



The potential effects of environmental tax reform in East Asia: analysis by a CGE model

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Introduction

- Two models:
 - A global CGE model for China, Japan and Korea
 - A single-country CGE model for Taiwan

Method: CGE models

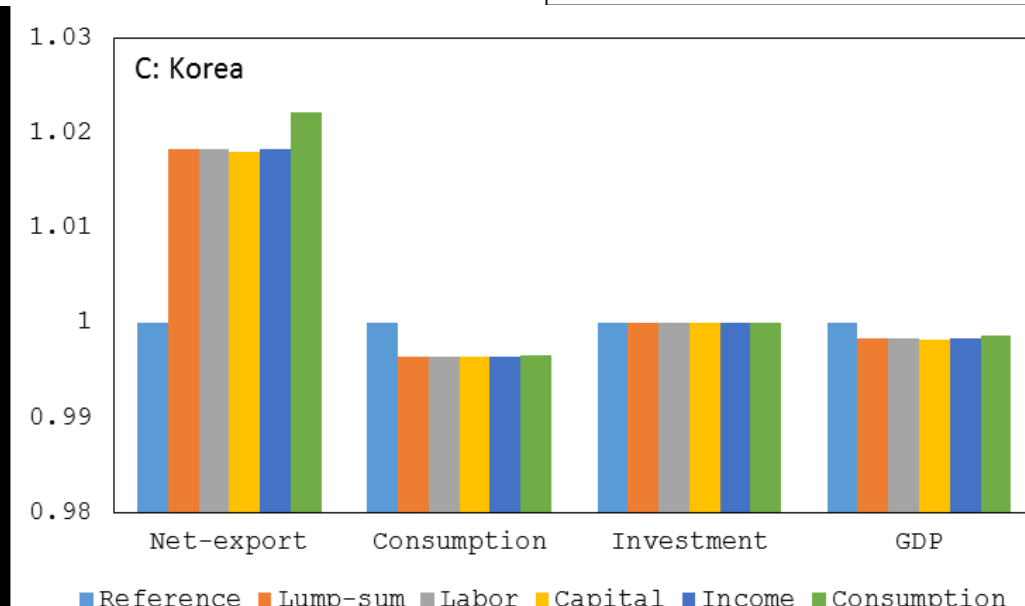
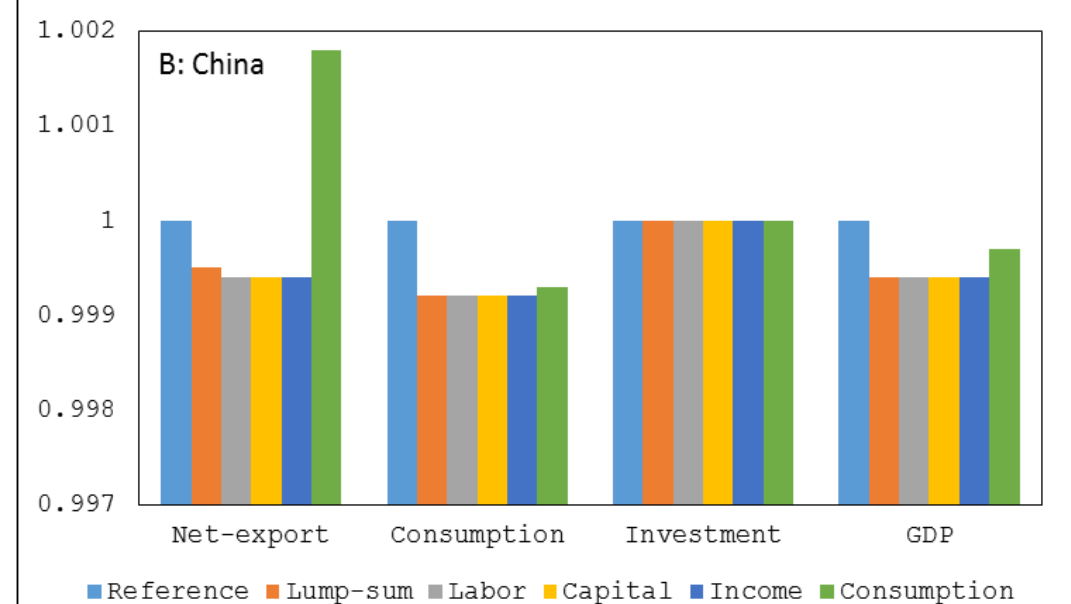
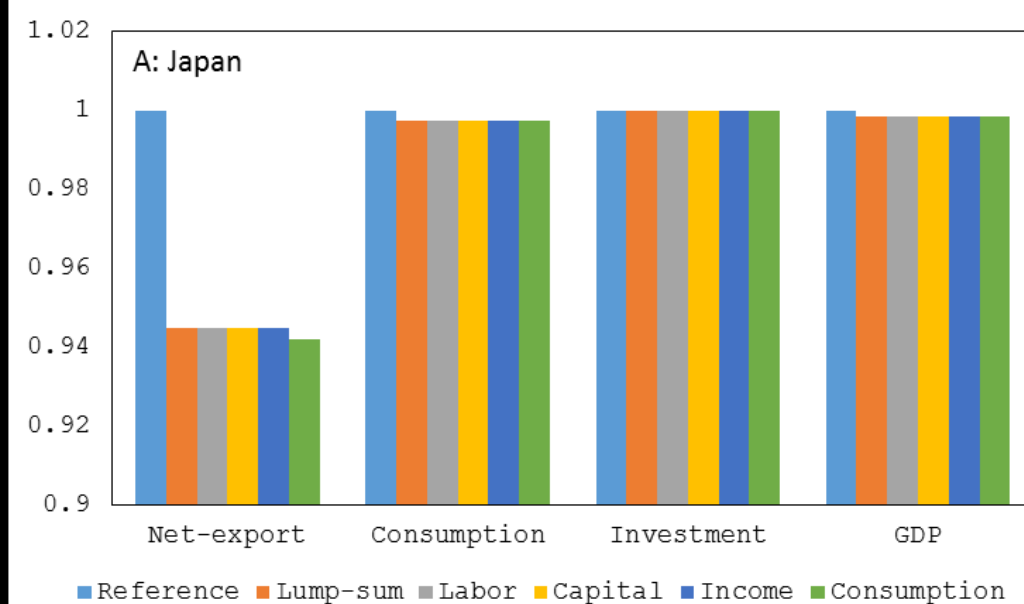
- The global model is the same as that used in Chapter 9.
 - ➔ A Global Recursive Dynamic CGE model which includes China, Japan and Korea (no Taiwan at the moment)
 - Note:** The reference scenario (GDP and CO2 emissions) is adjusted to meet the scenario in **Chapter 10** (or the E3ME).
 - ➔ A single-country dynamic CGE model for Taiwan

Method: Scenarios

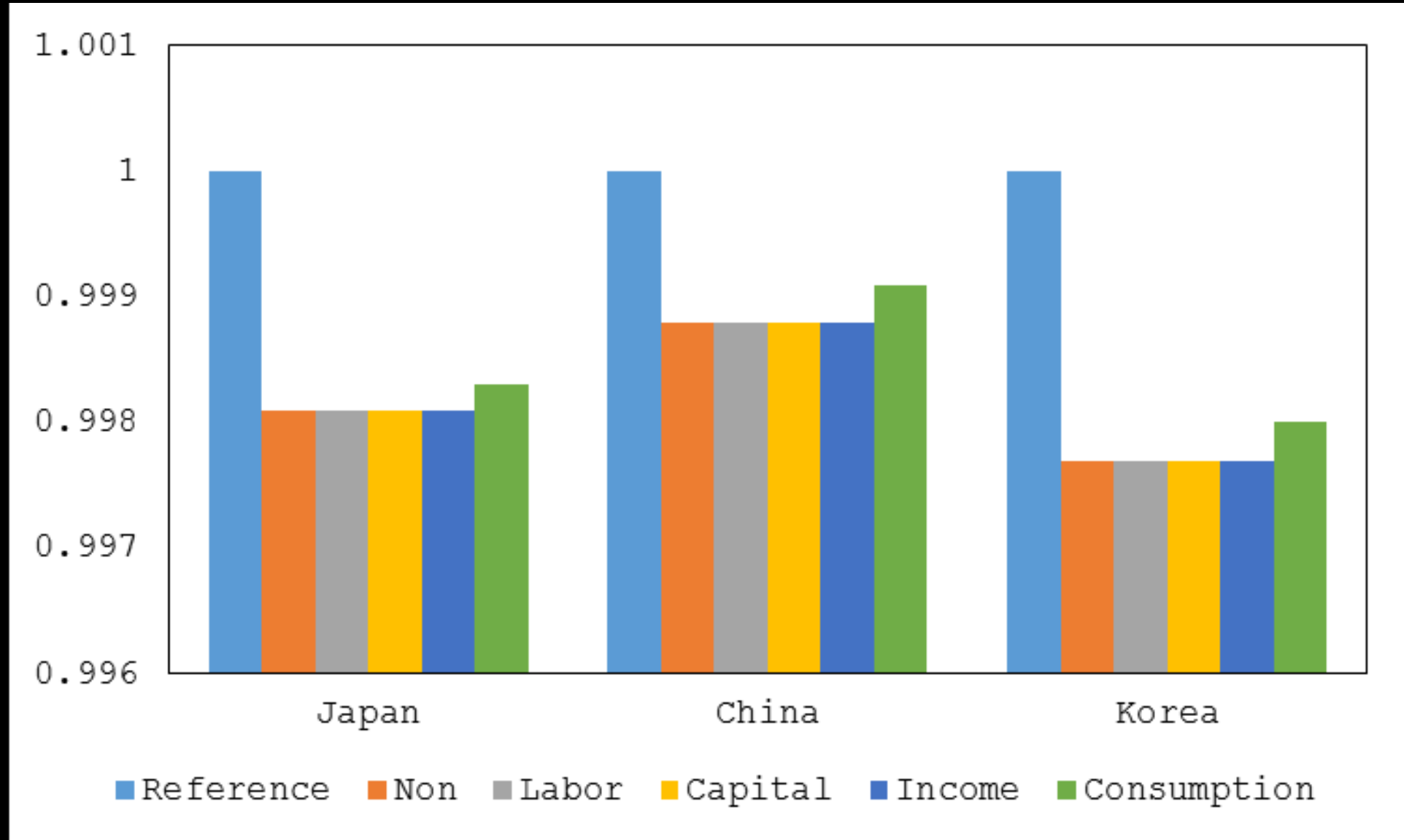
- The scenarios are based on Chapter 10.
 - The combination of x , y , and z (see table).

Emission reducing countries (x)	CO ₂ reduction (y)	Revenue recycling method (z)
Ea: All countries Jp: only Japan Cn: only China Kr: only Korea	N: national targets T: \$80/tCO ₂	S: lump-sum L: labor tax K: capital tax I: income tax C: consumption tax

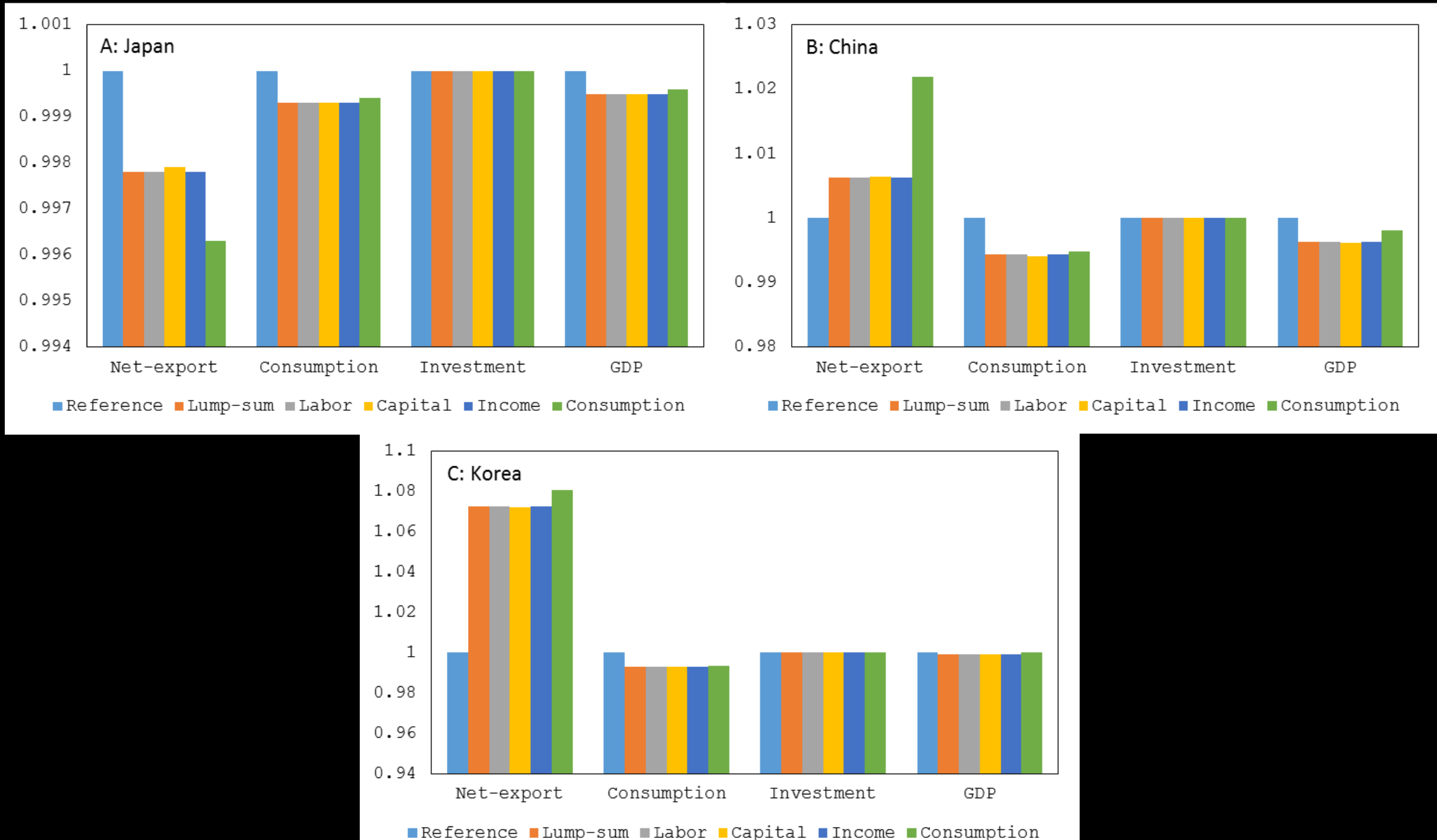
Results: National targets (by country)



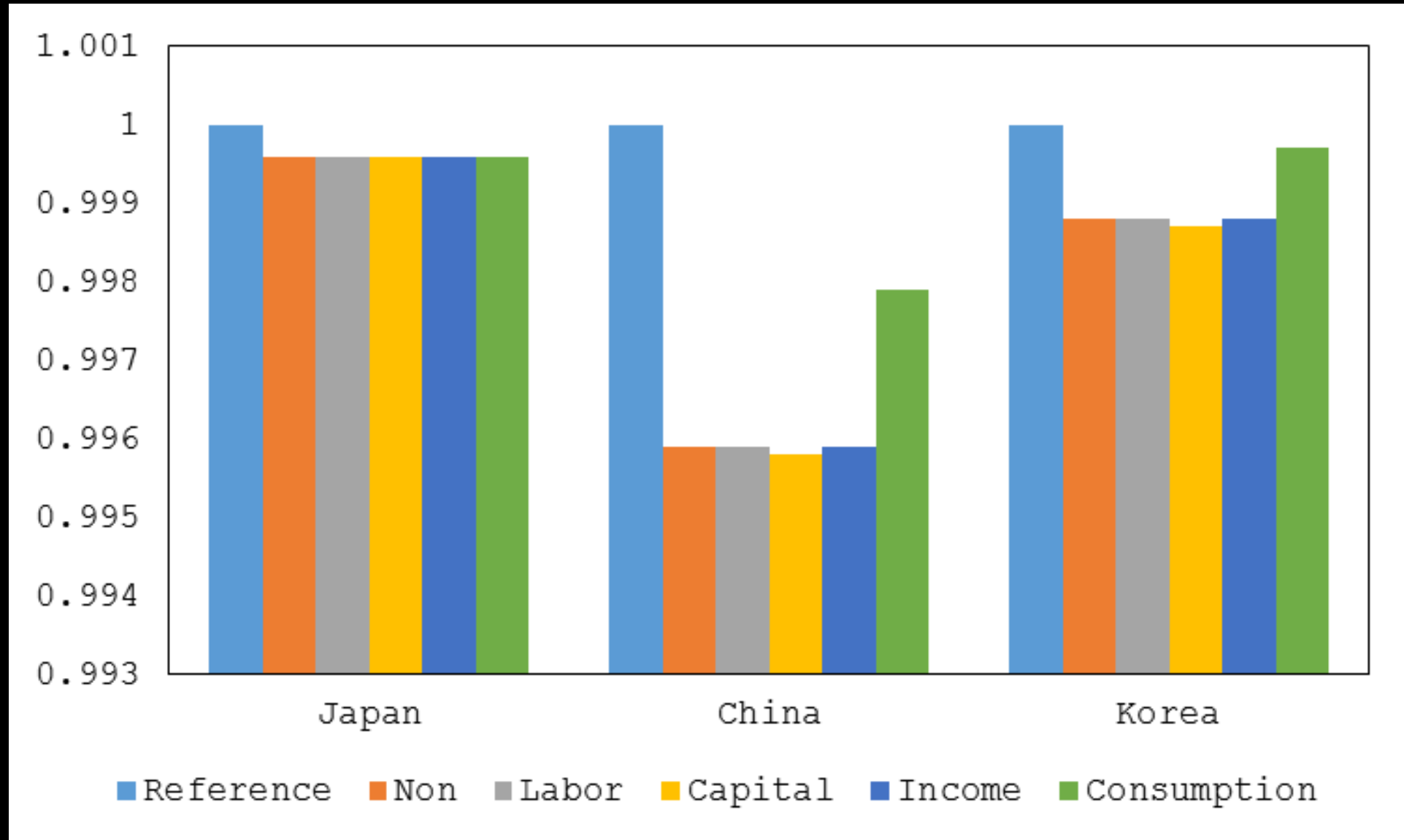
Results: National targets (East Asia)



Results: Common carbon tax rate (by country)



Results: Common carbon tax rate (East Asia)



Summary

The results suggest that economy will be negatively affected by reducing CO₂ emissions for climate change mitigation.

The impact is larger when the required emission reduction is larger (or the carbon tax rate is higher). However, if the tax revenue is recycled for reducing the rate of **consumption tax**, the impact can be slightly reduced.

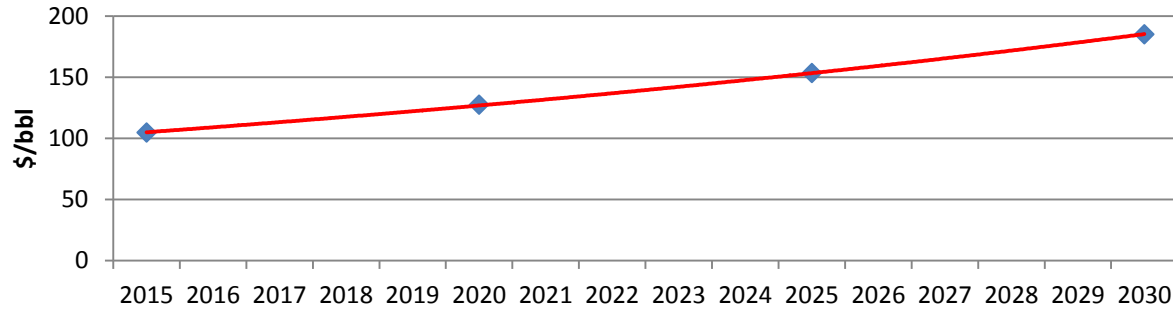
The Case of Taiwan

Baseline Assumptions

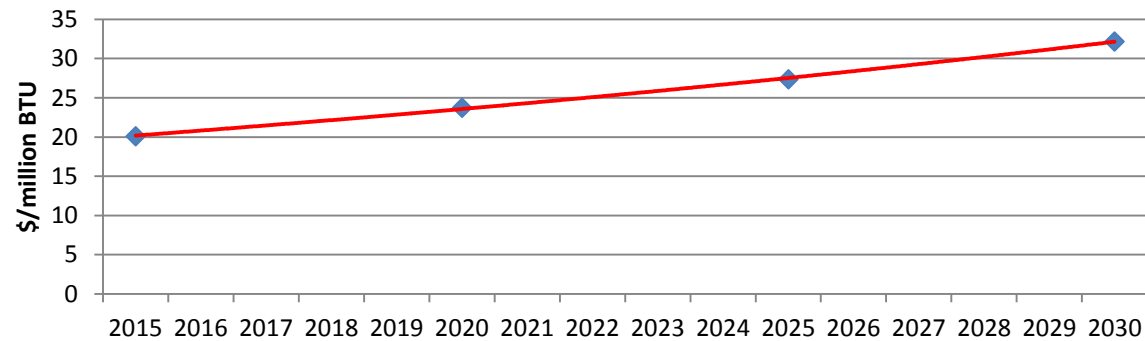
- We have two Baseline Scenarios, the common assumptions are as follows
 - The current three nuclear power plants will be gradually phased out in 2018, 2021, and 2024.
 - For hydro power technology, we assume a conservative annual growth rate of 0.28% due to Taiwan's limited hydro resource.
 - There is only feed-in tariff policy directly supporting renewable technology development.

Baseline Assumptions - International Energy Prices

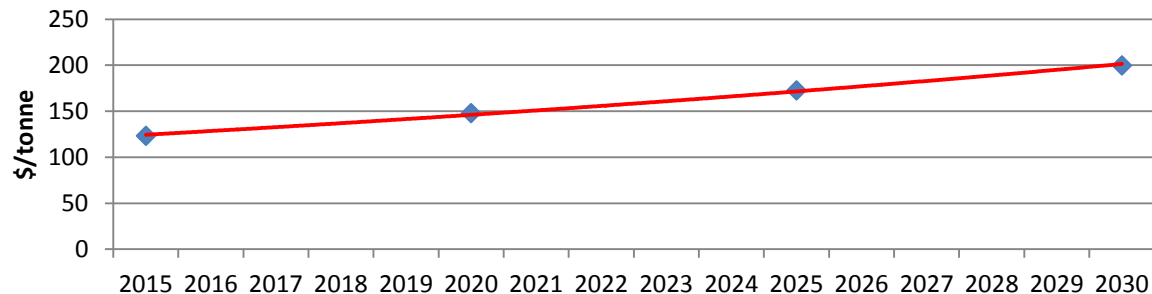
Crude Oil



LNG

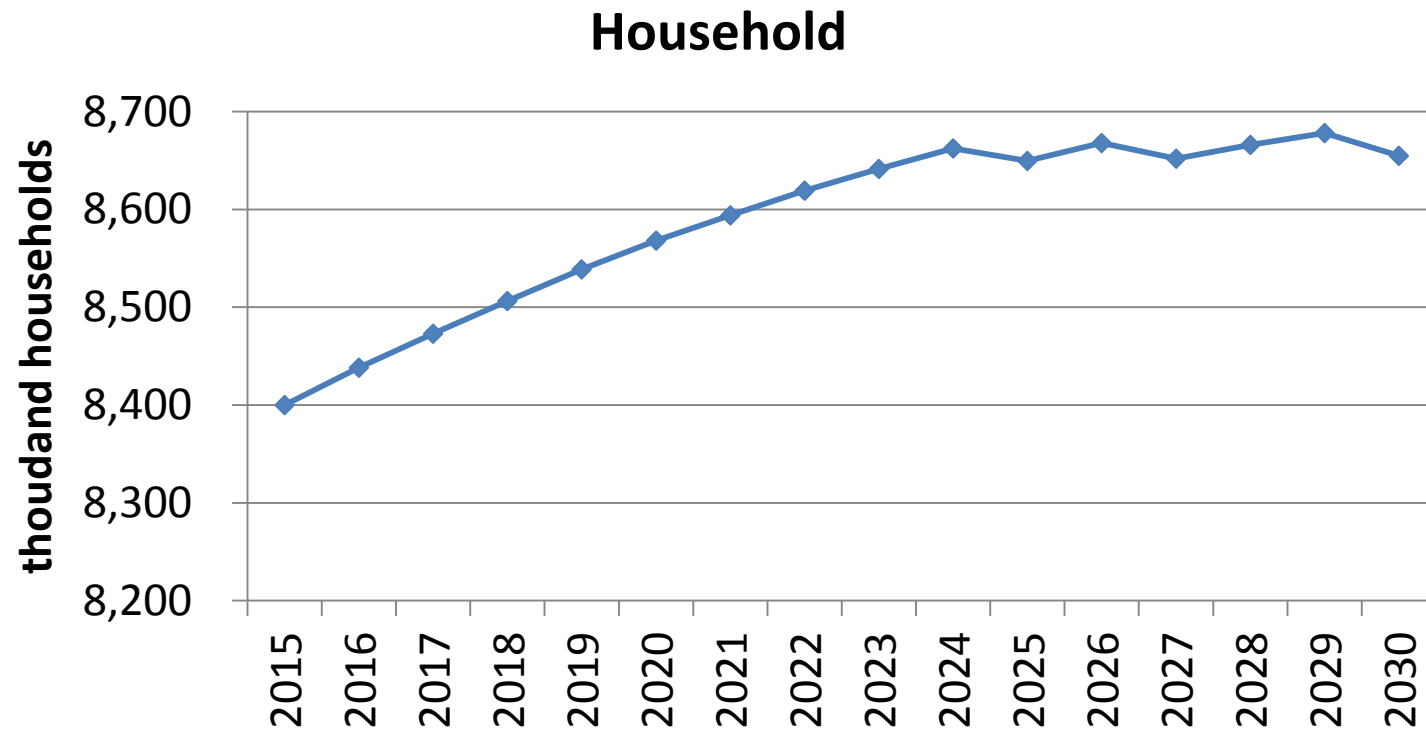


Coal



- The international energy price is an exogenous variable which is based on the projection of CPC Corporation and Institute of Nuclear Energy Research.

Baseline Assumptions-Household

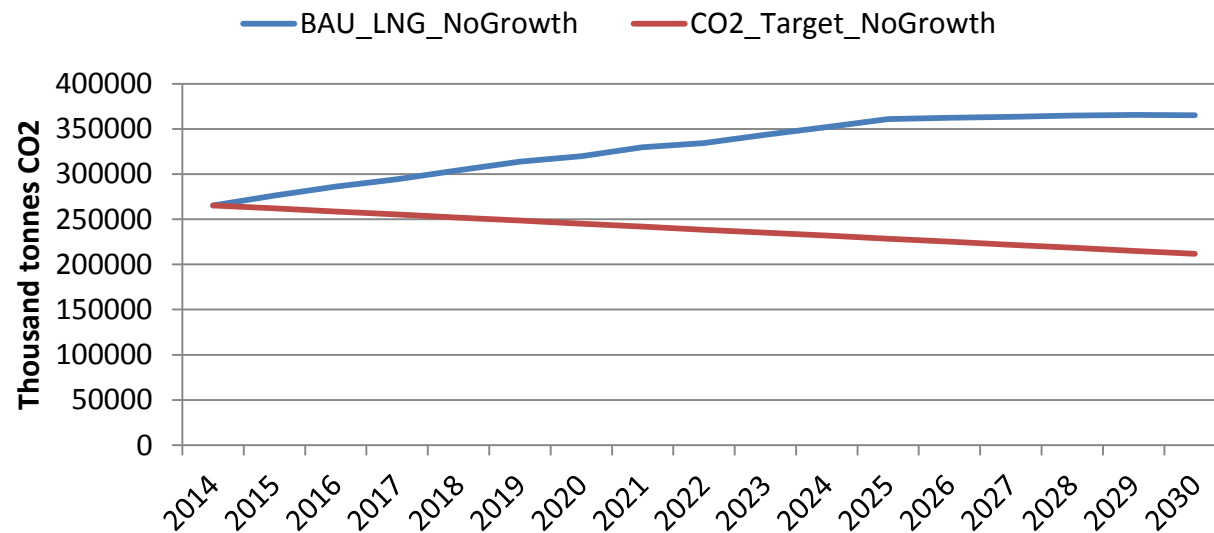


- The future development of household is based on the estimation of Institute for Information Industry.

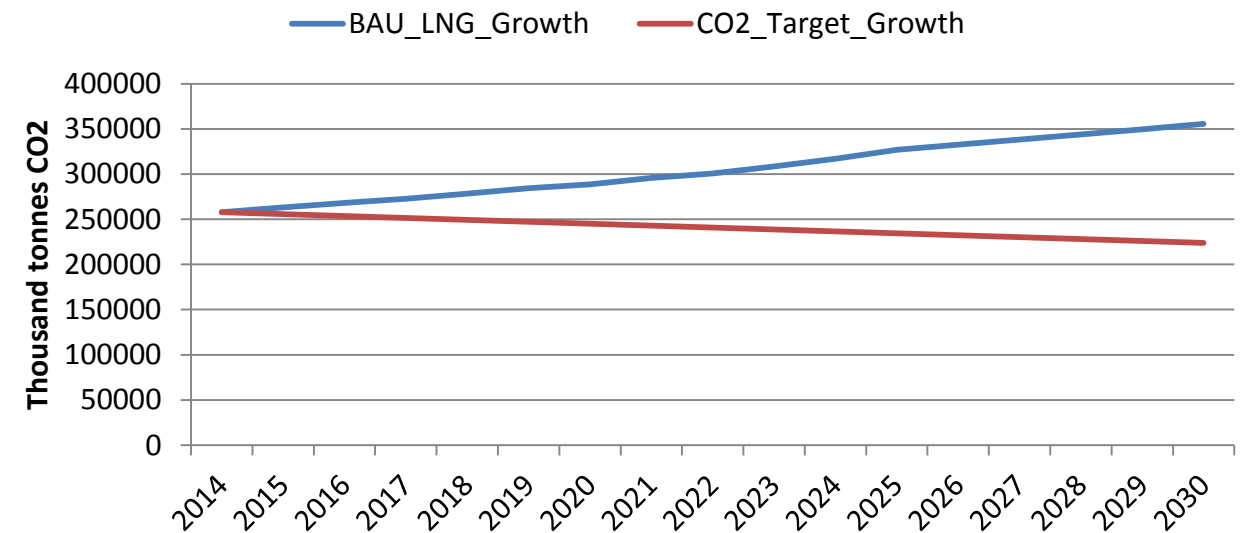
Baseline CO2 emission and reduction target

- The difference between two baseline scenarios is the growth of LNG.

LNG No Growth Baseline Scenario

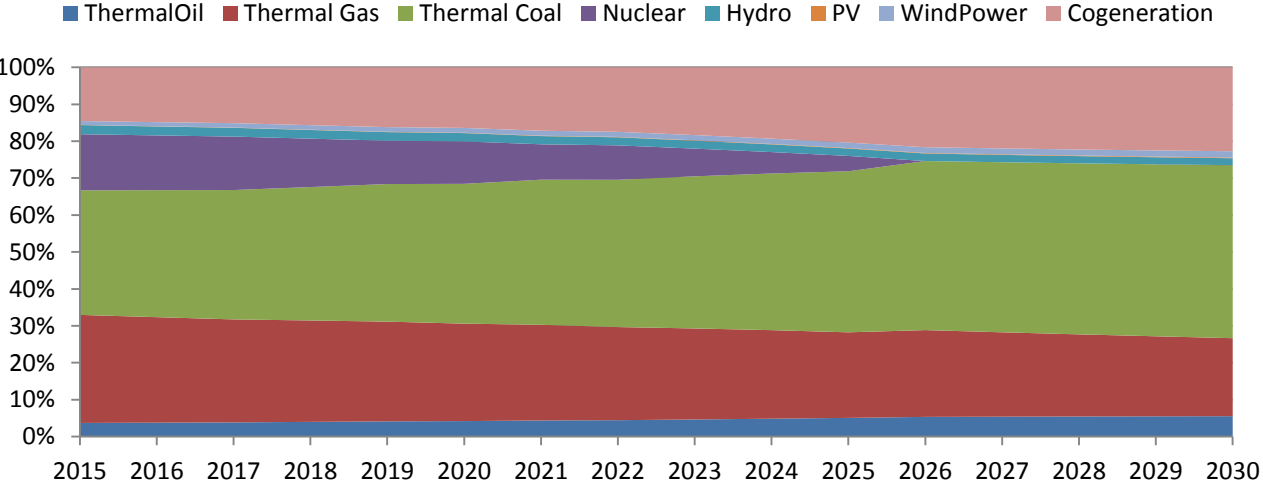


LNG Growth Baseline Scenario

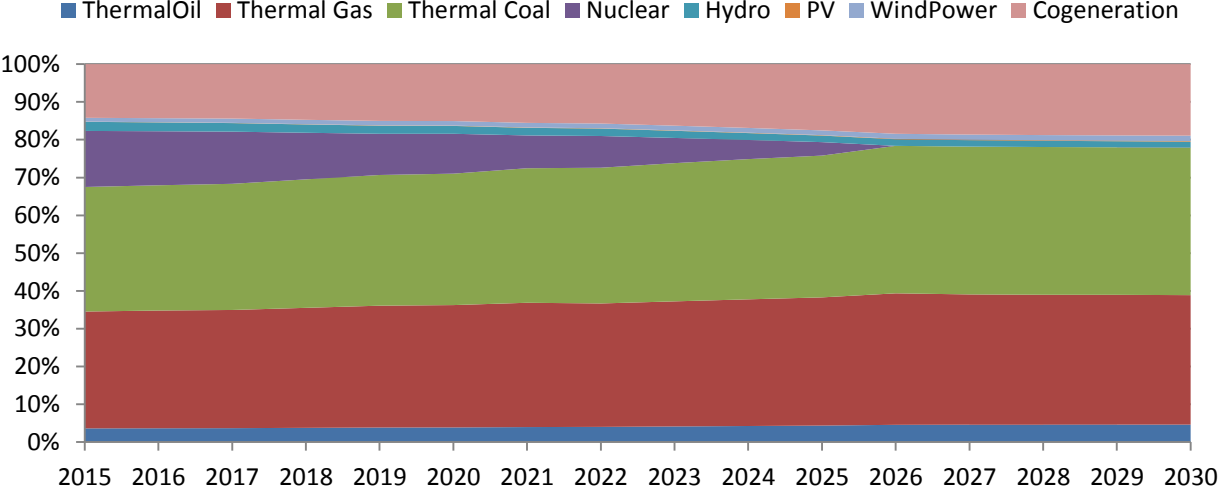


Baseline power generation mix

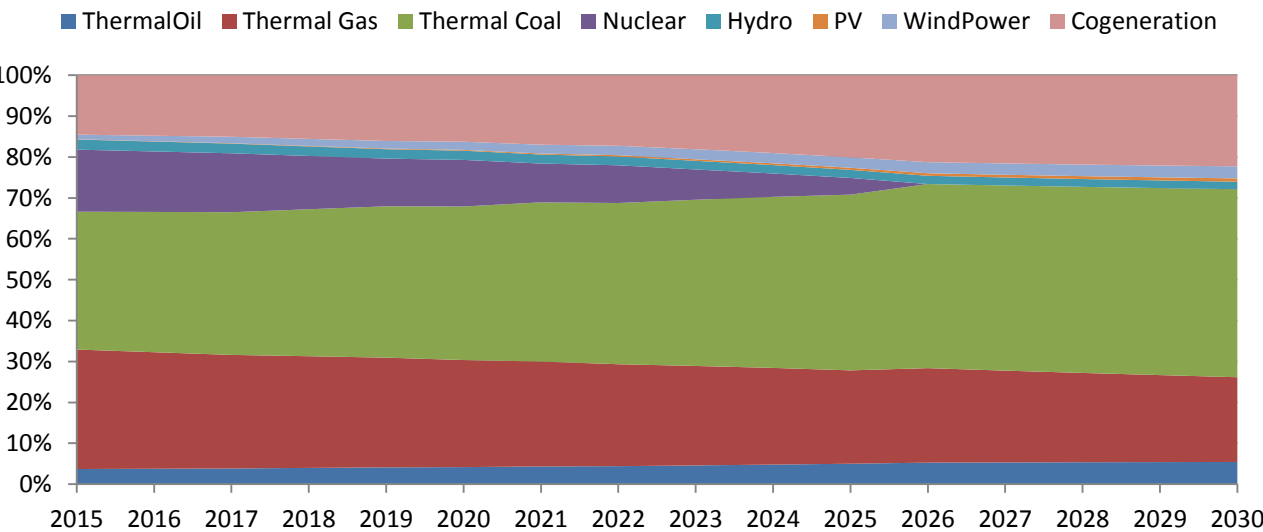
LNG No Growth Baseline Scenario



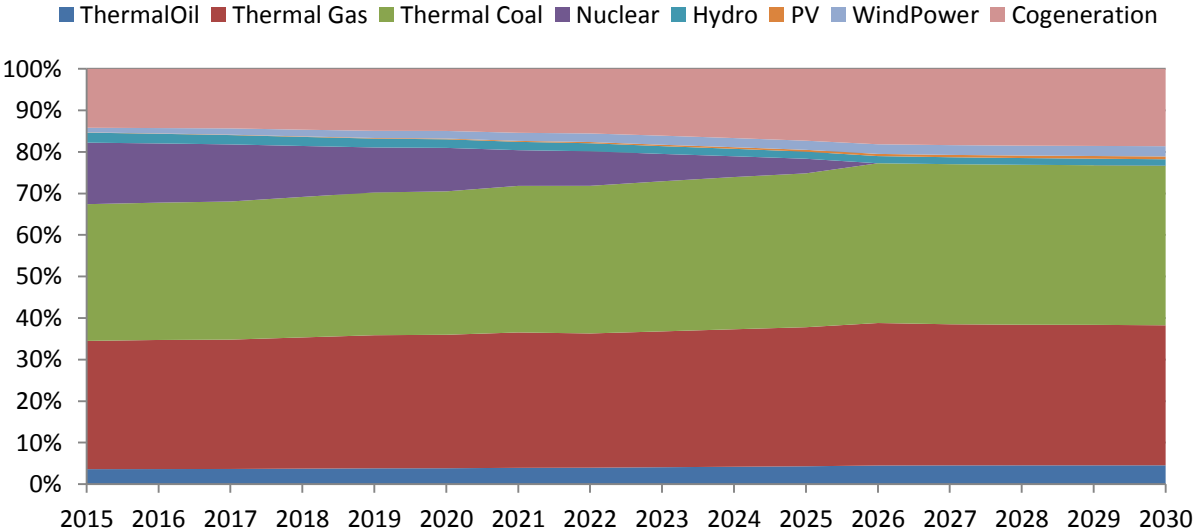
LNG Growth Baseline Scenario



LNG No Growth & RE Targets Scenario



LNG Growth & RE Targets Scenario



The comparison of CGE and E3ME with carbon tax rate to achieve the national target

	CGE (From LNG Growth Baseline Scenario)		E3ME-TNN	
	2020	2030	2020	2030
Real GDP	-4.04%	-8.63%	-1.23%	-1.46%
CO2	-15.10%	-37.01%	-41.93%	-65.47%
Employment	-2.27%	-4.60%	-0.67%	0.21%
Consumption	-2.25%	-4.85%	-4.85%	-6.77%
Investment	-5.60%	-11.89%	-1.38%	4.84%
Export	-1.24%	-2.65%	0.12%	0.44%
Import	-2.69%	-5.22%	-2.66%	-1.82%
Import: Oil and Gas etc.	-8.51%	-18.70%	-7.47%	-4.67%
Consumption Price	-1.09%	-2.26%	6.67%	8.58%
Nominal wage and salaries	-7.73%	-18.19%	2.68%	4.88%
Carbon Tax Rate (\$/tCO2)	49.9	107.6	586.5	1372.6

The comparison of CGE and E3ME with carbon tax rate at 735\$/tCO2

	CGE (From LNG Growth Baseline Scenario)		E3ME-TNN	
	2020	2030	2020	2030
Real GDP	-4.98%	-6.91%	-0.03%	0.10%
CO2	-26.44%	-30.41%	-18.00%	-35.52%
Employment	-2.83%	-3.98%	-0.13%	0.13%
Consumption	-2.95%	-3.16%	-0.92%	-1.15%
Investment	-6.49%	-6.91%	-0.19%	3.58%
Export	-1.43%	-1.58%	0.01%	0.09%
Import	-2.84%	-3.16%	-0.82%	-0.34%
Import: Oil and Gas etc.	-9.59%	-12.69%	-2.26%	-1.11%
Consumption Price	-1.36%	-148.56%	1.20%	1.47%
Nominal wage and salaries	-9.41%	-14.86%	0.42%	0.82%
Carbon Tax Rate (\$/tCO2)	73.5	87.0	73.5	87.0

The comparison of CGE and E3ME with carbon tax rate to achieve the national target

	CGE (From LNG No Growth Baseline Scenario)		E3ME-TNN	
	2020	2030	2020	2030
Real GDP	-4.75%	-8.72%	-1.23%	-1.46%
CO2	-23.37%	-42.01%	-41.93%	-65.47%
Employment	-2.45%	-0.56%	-0.67%	0.21%
Consumption	-2.72%	-3.80%	-4.85%	-6.77%
Investment	-5.87%	-7.99%	-1.38%	4.84%
Export	-1.15%	-1.88%	0.12%	0.44%
Import	-2.59%	-3.55%	-2.66%	-1.82%
Import: Oil and Gas etc.	-6.77%	-10.69%	-7.47%	-4.67%
Consumption Price	-1.03%	-1.72%	6.67%	8.58%
Nominal wage and salaries	-8.33%	-14.48%	2.68%	4.88%
Carbon Tax Rate (\$/tCO2)	65.7	105.8	586.5	1372.6

The comparison of CGE and E3ME with carbon tax rate at 735\$/tCO2

	CGE (From LNG No Growth Baseline Scenario)		E3ME-TNN	
	2020	2030	2020	2030
Real GDP	-5.22%	-7.08%	-0.03%	0.10%
CO2	-25.35%	-33.24%	-18.00%	-35.52%
Employment	-2.68%	-0.46%	-0.13%	0.13%
Consumption	-3.04%	-3.26%	-0.92%	-1.15%
Investment	-6.68%	-7.15%	-0.19%	3.58%
Export	-1.21%	-1.50%	0.01%	0.09%
Import	-2.74%	-2.88%	-0.82%	-0.34%
Import: Oil and Gas etc.	-7.95%	-8.03%	-2.26%	-1.11%
Consumption Price	-1.07%	-1.35%	1.20%	1.47%
Nominal wage and salaries	-8.96%	-11.97%	0.42%	0.82%
Carbon Tax Rate (\$/tCO2)	73.5	87.0	73.5	87.0