A tentative evaluation of Taiwan's 2050 net-zero carbon emissions target

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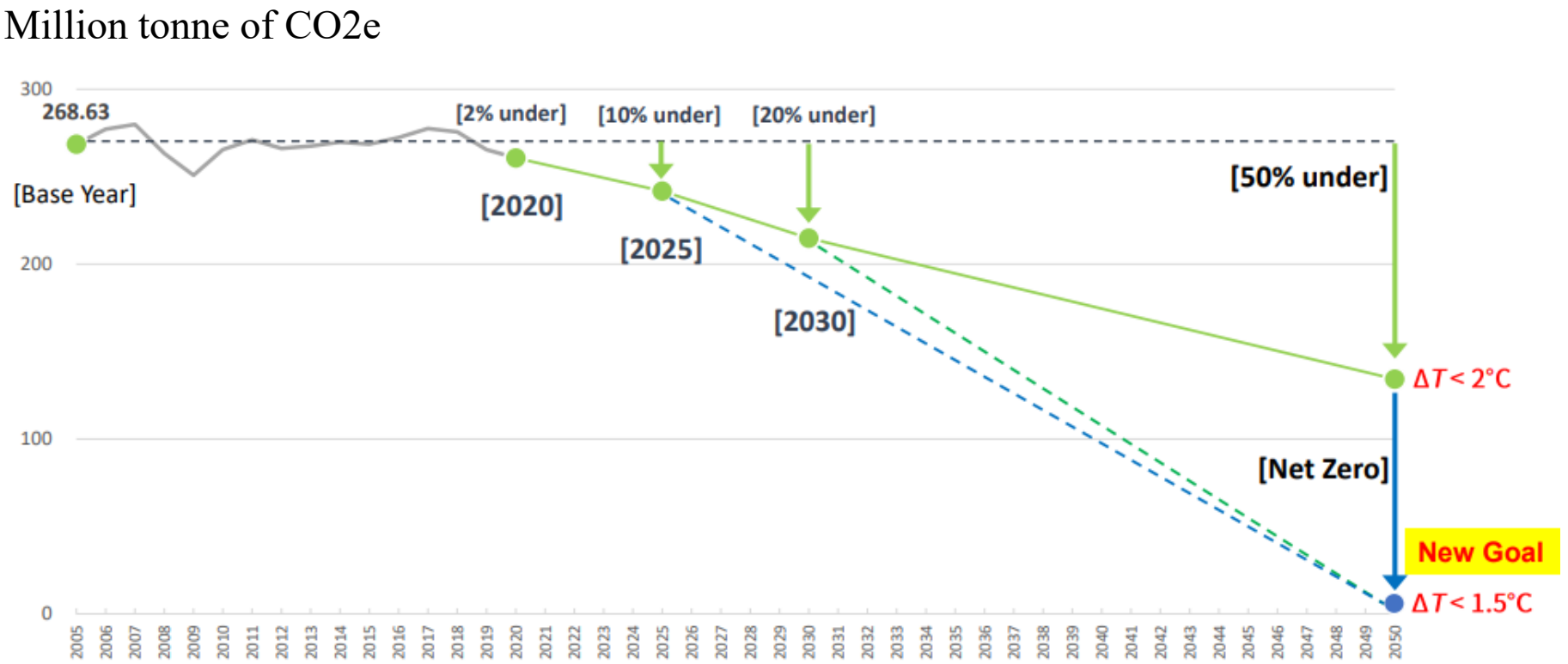
2024/07/22

Taiwan's official net-zero-emission pathway

- In 2022, the Taiwanese government announced the net zero target for 2050

Emission target for 2050



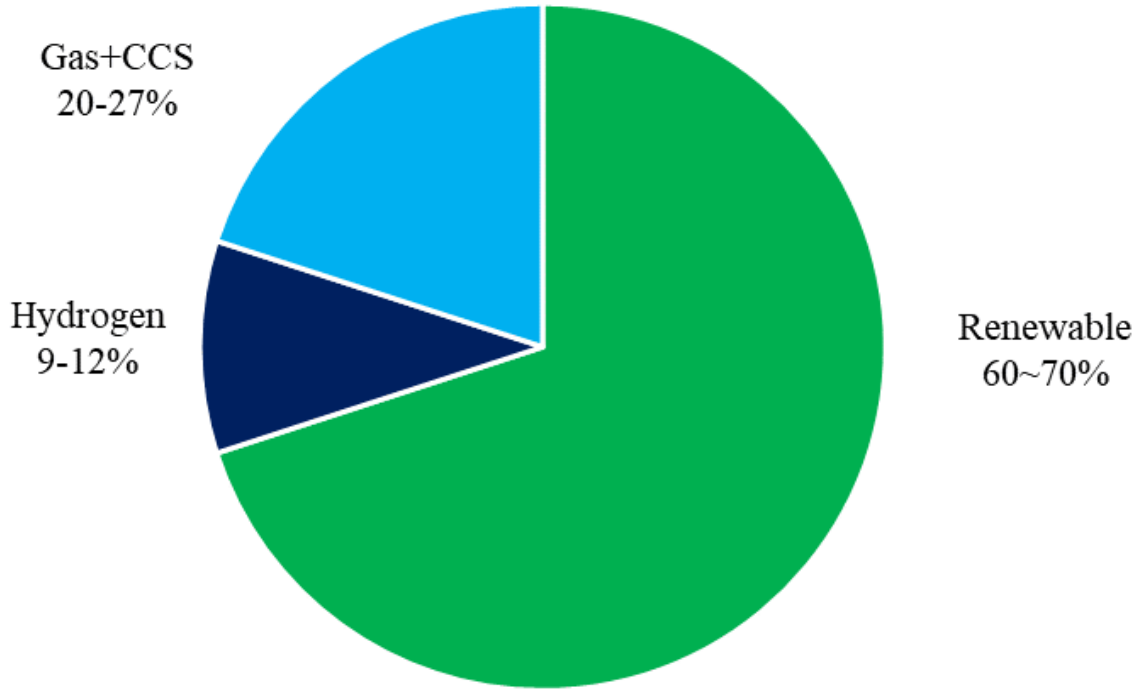
Source: National Development Council (2022)

Taiwan's power supply target for 2050

- **2050 power supply mix**
  - ✓ Renewables **60-70**%
  - ✓ Hydrogen: **9-12**%
  - ✓ Gas+CCUS: **20-27**%

- **Limitations:**
  - ✓ No **details** on the **renewable portfolio**
  - ✓ No reveal of **power generation costs**
  - ✓ No reveal of **economic impacts**

The 2050 official power supply target for Taiwan



Source: National Development Council (2022)

The purpose of this study

- **Purpose**: a **very tentative** evaluation of Taiwan's net-zero emissions in 2050
- **Integrate two models**:
  - ✓ **CGE model**: based upon input-output table of Taiwan
  - ✓ **Power supply model**: use hourly data (8,760 hours) for power supply/demand within a year

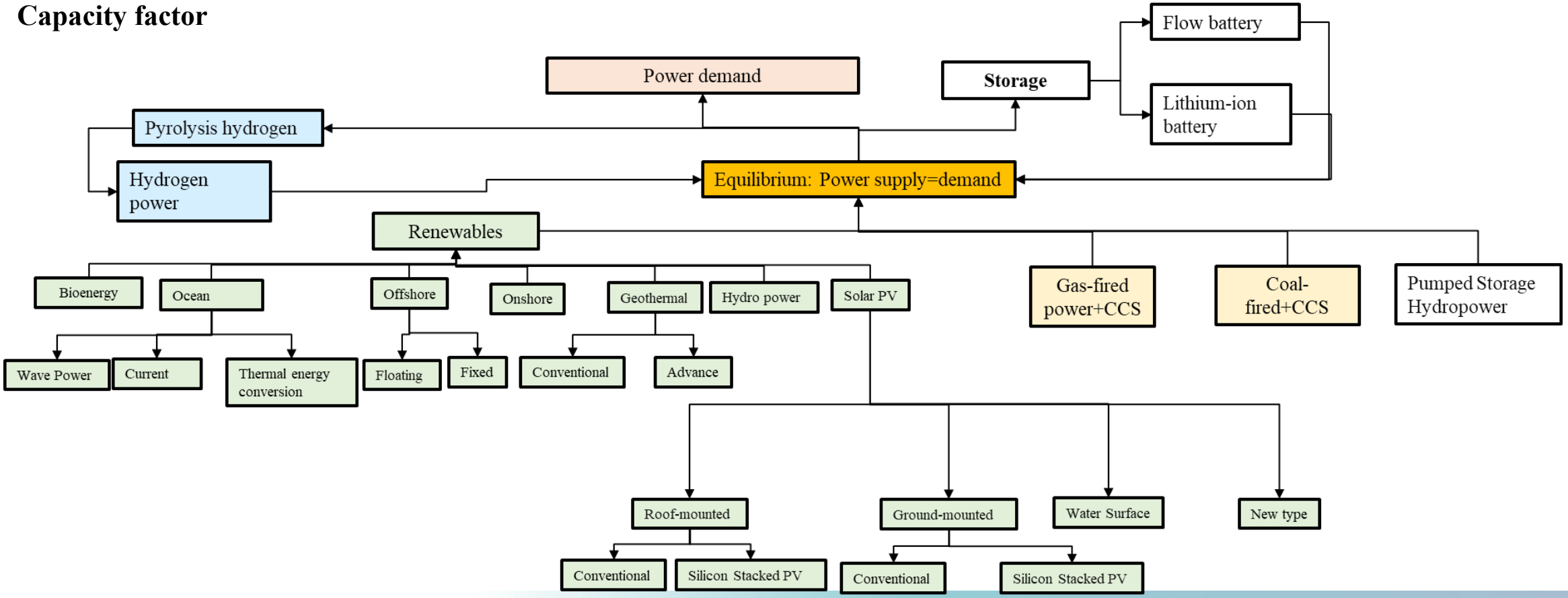
Economic Analysis
CGE model ◆ Carbon pricing policy ◆ Economic impacts

Power supply analysis
Power supply model ◆ Minimize power generation cost ◆ Power supply portfolio

Structure of power supply model

- **Cost minimization considering**
  - ✓ Data **8760** hours/year
  - ✓ **Installation potentials**
  - ✓ **Installation/maintenance costs**
  - ✓ **Capacity factor**

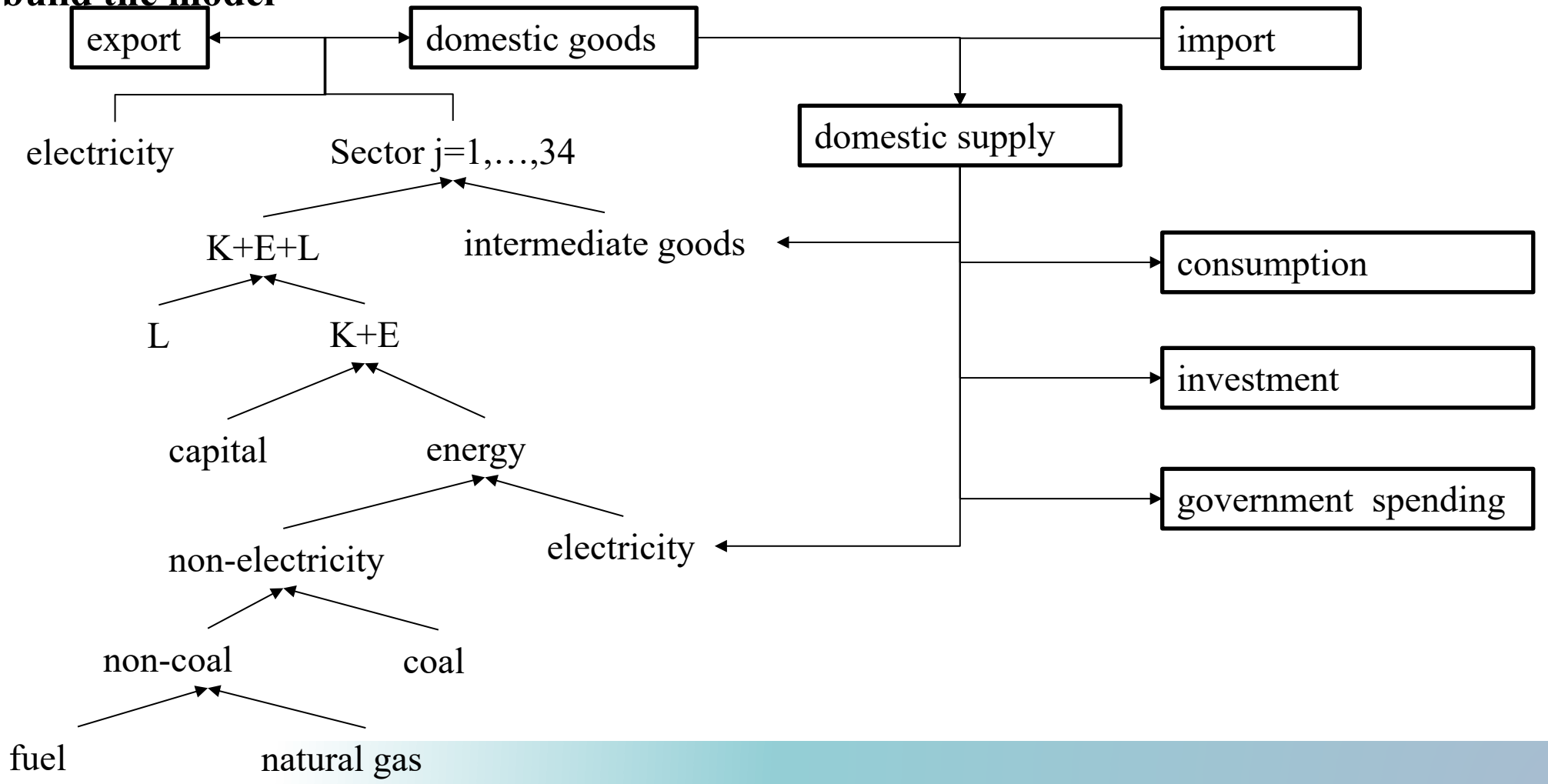
The structure for power supply model



Structure of CGE

- **Producers, consumers and government**
- **Using MPSGE to build the model**

The structure for power supply model



Integration procedure

Step 1
Setup baseline scenario

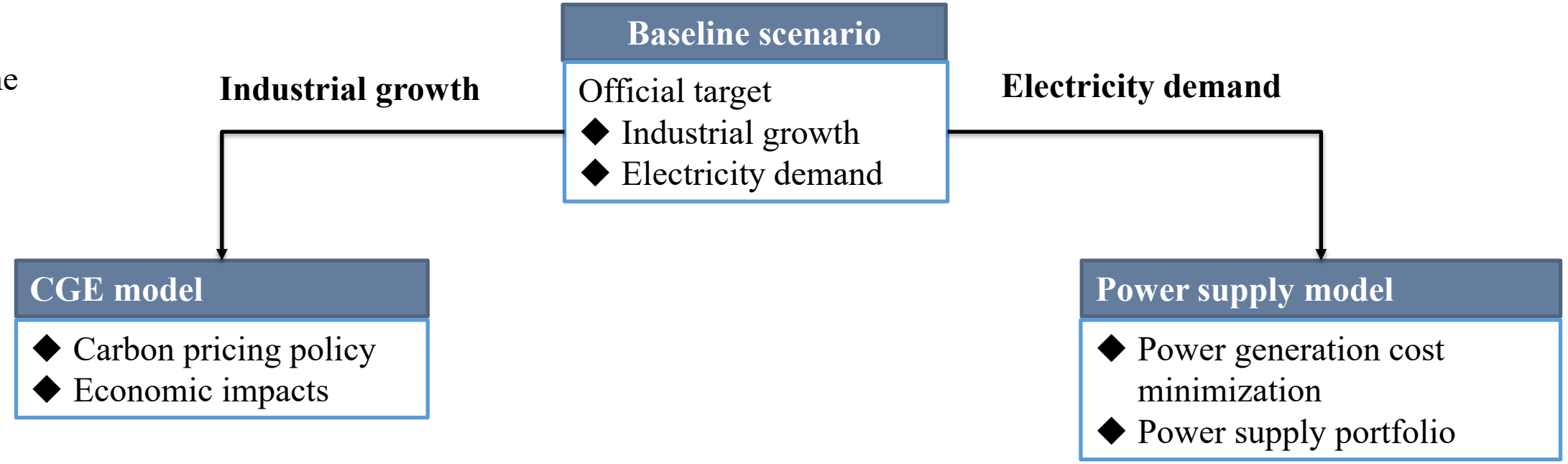
Baseline scenario

Official target
- Industrial growth
- Electricity demand

Integration procedure

Step 1
Setup baseline scenario

Step 2:
Integration



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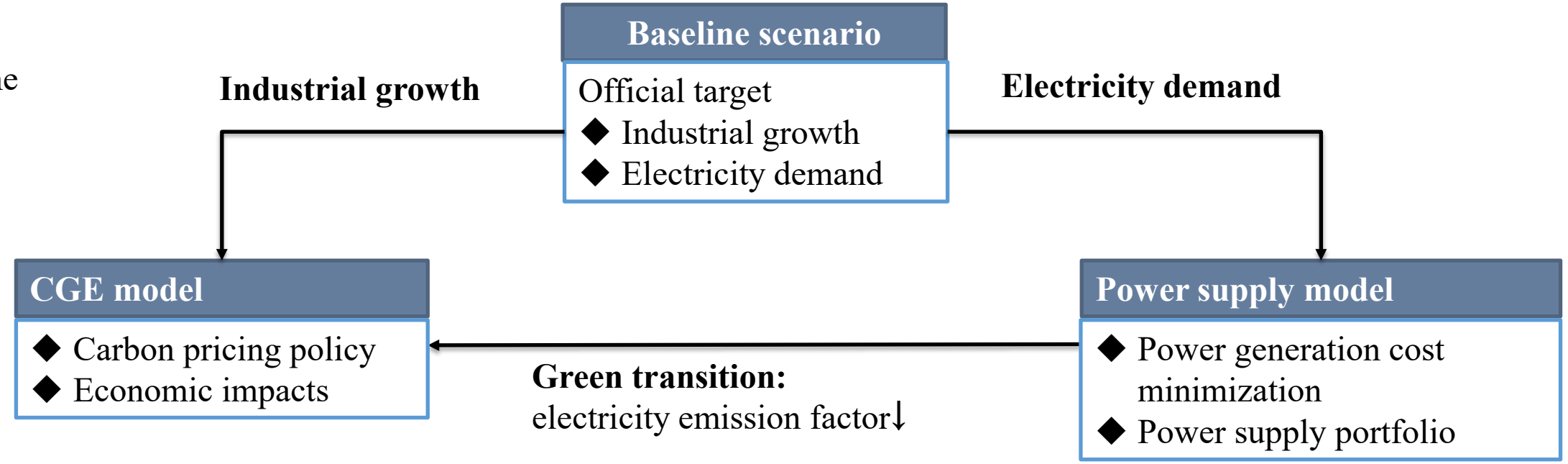

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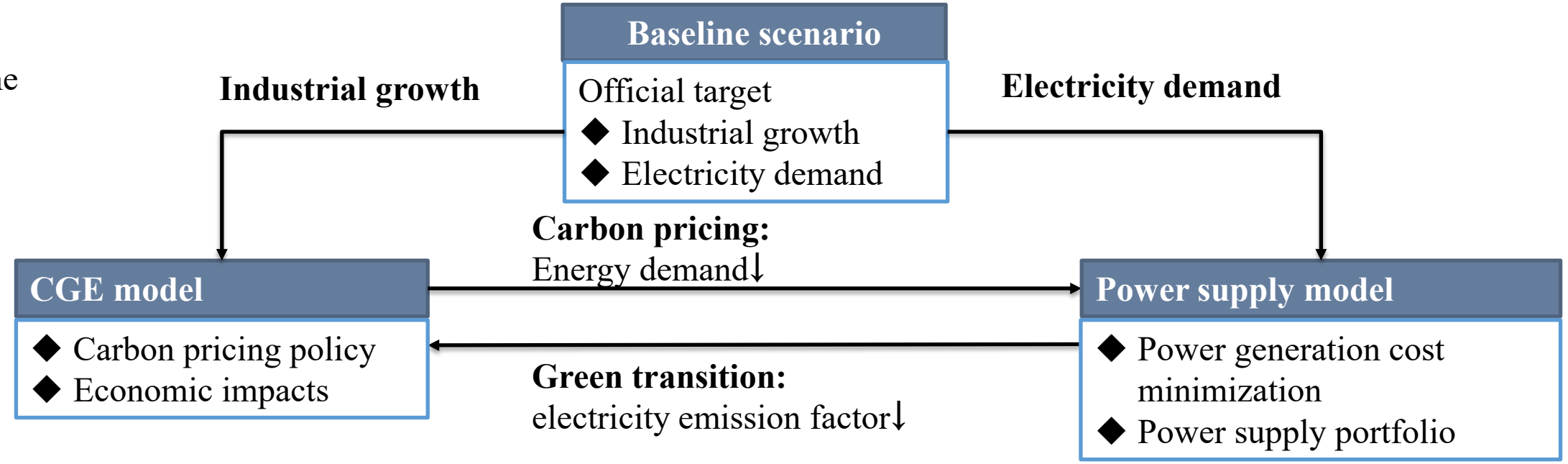

Integration procedure

Step 1
Setup baseline scenario

Step 2:
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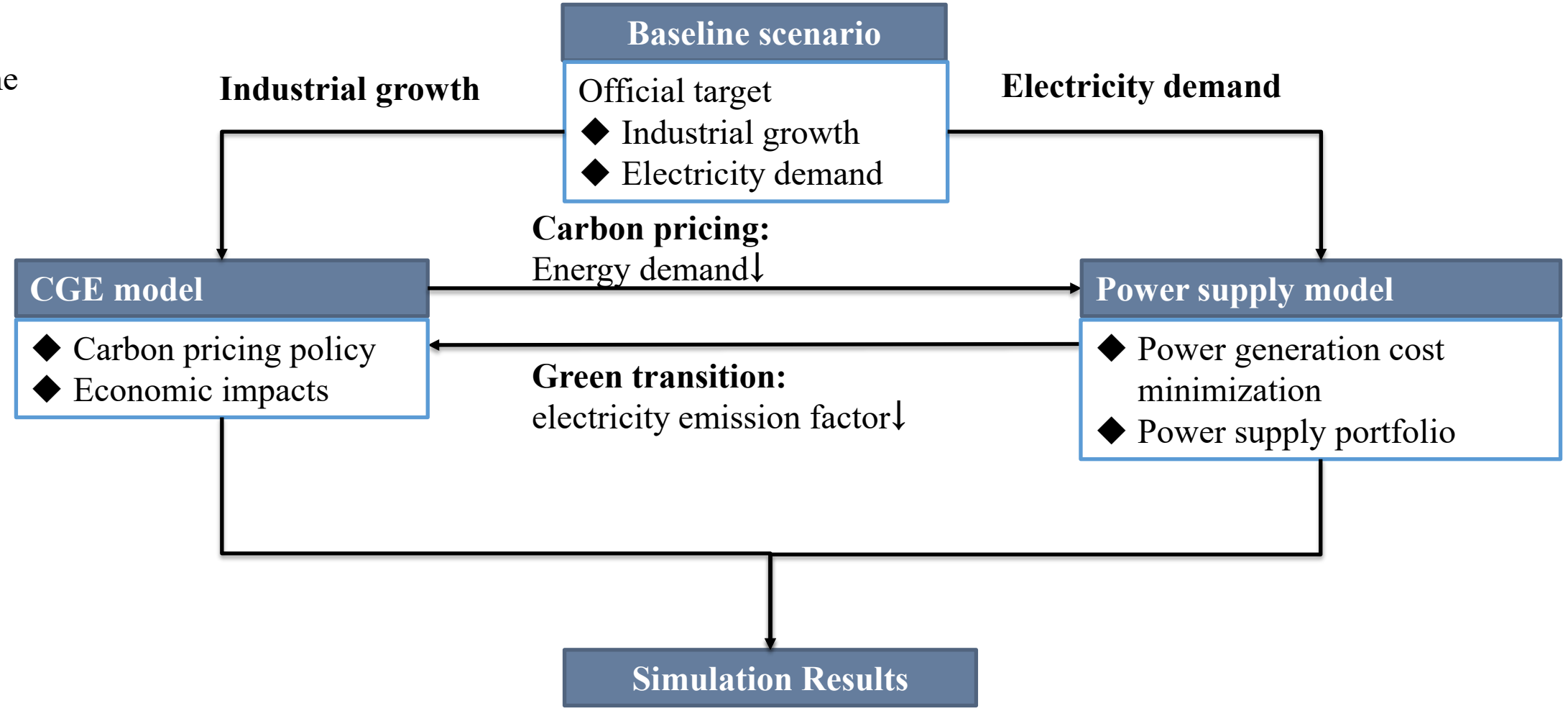
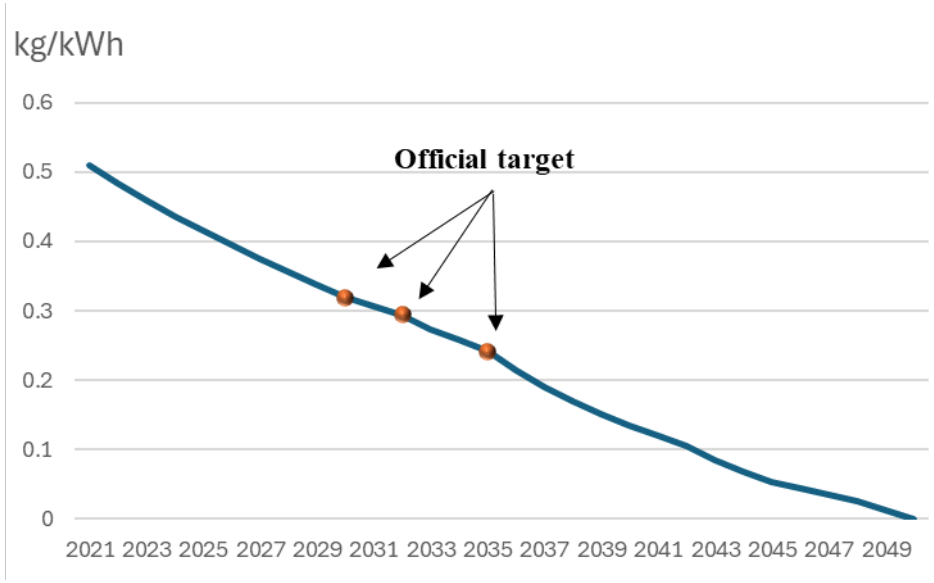
Step 3:
Results



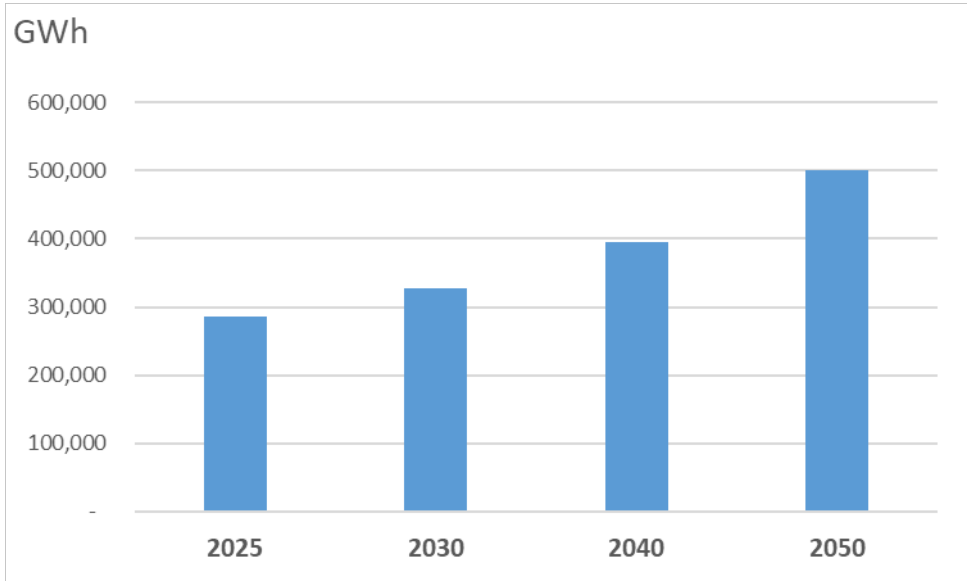
Scenario settings and official targets

- Taiwan has set targets for **electricity emission factor** for **2030, 2032, and 2035**
- The **power supply model** simulates that the **electricity emission factor** is **close to zero** in **2050 (interpolate the other years)**
- Taiwan has announced target for the **2050 electricity demand**

Electricity emission factor



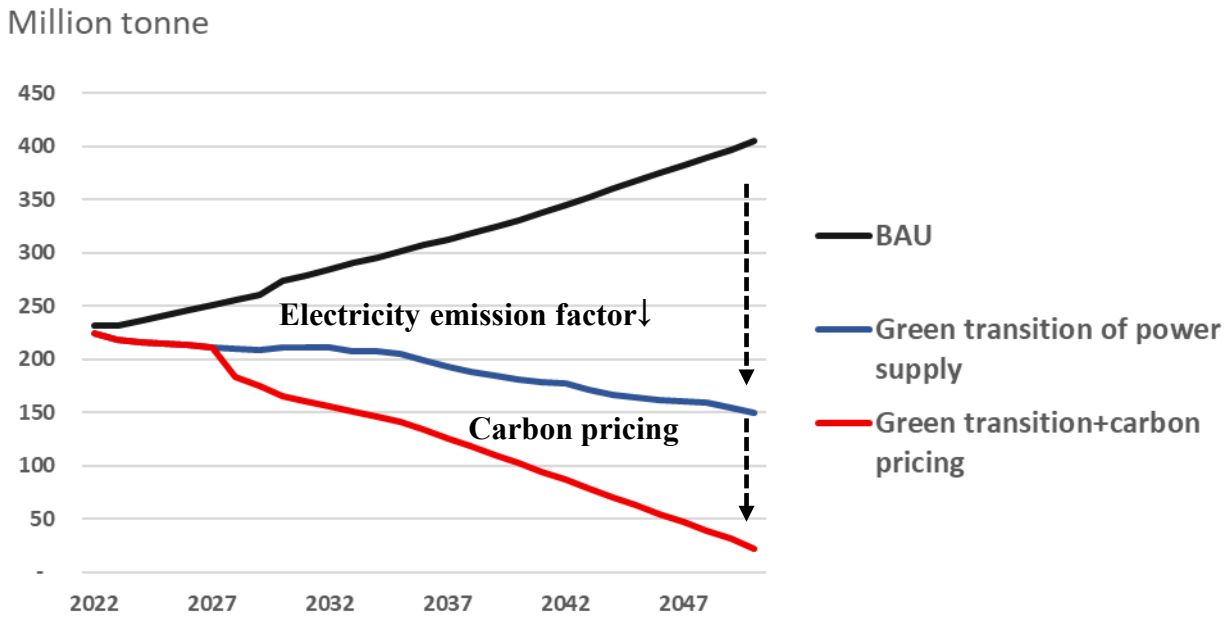
Official scenario of electricity demand



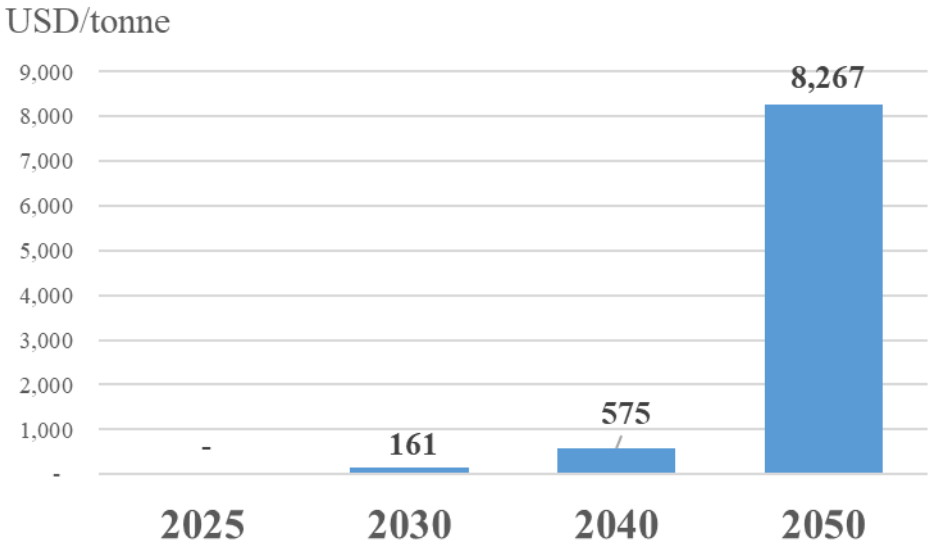
Carbon price evaluation using CGE

- The **green transition** of power supply (reduced electricity emission factor) significant **decrease carbon emissions**
- The **carbon pricing** can help reach net-zero emissions
- However, **carbon price** should be **very high** in 2050 for the achievement of net-zero-emission target

Carbon emissions (CGE)



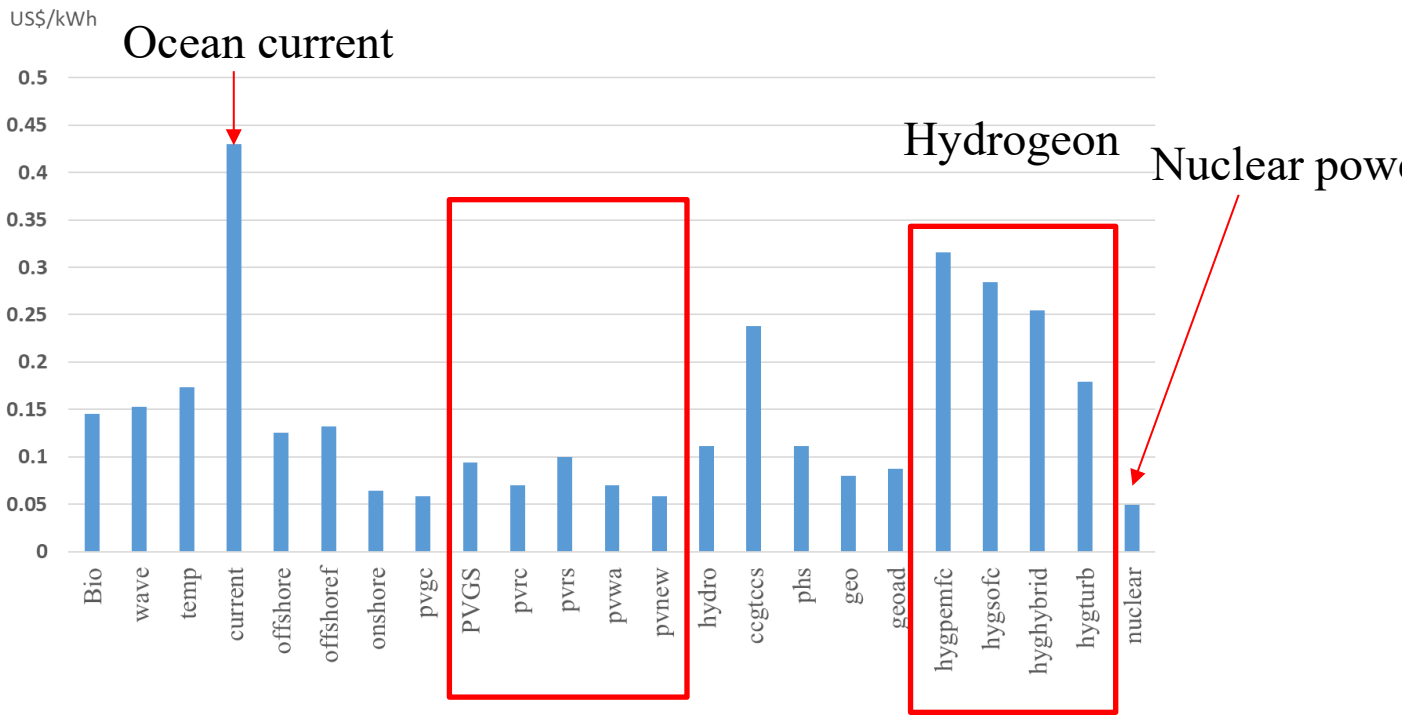
Carbon price to achieve the emission targets (CGE)



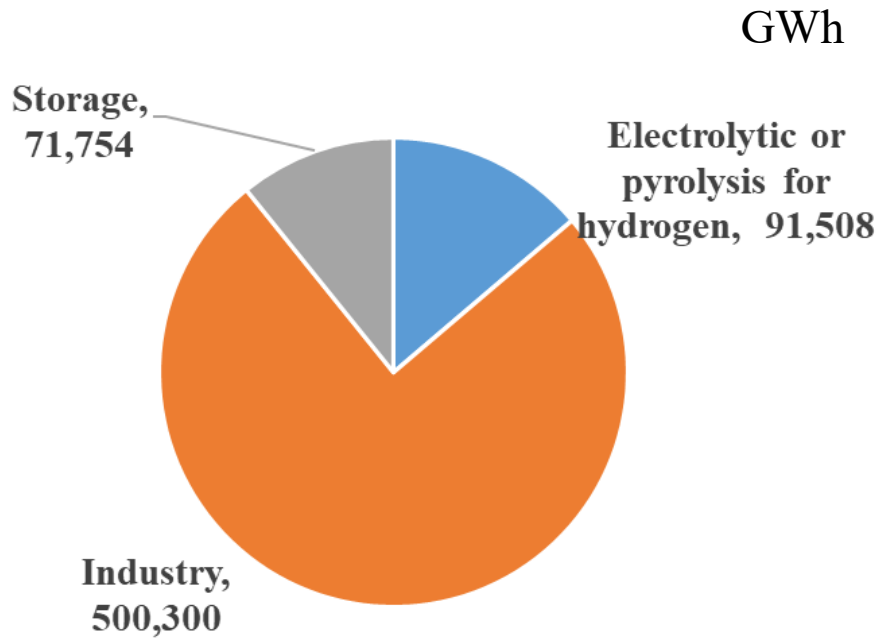
Electricity supply evaluation using a power supply model

- The power supply model solve the cost minimization problem
- The cheep technology is **nuclear power** (but it is **permanently shutdown** in Taiwan)
- New technology is **relatively expensive** (such as **ocean current power**, and **hydrogen power**)

Power generation costs



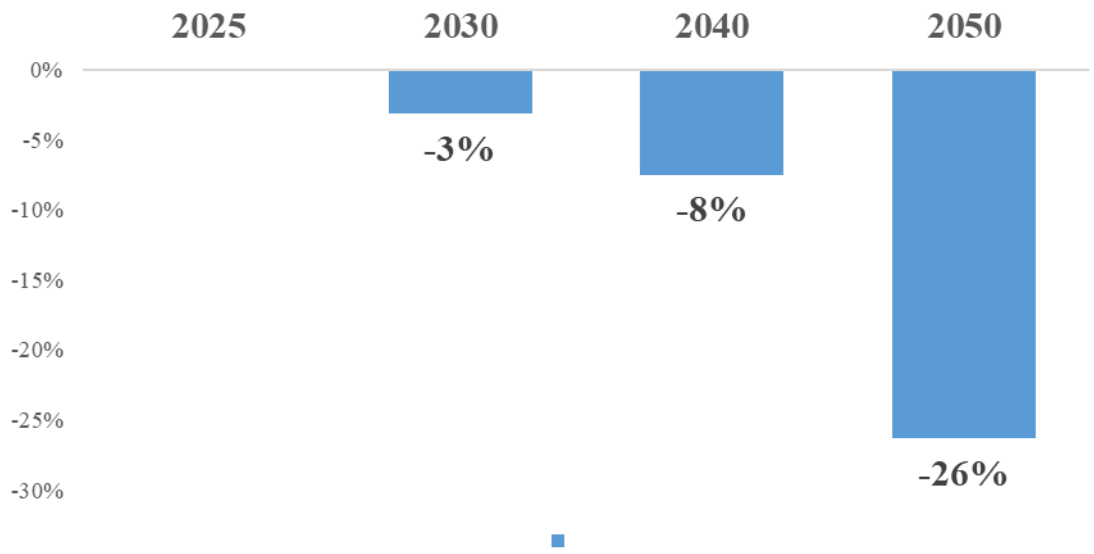
Power demand in 2050



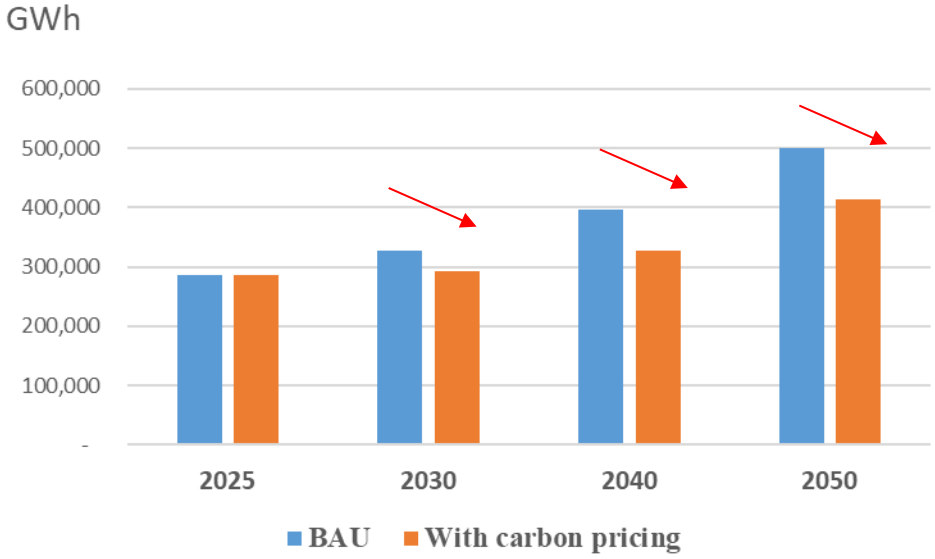
Impacts of carbon pricing on economy and electricity demand

- The carbon pricing help achieve the net-zero target, but it generates a huge GDP loss (-26% in 2050 relative to BAU)
- The carbon pricing also reduce electricity demand in Taiwan

GDP loss due to carbon pricing



Electricity demand with/without carbon pricing

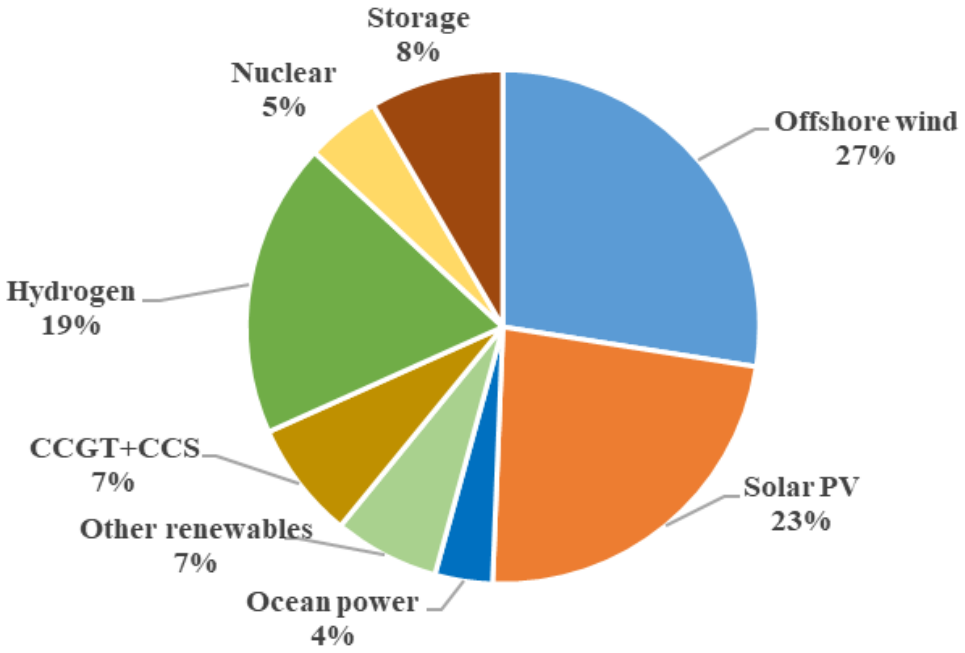


Carbon pricing reduces pressure for electricity supply

- **With carbon pricing in the CGE**: the electricity demand in 2050 decrease from **607,625 GWh** to **478,393 GWh**
- **Reduce** the use of **hydrogen power**, which is **relatively expensive**

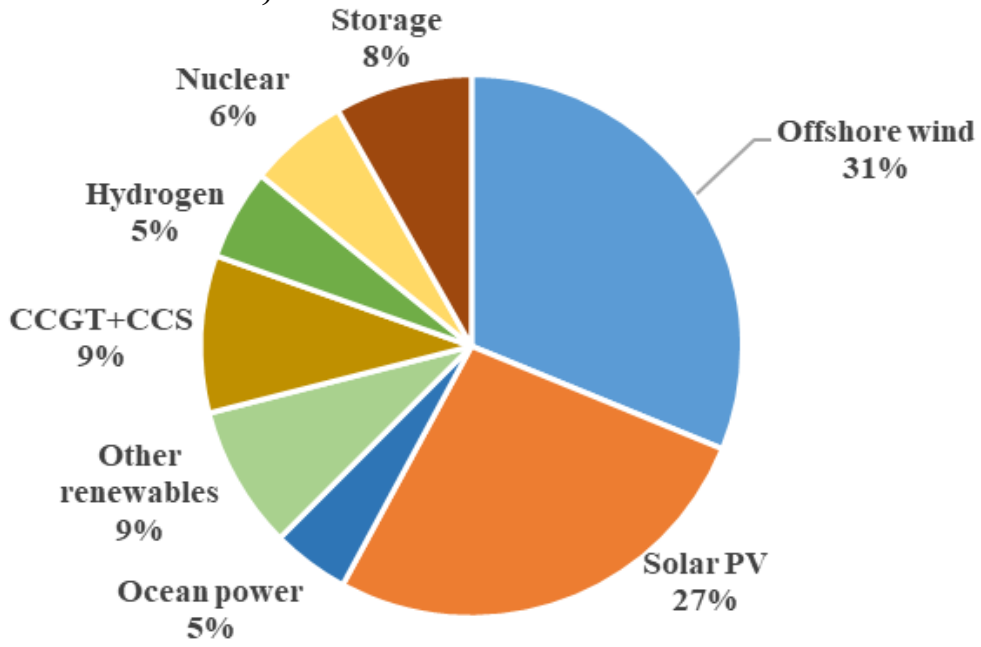
Power supply for 2050 without integration with CGE

- Total electricity supply in 2050: **607,625 GWh**



Power supply for 2050 with integration with CGE

- Total electricity supply in 2050: **478,393 GWh**



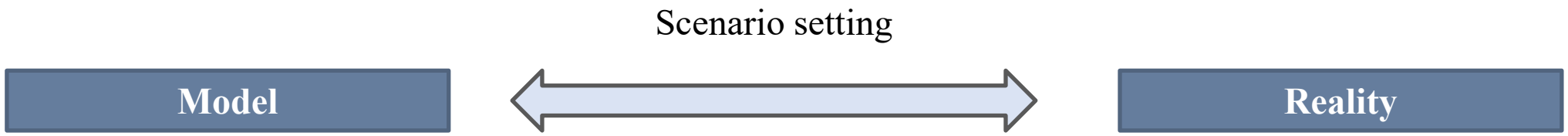
Conclusions

A first attempt at evaluation the impact of achieving Taiwan's net zero emission

- Net zero emission is **achievable** for Taiwan
- However, the **cost** is **relatively high**
  - ✓ **High carbon price in 2050 (8,256 USD/tonne in 2050)**
  - ✓ **High impact on GDP (-26% relative to BAU in 2050)**

Discussions

- Any suggestion for the **scenario setting** between the **CGE** and **power supply model**?
  - ✓ **Beside carbon pricing**, any suggestion for CGE to evaluate the **net-zero emission? Such as energy efficiency improvement?**
  - ✓ **Build a clean energy technology for a CGE model, such as hydrogen?**



Thank you for your attentions