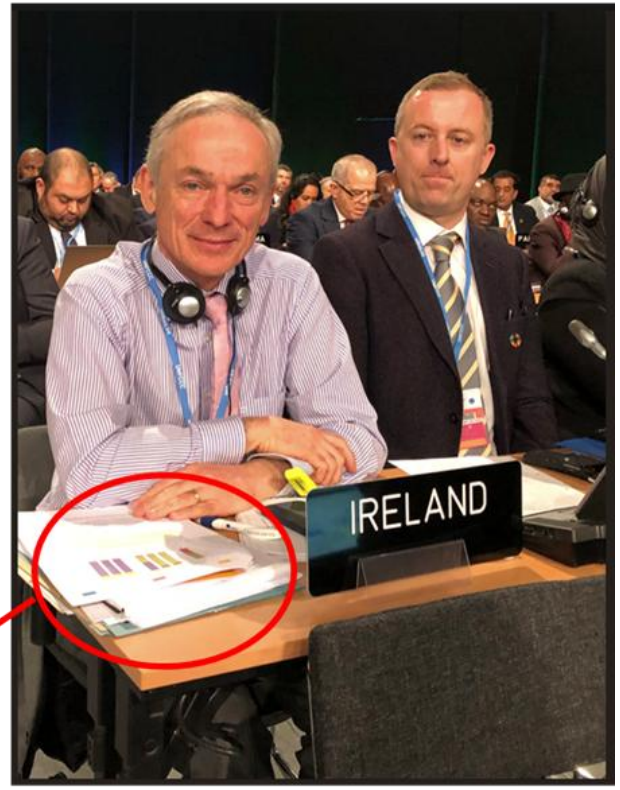
IRELAND CARBON BUDGET LAW in Statute Book



Co-Created Modelling Research Informing International Policy Negotiation & Law

National Policy Impact





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Critical Minerals In ESOMs

Some Context from IEA Energy Technology Perspectives

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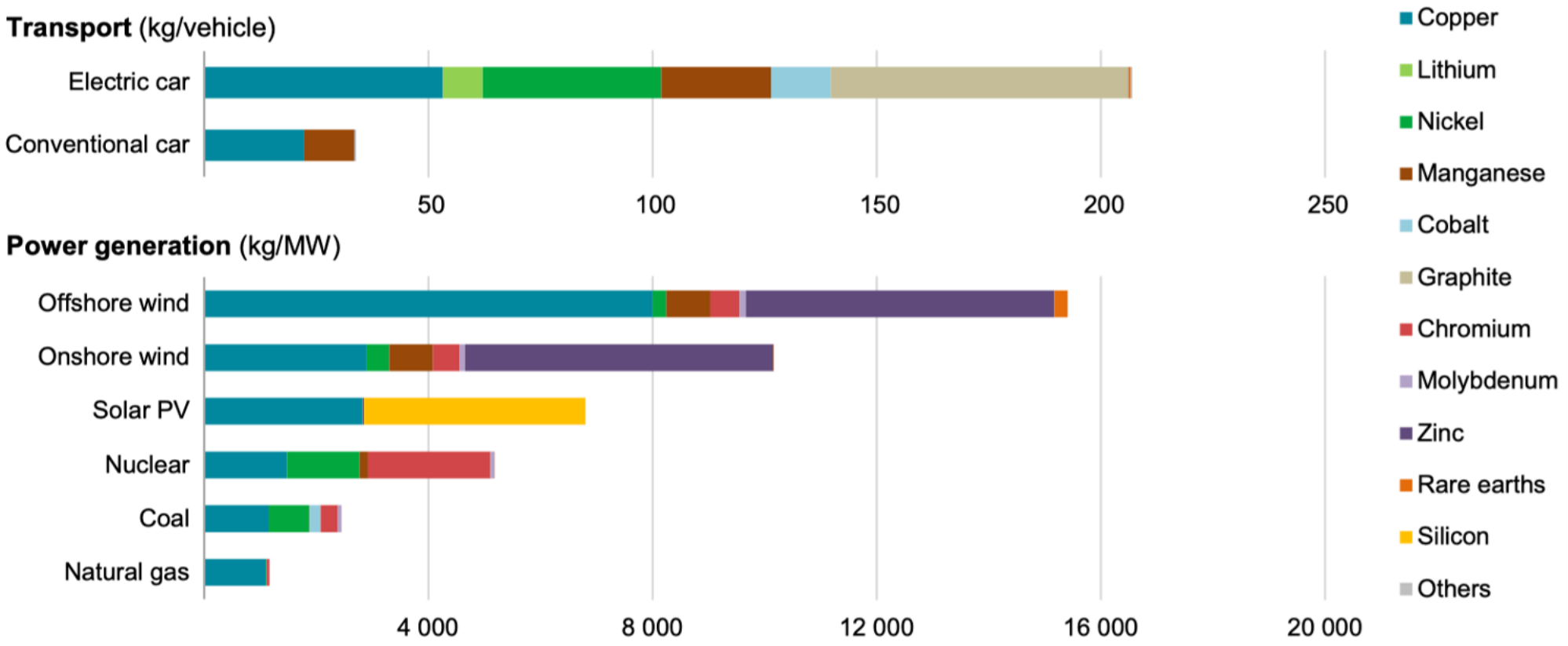
Critical mineral intensity

Critical minerals supply will dictate the pace of the energy transition as their price directly affect technology costs and cost reductions.



Minerals used in selected clean energy technologies (IEA 2022 – The role of critical minerals in clean energy transitions)

Source: IEA, 2022, The role of critical minerals in clean energy transitions

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Open TIMES United States of America (OTUS)

Role of CM in Constraining VRES

… CM in Constraining Transmission

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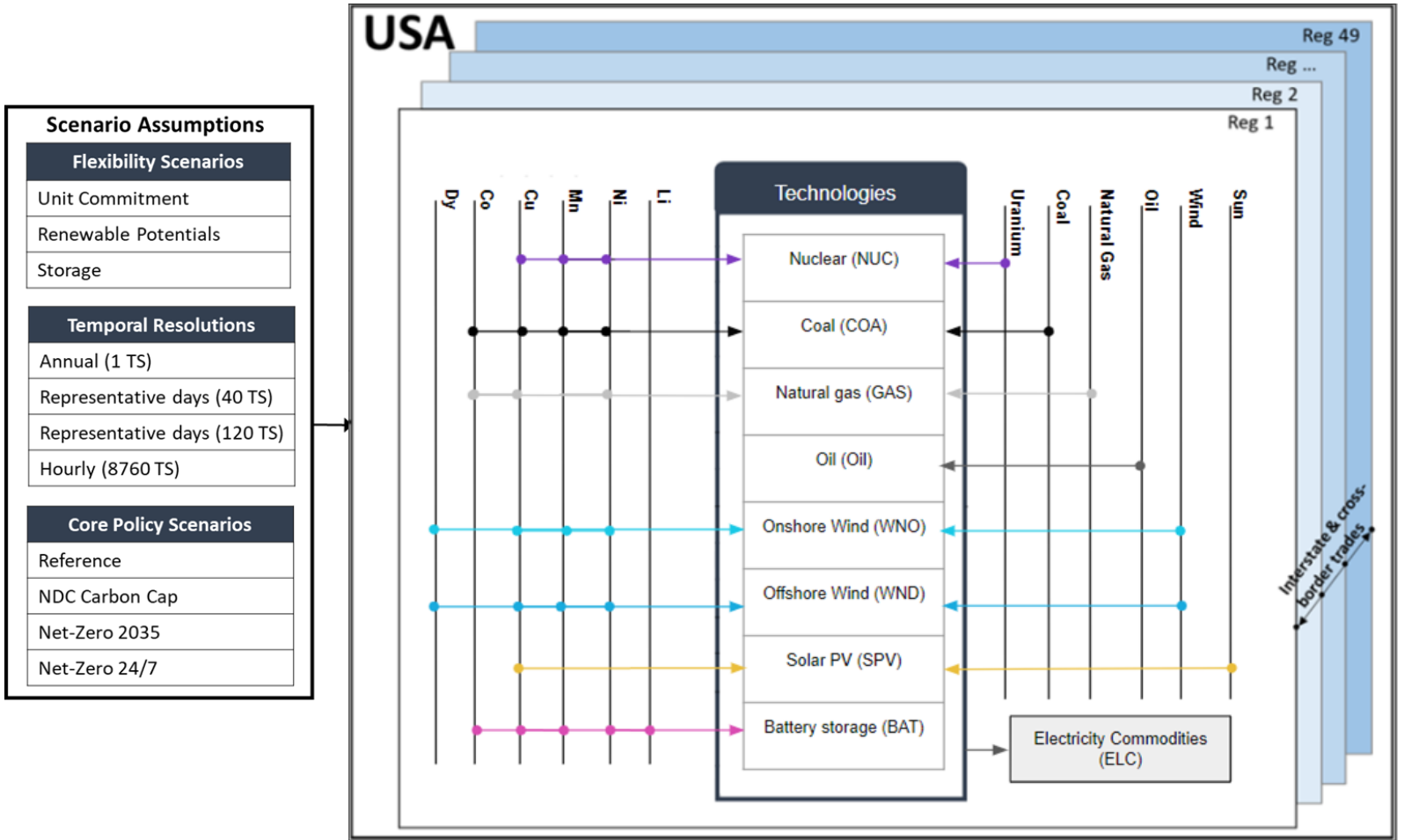
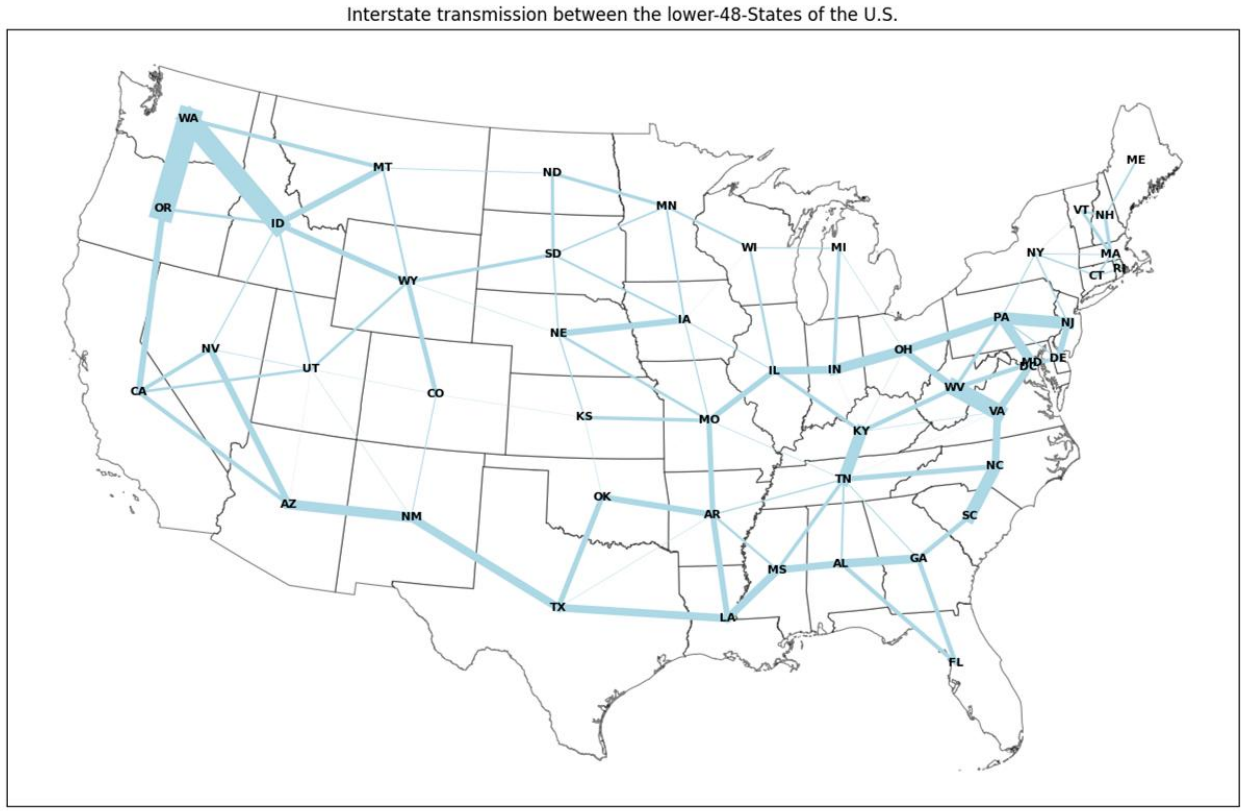
Hybrid Energy & Materials RES Schema

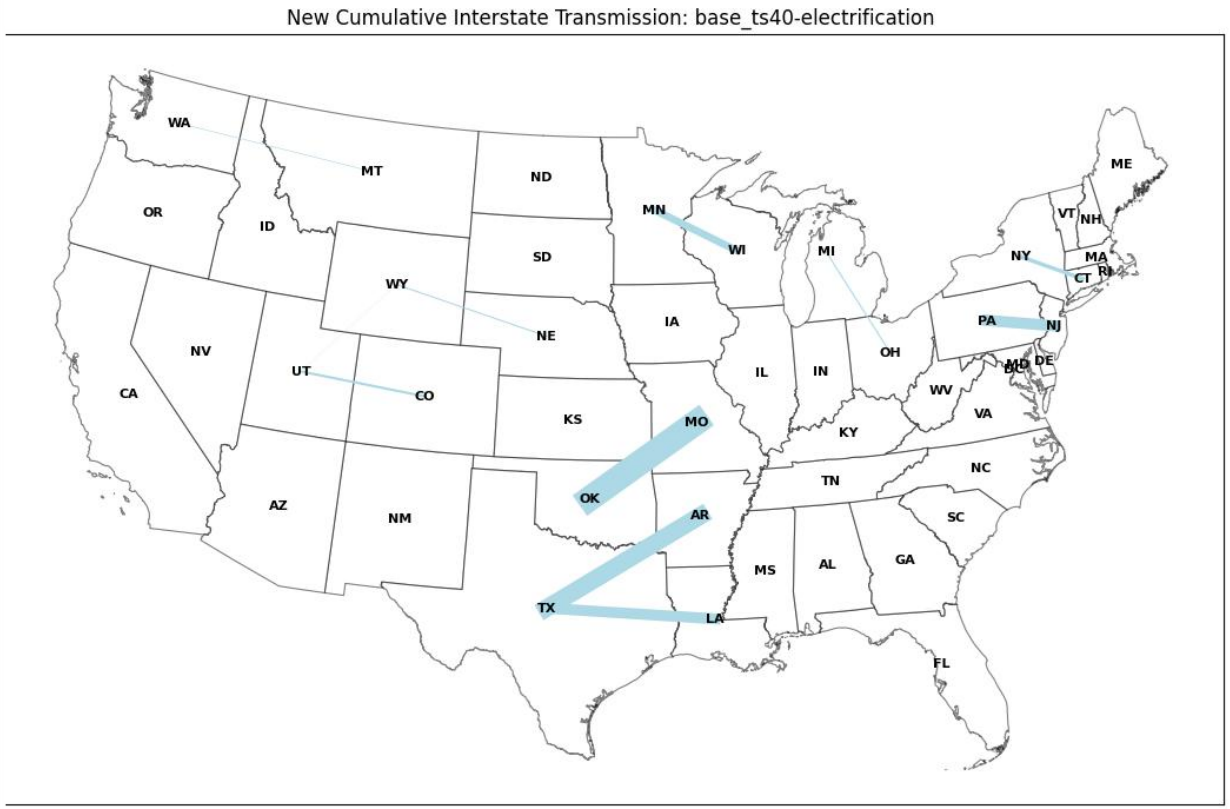
Adding 50 USGS Critical Materials to the Reference Energy System (RES) Topology



Transmission infrastructure: baseline

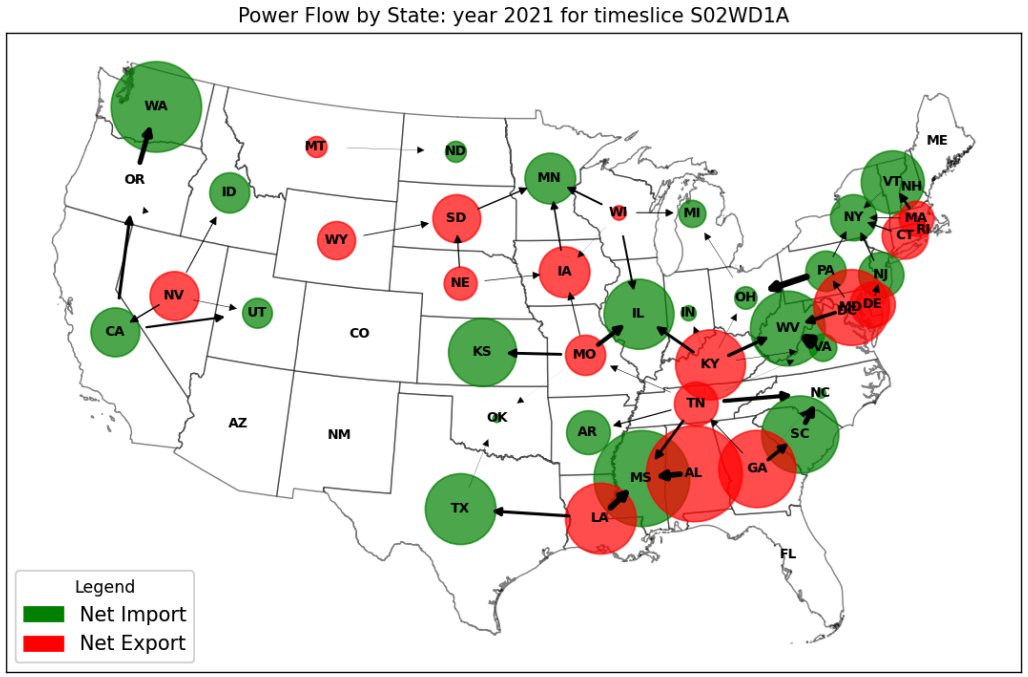
We must consider Copper and Aluminium embodied in Transmission & Substation Hardware

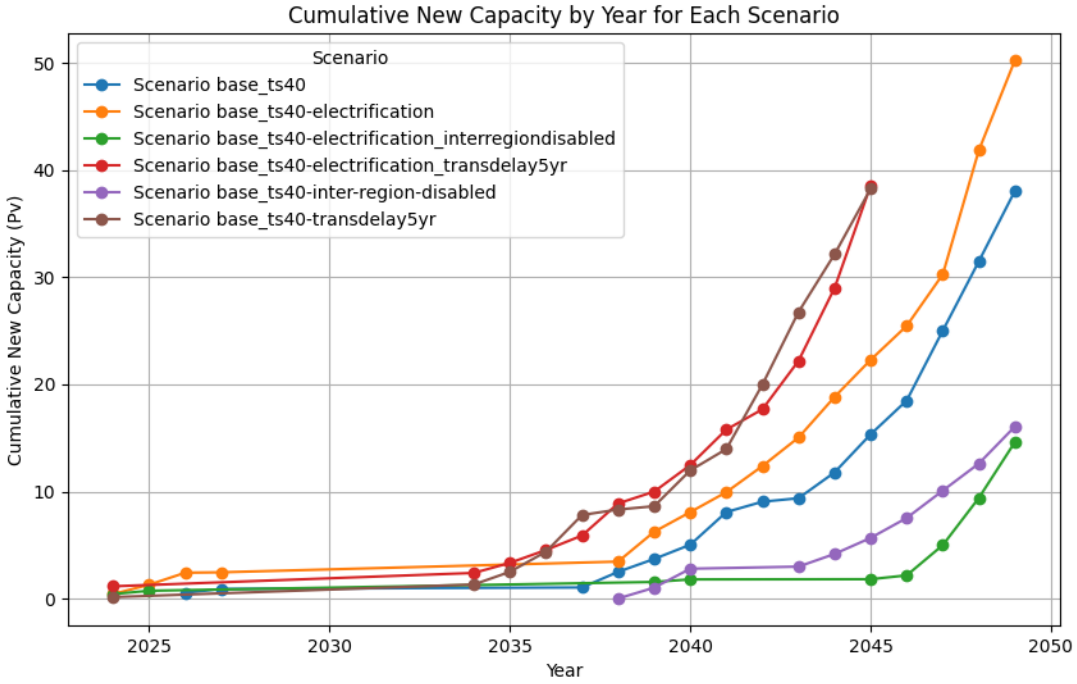




Hybrid Energy & Materials RES Schema

Hourly Supply Demand Balancing between Coastal cities and Energy Potential states drives transmission demand - non technical and geopolitical barriers to Transmission



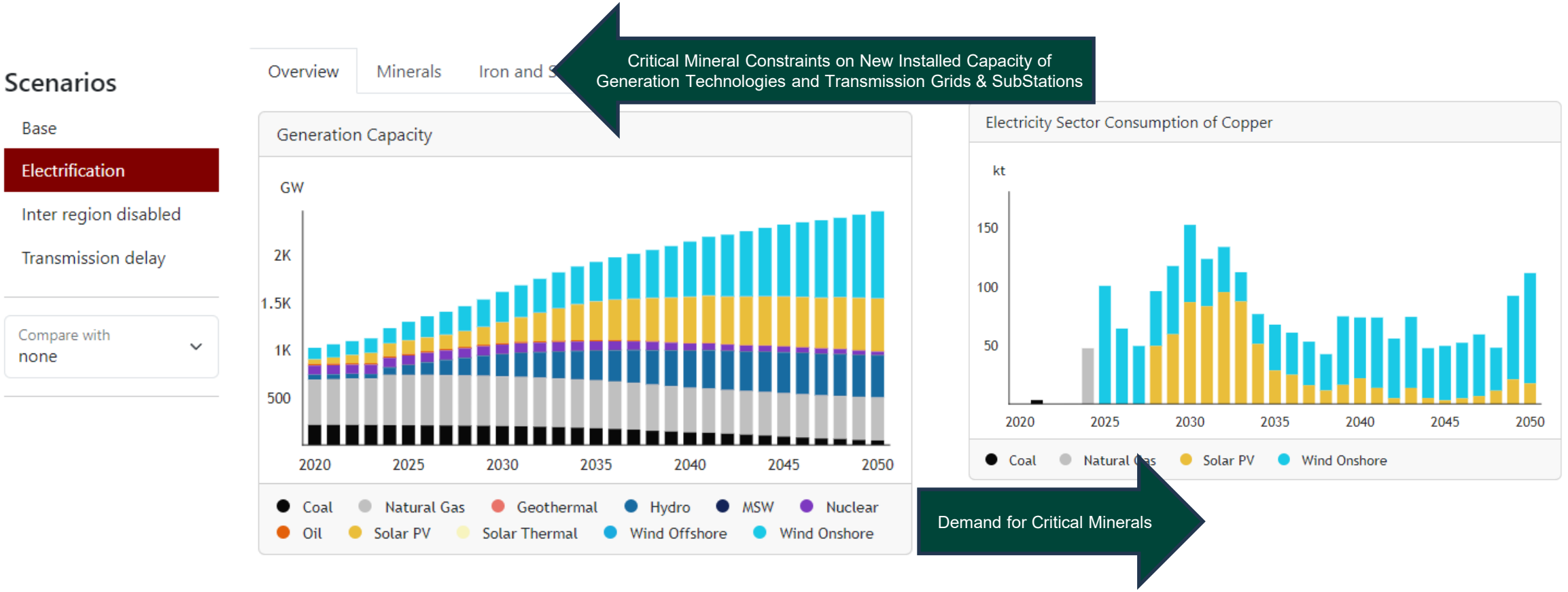


TimeSlice 10

Year 1

Results: optimising for cost, CO_2 with geopolitics weaponization of CM trade

New Installed Electricity Capacity Drives endogenous CM [#50] demand.
Endogenous Traded CM Constraints and re-optimised and distribute



Results Dashboard URL:https://esma-playground.netlify.app/tusm-transmission-study/results/minerals
Results data in open public Github Repository: https://github.com/esma-cu/tusm-transmission-study

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Open TIMES All Island – OTAI

Very High VRES Penetration

Highest % Penetration of Data Centres

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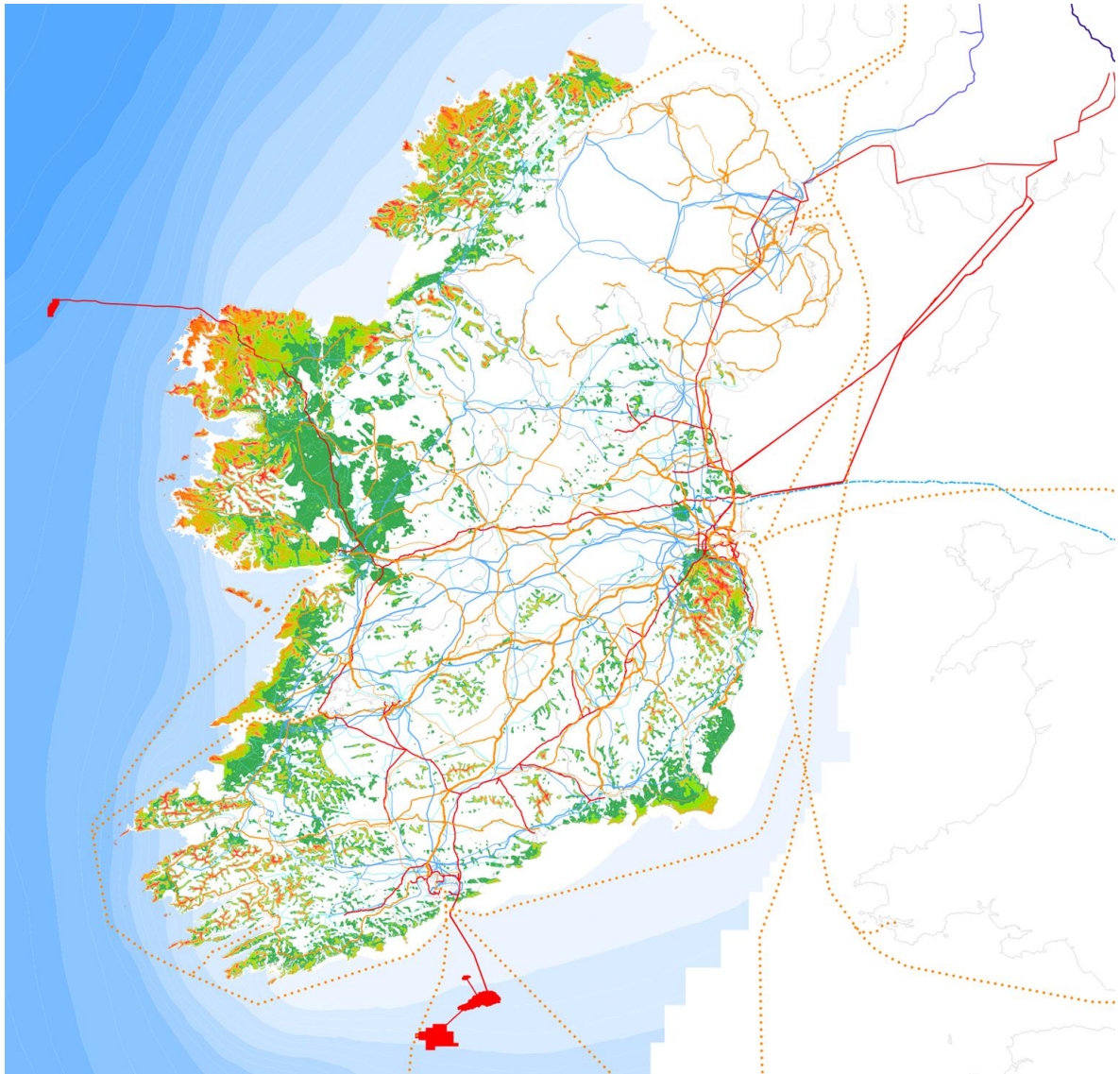
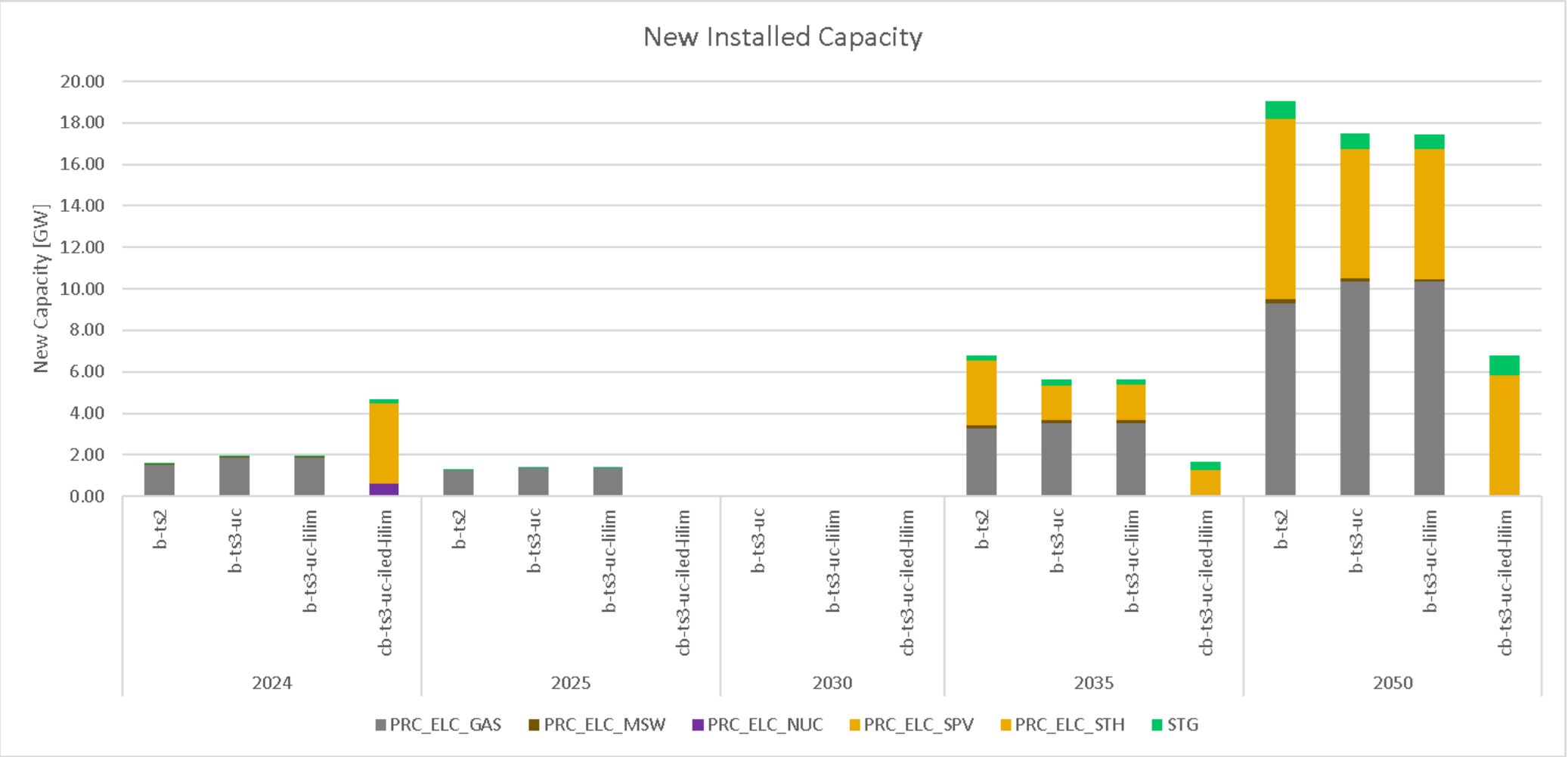
Open TIMES All Island (OTAI) - An experimental dev model

1. Setup as a 2 region (IE (Republic) + NI {UK}) power system model with existing individual geolocated power plant units, wind turbines, solar farms.
    1. Technology stock from EIRGRID GCS and Open Street Maps Infrastructure.
    2. Future Tech from NREL ATB & EIA
2. Demands are derived in the short term from EIRGRID GCS (GDP, DC, EV), and long term from SSP narratives from GDP/Capita correlations
3. Renewables Availability Factors (AF) are derived from MÉRA renalysis in the short term and ISIMIP in the long term
4. Renewables Capacity factors can take into account Dispatch Down and grid constraints based on history or narratives.



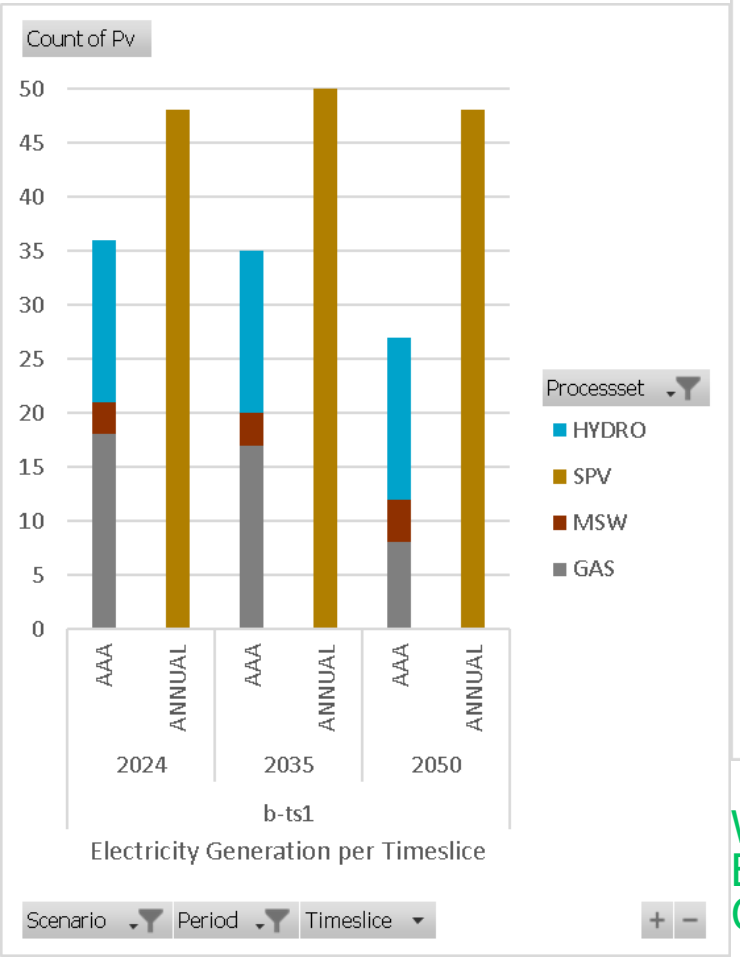
Optimsed new ELC Capacities with embodied critical mineral Limits

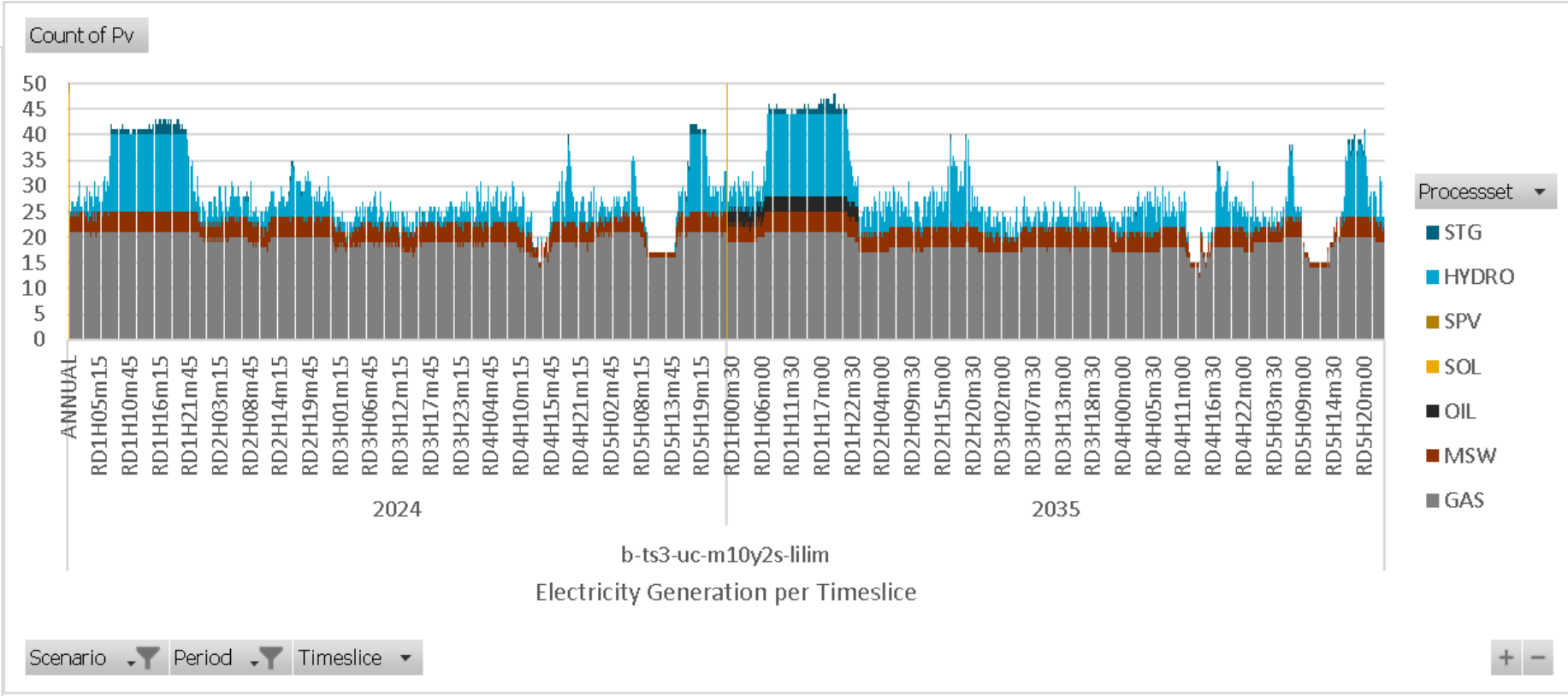
Typical ESOM Vs High temporal and technical granularity with CM and Trade constraints



Hybrid Energy & Materials RES Schema

Typical ESOM Vs High temporal and technical granularity with CM and Trade constraints





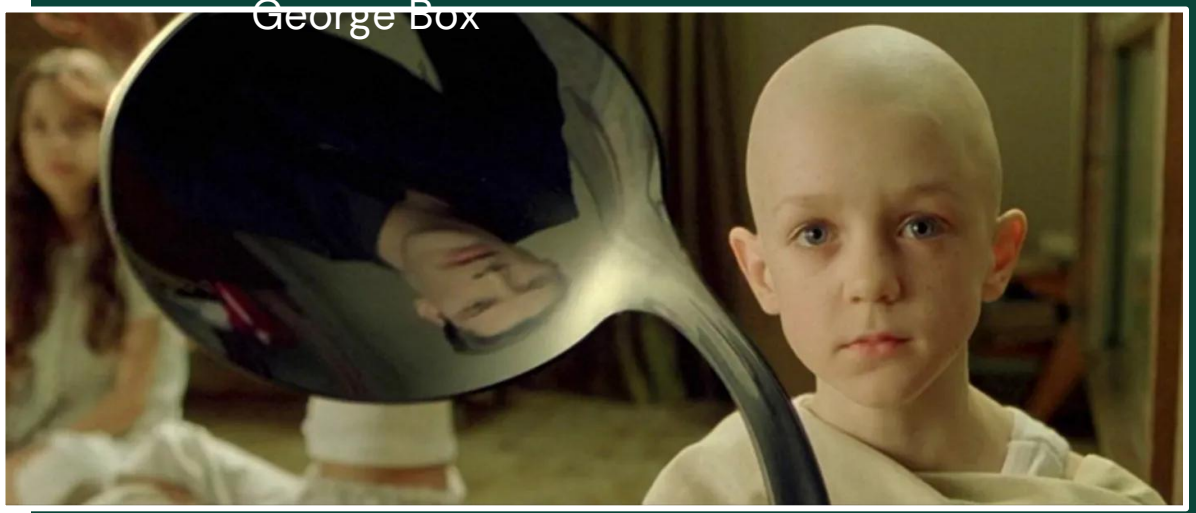
What does the Scenario name mean : B-ts3-uc-m10y2-lilim =
BASE case 15 Minutes resolution for 5 representative days per year with Unit Commitment, myopic foresight with 2x10 year overlapping periods with Lithium Limits

What did we/I learn?

1. Multi-dimensional “Peaks” drive investment decisions such as Peaks in Demand (energy dimension) & “Peaks” in volatility (short time dimension)
    1. How to consider “Peak” Extreme events? Floods/Droughts/Fires
        1. Spatio-temporal-scenario correlations
2. **Trade Wars and Security**
    1. Remembering the Energy Security Legacy of Energy systems Modelling
    2. IEA-ETSAP emerged from the 1970’s Oil Crisis to mitigate Oil supply insecurity
    3. Similar security modelling methods & diversification can be used to mitigate re-weaponization of energy & critical minerals supply chains as tensions rise between USA and CN

“All models are wrong but some are useful… “

George Box



.. Don’t try to build a correct model, that is impossible, instead try to realise the truth, *There is no correct model*, then you will understand that it is not you that builds the model, but it is the model that builds you,… your intuition and your insights through an iterative co-creation modelling practice

Adapted from the film “The Matrix”

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THANK YOU

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