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Thailand's Road to Net-Zero Emissions: An Analytical Perspective using AIM

22-23 July, 2025

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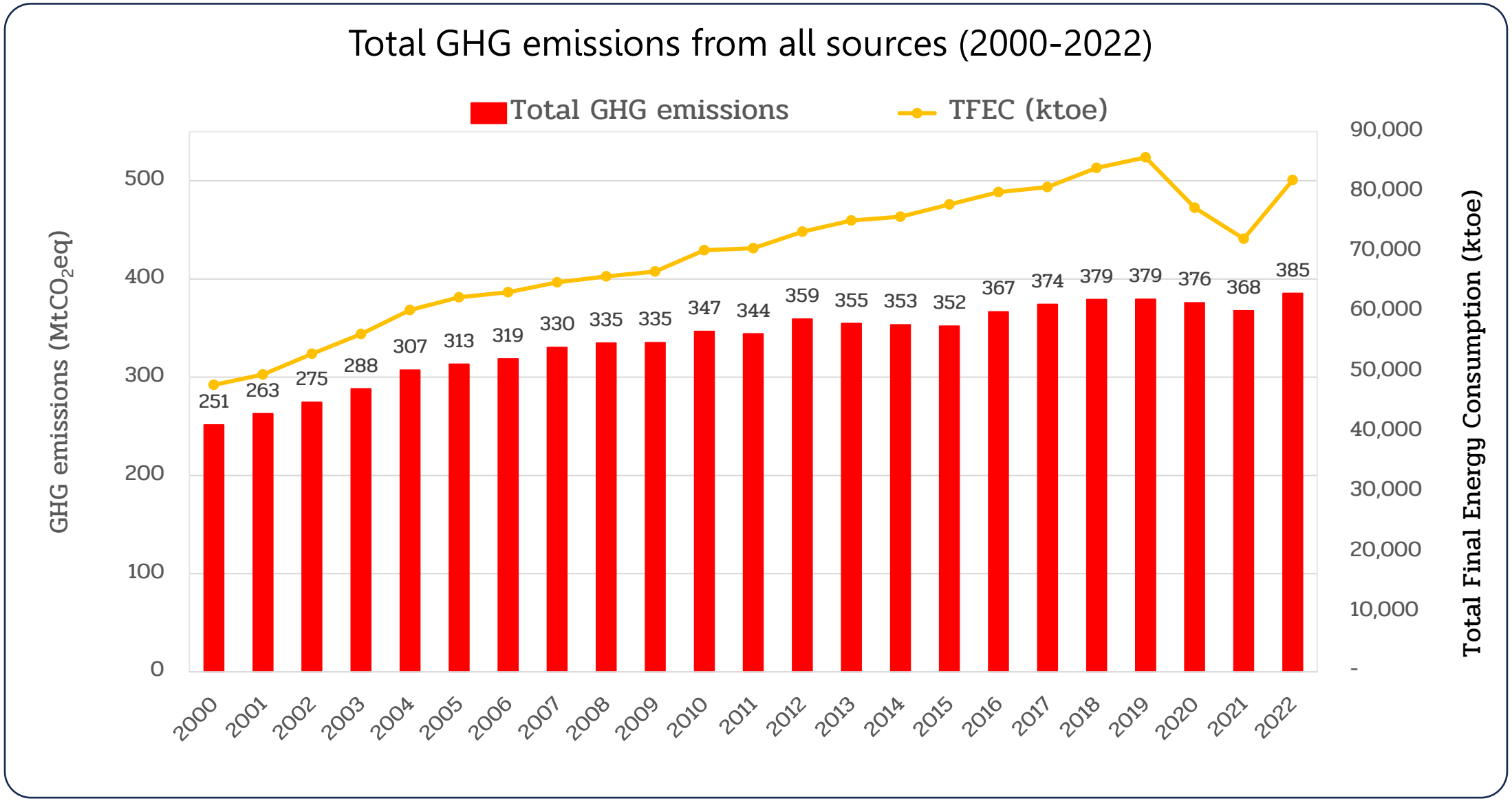
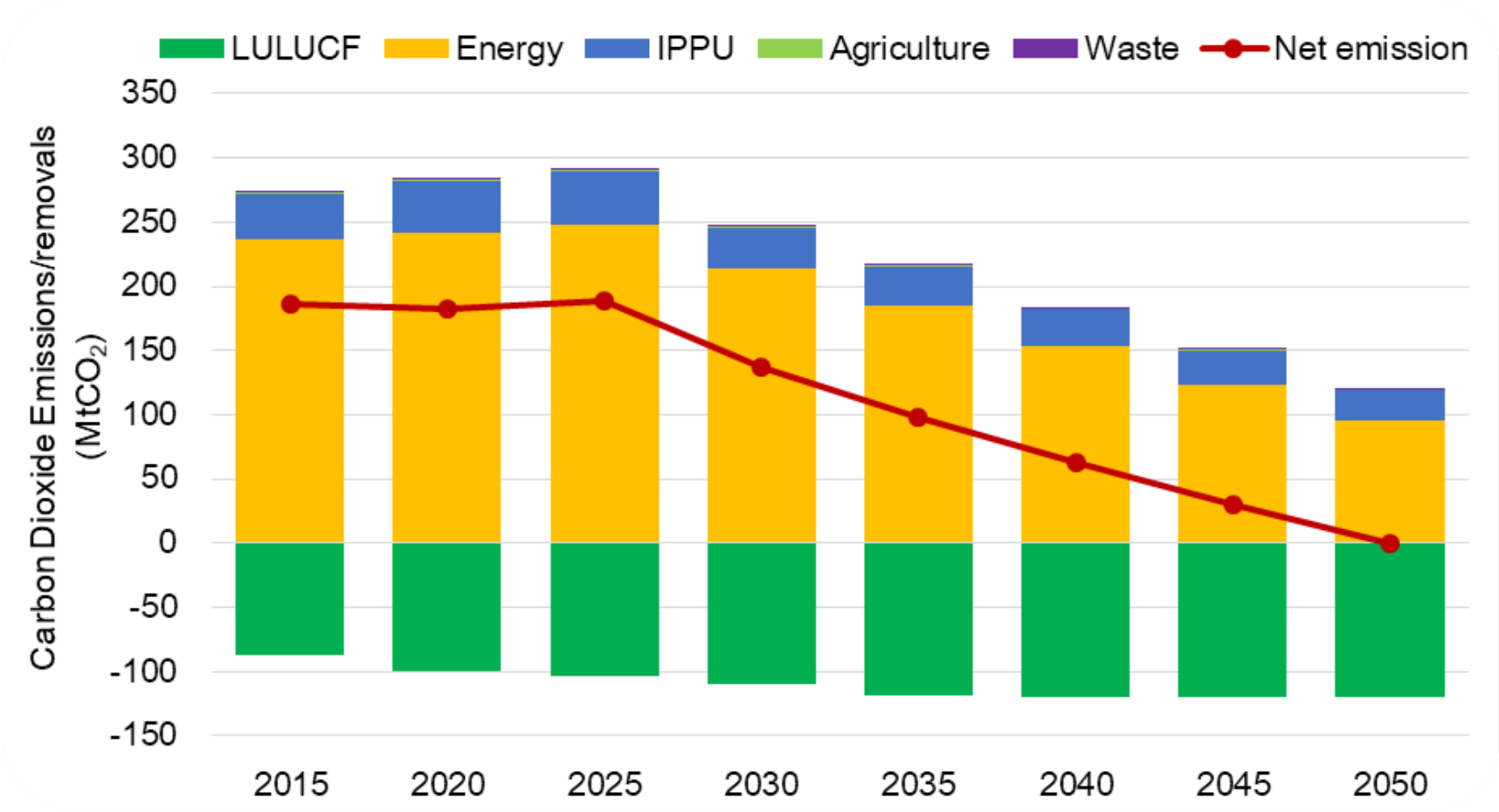
GHG Inventory in Thailand's BTR1



Source: Thailand's BTR1 (UNFCCC, 2024)

Reaffirmed Targets: Carbon Neutrality 2050



Source: Thailand LT-LEDS (Revised Version)_08Nov2022.pdf (unfccc.int)

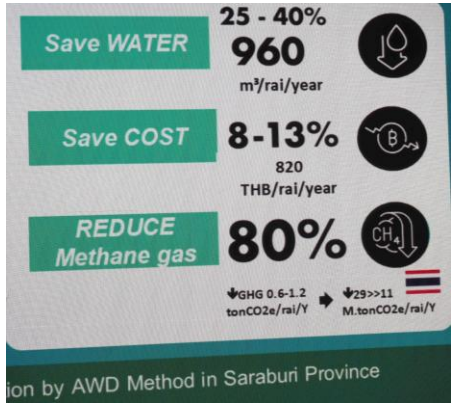
Thailand NDC Action Plan: Approved by Cabinet on 11 Dec. 2024

Sectoral Emissions Mitigation Targets by 2030

Sector	Thailand NDC Mitigation target in 2030					
	Unconditional NDC		Conditional NDC			
			In process of Article 6		Support needed	
	$MtCO_2e$	%	$MtCO_2e$	%	$MtCO_2e$	%
Energy	124.6	22.5	-	-	32.1	5.8
Transport	45.6	8.2	-	-	2.5	0.4
Waste	9.1	1.6	-	-	1.9	0.3
IPPU	1.4	0.3	0.1	0.02		
Agriculture	4.1	0.7	1	0.18		
Total	184.8	33.3	1.1	0.2	36.4	6.5
			37.5 $MtCO_2e$ or 6.7%			
	222.3 or 40%					

Source: NDC Action Plan (DCCE, 2024)

Kubota Smart Farming
Changing the Way We Farm



Public Hearing on Thailand's NDC 3.0 Targets (27 March 2025)

AIM Training at Department of Climate Change & Environment

28-30 May 2025, Bangkok

3-day AIM/ExSS Training in Bangkok (May 29, 2025)

3-day AIM/ExSS Training in Bangkok (May 30, 2025)

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An Investigation of Internationally Transferred Mitigation Outcomes (ITMOs) on GHG Emissions Reduction in Thailand's NDC

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Paris agreement

ABSTRACT

Thailand commits to achieving Carbon Neutrality by 2050 and net-zero GHG emissions by 2065. Its Nationally Determined Contributions (NDC) also aims to reduce greenhouse gas (GHG) emissions by 30% by 2030 through domestic efforts, termed "Unconditional NDC," and up to 40% with international support, termed "Conditional NDC," compared to its 2030 Business-as-Usual (BAU) of 555 $MtCO_2eq$. This study explores the potential for reducing GHG emissions in Thailand's energy sector through international cooperation such as the Joint Credit Mechanism (JCM), in accordance with of the Paris Agreement (PA). It is essential that the results of international transfers are accurately accounted for and reported in the NDC tracking under Article 13 by both Parties to prevent double counting. The investigation utilizes the AIM/EndUse model, created by the National Institute for Environmental Studies in Japan. The results show that under the international cooperation framework, Thailand needs to reduce GHG emissions beyond the target specified in the conditional NDC. Finally, to enable the transfer of Internationally Transferred Mitigation Outcomes (ITMOs) under Article 6.2 of PA, Thailand's share of carbon credits should reasonably be capped at no more than 20%, with an additional emission reduction of 12.34 $MtCO_2$ beyond the conditional Nationally Determined Contribution (NDC) target of 49.34 $MtCO_2$.

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Role of Discount Rate and Social Cost of Carbon for Carbon Capture Utilization and Storage Technologies in Thailand's Low Emissions Pathways

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ABSTRACT

In order to meet Thailand's carbon neutrality target by 2050 (CN2050), it has been proposed that state-of-the-art—but costly—CCUS and BECCS technologies be integrated into the country's electricity generation framework. Climate projects are advised to utilize low discount rates and incorporate the social cost of carbon (SCC). This study employed the AIM/Enduse model, a framework developed by Japan's National Institute for Environmental Studies (NIES), to evaluate suitable discount rates and estimate SCC as the carbon pricing for electricity generation employing CCUS and BECCS technologies. Findings indicate that with a fixed discount rate of 3 percent, SCC begins at 63 USD/tCO$_2$ for achieving the CN2050 target. Conversely, under a declining discount rate scenario - where a 6 percent rate is applied prior to 2037 and then reduced to 3 percent post-2037 - the SCC starts at 21 USD/tCO$_2$ before 2037 and increases to 63 USD/tCO$_2$ thereafter. Therefore, it is crucial to apply suitable discount rates and SCC to encourage adoption of costly negative emissions technologies and achieve objectives of the CN2050 targets.

Thailand's Transport study using AIM/Enduse and AIM/Transport

Transforming Thailand's Transport Sector: Modal Shifts and Advanced Technologies toward Deep Decarbonization

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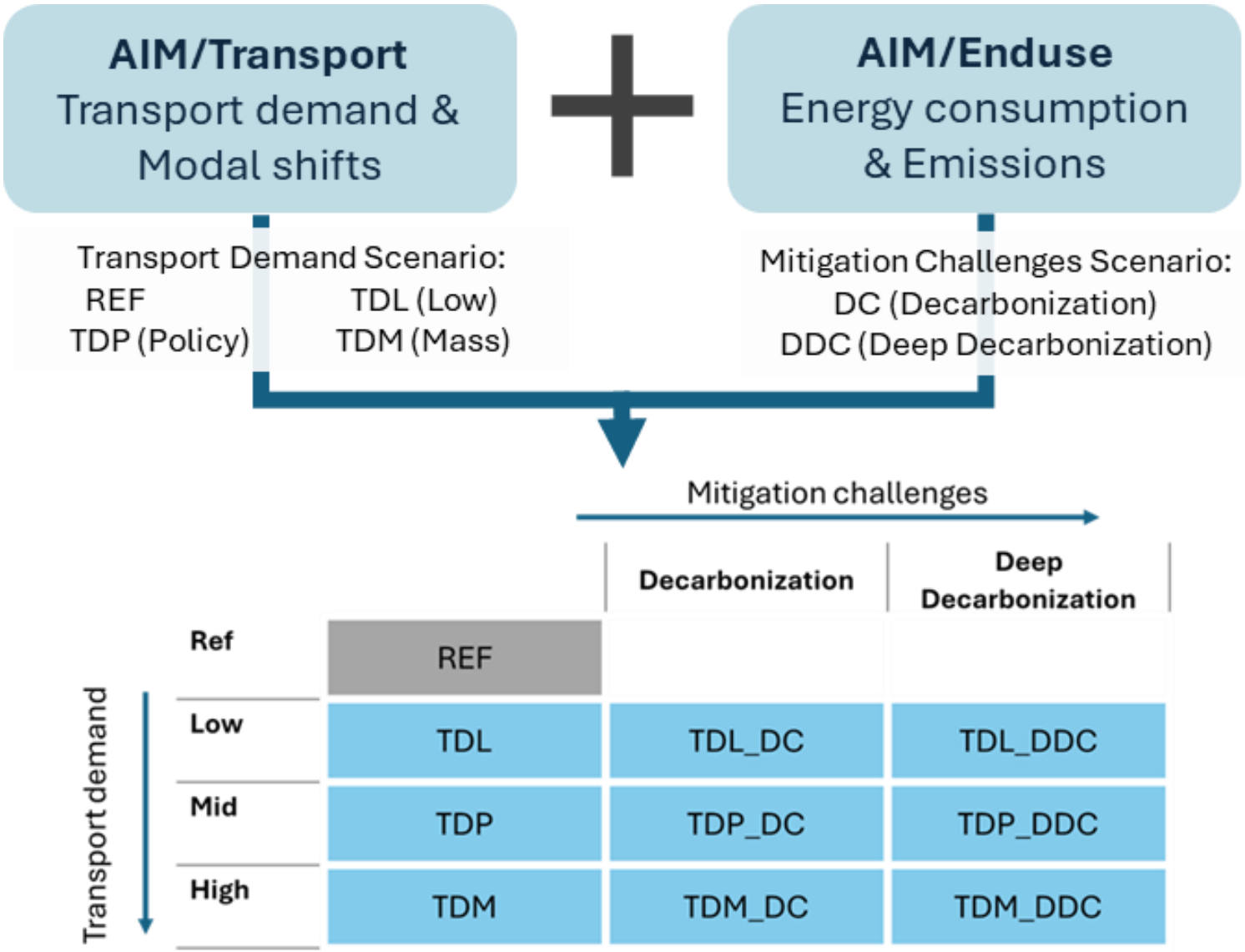
Highlights :

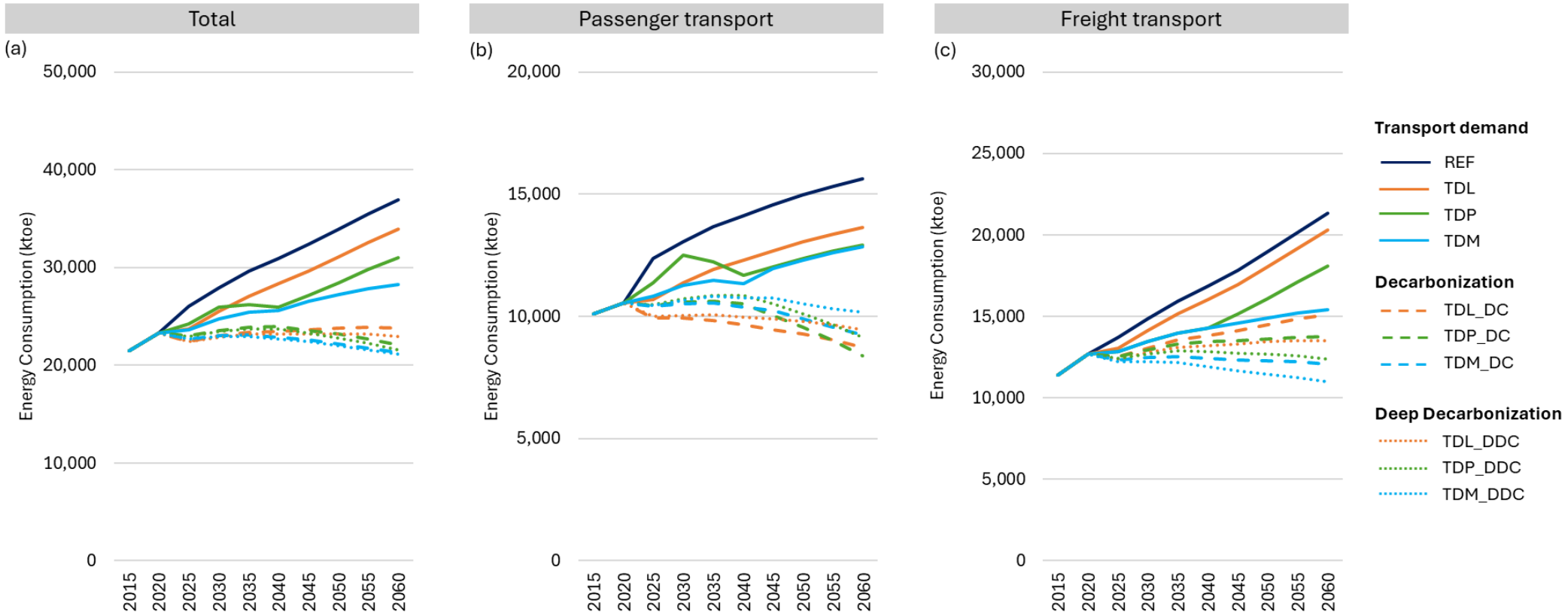
- Mass transit plus advanced technologies significantly cuts transport emissions.
- A clean electricity grid further reduces emissions from EVs and electric trains.
- Hydrogen-powered FCVs crucially decarbonize freight in deep reduction scenarios.
- In investing, mass transit is more cost-effective than private vehicles.

Methodology

- This study develops an integrated model linking two Asia-Pacific Integrated Models (AIMs): **AIM/Transport**, which projects transport demand and modal shifts, and **AIM/Enduse**, which evaluates energy use and emissions under different policy and technology scenarios.
- With the integration of the transport demand and mitigation scenarios, a total of 10 scenarios are produced.

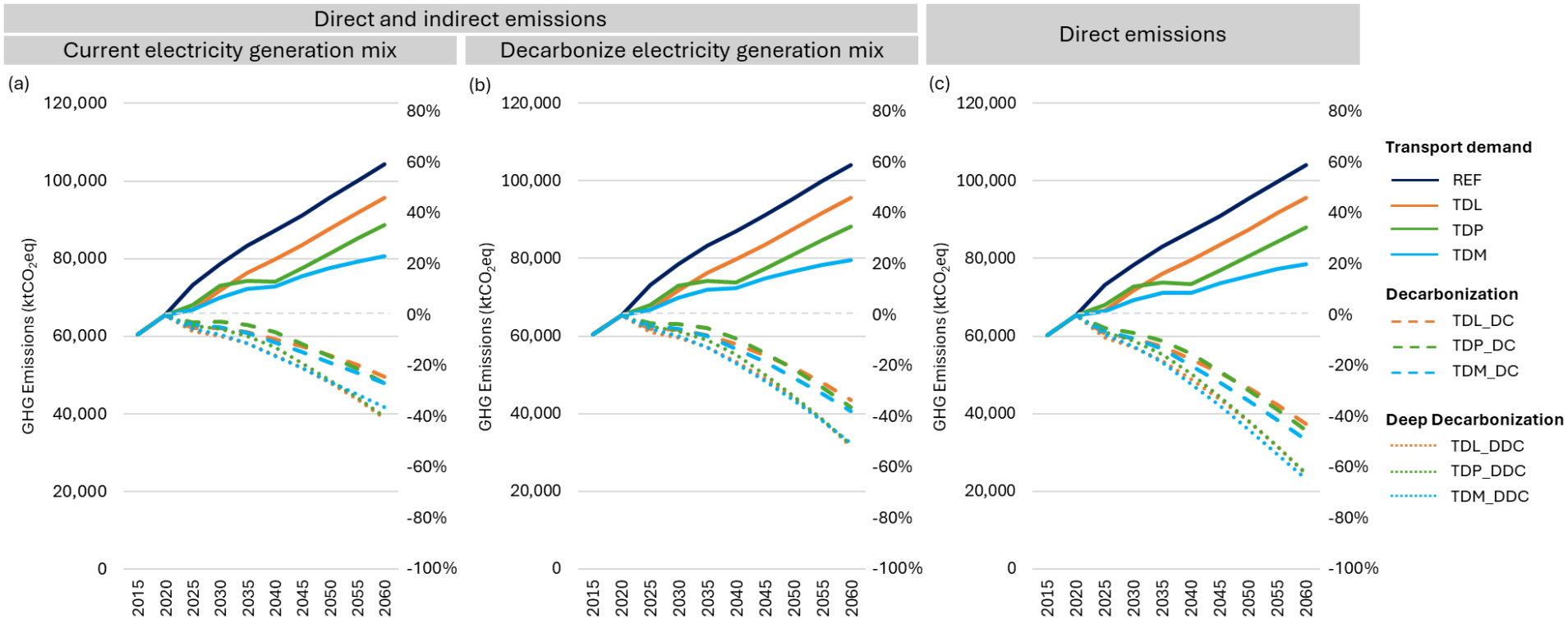


Energy Consumption



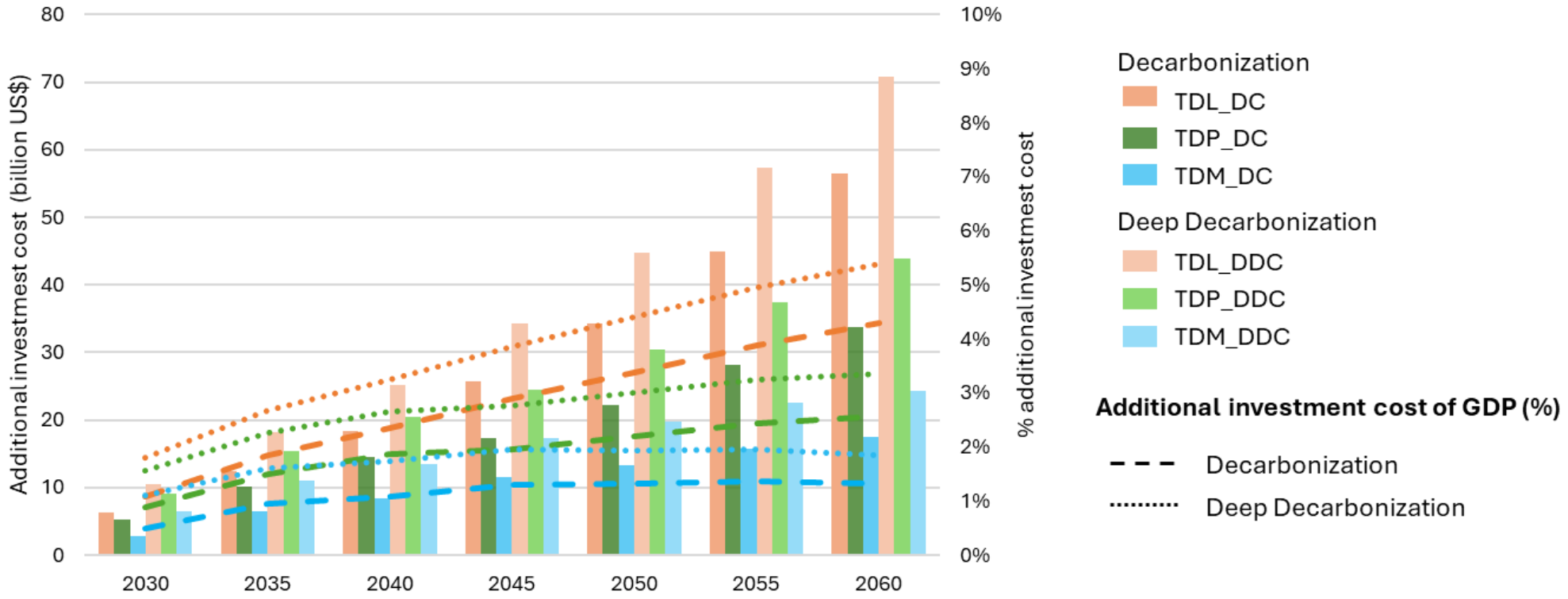
- Due to COVID-19's temporary impact on demand, the TDL scenario shows an 8.2% decrease in total transport energy consumption versus the REF scenario.
- By 2060, expanded mass transit will lower energy consumption by 23.6% in the TDM scenario.
- Adopting advanced technologies reduces energy consumption even more.

GHG Emissions



- In the REF, TDL, TDP, and TDM scenarios, reliance on current technologies causes GHG emissions to rise, driven by growing energy consumption and transport demand.
- Advanced technologies can reduce emissions significantly. Compared to 2020 levels, reductions are 24.3-26.0% in DC and 36.2-40.8% in DDC.
- A decarbonized electricity mix would further cut transport emissions by approximately 8% compared to the current mix.

Investment Cost



- Investment costs for decarbonization rise over time. As a share of GDP, these investments also grow, but at a slower rate than the absolute costs.
- The TDL_DDC pathway is the most resource-intensive, with investment costs reaching approximately 5% of GDP.
- This high ratio is driven by the greater cost of private transportation investments compared to mass transit systems.

Thailand's Power Sector Decarbonization Analysis using AIM/CGE Model

Macroeconomic Implications of Power Sector Decarbonization in Thailand to Achieve Net-Zero Emissions Goal

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Key Message:

- Disaggregation in electricity production is important for quantifying the economic impacts of carbon mitigation.
- Deployment of natural gas-based CCS and BECCS technologies are crucial to decarbonize the power sector.
- Increasing power generation costs, negatively impacts household consumption and leads to economic loss.

Methodology

- **Exogenous Parameters**
  - Available resources
  - Cost and efficiency of technologies
  - Sectoral energy demand
- **Endogenous Parameters**
  - Energy consumptions
  - Emissions
  - Total investment and O&M costs

Electricity generation mix
Carbon capture and storage
Technological advancement

Bottom-up AIM/Enduse Model

Soft-linking

Top-Down AIM/CGE Model

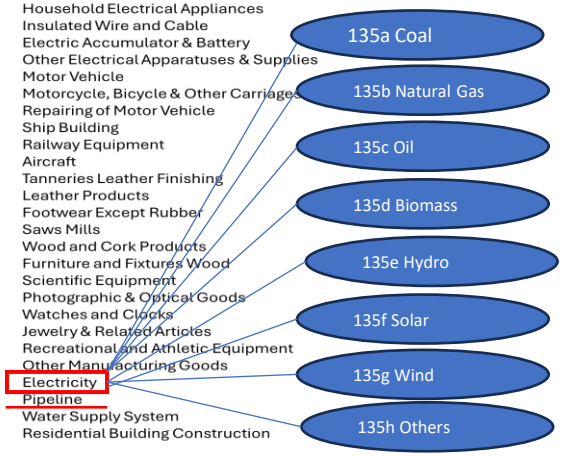
- **Exogenous Parameters**
  - National economic accounts
  - Environmental information
  - Elasticities
  - Productivities and technology inputs
- **Endogenous Parameters**
  - GDP and economic production
  - Household and government consumptions
  - Trade
  - Carbon price
  - Emissions
  - Energy uses

Change in energy technologies
Change in economic productivity

Classification in the 2015 Input-Output Table of Thailand

The I/O table developed by the NESDC is originally classified into 180x180 sectors

001	Paddy
002	Maize
004	Cassava
006	Beans and Nuts
007	Vegetables
008	Fruits
009	Sugarcane
016	Rubber
003	Other Cereals
005	Other Root Crops
010	Coconut
011	Oil Palm
012	Kenaf and Jute
013	Crops for Textile and Matting
014	Tobacco
015	Coffee and Tea
017	Other Agricultural Products
024	Agricultural Services
018	Cattle and Buffalo
019	Swine
020	Other Livestock
021	Poultry
022	Poultry Products
023	Silkworm
025	Logging
026	Charcoal and Firewood
027	Other Forestry Products
028	Ocean and Coastal Fishing
029	Inland Fishing
030	Coal and Lignite
031	Petroleum and Natural Gas
032	Iron Ore
033	Tin Ore
034	Tungsten Ore
035	Other Non-ferrous Metal Ore
036	Fluorite
037	Chemical Fertilizer Minerals
038	Salt Evaporation
039	Limestone
040	Stone Quarrying
041	Other Mining and Quarrying
042	Slaughtering
043	Canning Preserving of Meat
044	Dairy Products
045	Canning of Fruits and Vegetables
046	Canning Preserving of Fish
047	Coconut and Palm Oil
048	Other Vegetable Animal Oils
049	Rice Milling
050	Tapioca Milling
051	Drying and Grinding of Maize
052	Flour and Other Grain Milling
055	Sugar
053	Bakery Products
054	Noodles and Similar Products
056	Confectionery
057	Ice
058	Monosodium Glutamate
059	Coffee and Tea Processing
060	Other Food Products
061	Animal Feed
062	Distilling Blending Spirits
063	Breweries
064	Soft Drinks
065	Tobacco Processing
066	Tobacco Products
067	Spinning
068	Weaving
069	Textile Bleaching and Finishing
070	Made-up Textile Goods
071	Knitting
072	Wearing Apparels Except Footwear
073	Carpets and Rugs
074	Cordage Rope and Twine Products
081	Pulp Paper and Paperboard
082	Paper Products
083	Printing and Publishing
084	Basic Industrial Chemicals
086	Petrochemical products
085	Fertilizer and Pesticides
087	Paints Varnishes and Lacquers
088	Drugs and Medicines
089	Soap and Cleaning Preparations
090	Cosmetics
091	Matches
092	Other Chemical Products
093	Petroleum Refineries
094	Other Petroleum Products
095	Rubber Sheets and Block Rubber
096	Tires and Tubes
097	Other Rubber Products
098	Plastic Wares
102	Cement
103	Concrete and Cement Products
099	Ceramic and Earthen Wares
100	Glass and Glass Products
101	Structural Clay Products
104	Other Non-metallic Products
105	Iron and Steel
106	Secondary Steel Products
107	Non-ferrous Metal
108	Cutlery and Hand Tools
109	Furniture and Fixtures Metal
110	Structural Metal Products
111	Other Fabricated Metal Products
112	Engines and Turbines
113	Agricultural Machinery
114	Wood and Metal Working Machinery
115	Special Industrial Machinery
116	Office and Household Machinery
117	Electrical Industrial Machinery
118	Radio and Television
119	Household Electrical Appliances
120	Insulated Wire and Cable
121	Electric Accumulator & Battery
122	Other Electrical Apparatuses & Supplies
125	Motor Vehicle
126	Motorcycle, Bicycle & Other Carriages
127	Repairing of Motor Vehicle
123	Ship Building
124	Railway Equipment
128	Aircraft
075	Tanneries Leather Finishing
076	Leather Products
077	Footwear Except Rubber
078	Saws Mills
079	Wood and Cork Products
080	Furniture and Fixtures Wood
129	Scientific Equipment
130	Photographic & Optical Goods
131	Watches and Clocks
132	Jewelry & Related Articles
133	Recreational and Athletic Equipment
134	Other Manufacturing Goods
135	Electricity
136	Pipeline
137	Water Supply System
138	Residential Building Construction
139	Non-Residential Building Construction
140	Public Works for Agriculture & Forestry
141	Non-Agricultural Public Works
142	Construction of Electric Plant
143	Construction of Communication Facilities
144	Other Constructions
145	Wholesale Trade
146	Retail Trade
147	Restaurant and Drinking Place
148	Hotel and Lodging Place
149	Railways
150	Route & Non-Route of Road Passenger Trans.
151	Road Freight Transport
152	Land Transport Supporting Services
153	Ocean Transport
154	Coastal & Inland Water Transport
155	Water Transport Services
156	Air Transports
157	Other Services
158	Silo and Warehouse
159	Post and Telecommunication
160	Banking Services
161	Life Insurance Service
162	Other Insurance Service
163	Real-estate
164	Business Service
165	Public Administration
166	Sanitary and Similar Services
167	Education
168	Research
169	Hospital
170	Business and Labor Associations
171	Other Community Services
172	Motion Picture Production
173	Movie Theater
174	Radio, Television and Related Services
175	Library and Museum
176	Amusement and Recreation
177	Repair, Not Elsewhere Classified
178	Personal Services
179	Other Service not Classified Elsewhere
180	Unclassified
190	Total Intermediate Transaction
201	Wages and Salaries
202	Operating Surplus
203	Depreciation
204	Indirect Taxes less Subsidies
209	Total Value Added
210	Control Total
301	Private Consumption Expenditure
302	Government Consumption Expenditure
303	Gross Fixed Capital Formation
304	Increase in Stock
305	Exports (F.O.B.)
306	Special Exports
309	Total Final Demand
310	Total Demand
401	Imports (C.I.F.)
402	Import Duty
403	Import Tax
404	Special Imports
409	Total Imports
501	Wholesale Trade Margin
502	Retail Trade Margin
503	Transportation Cost
509	Total Margin and Transportation Cost
600	Control Total
700	Total Supply



- Total value of each commodity is allocated in proportion to the electricity generation share by technology
- Annualized capacity cost is used for disaggregating the operating surplus & depreciation among the various electricity generation technologies
- To reduce the computational time, the original 180 sectors have been grouped & consolidated into 32 production sectors, including five energy sectors

Source: NESDC (2021)

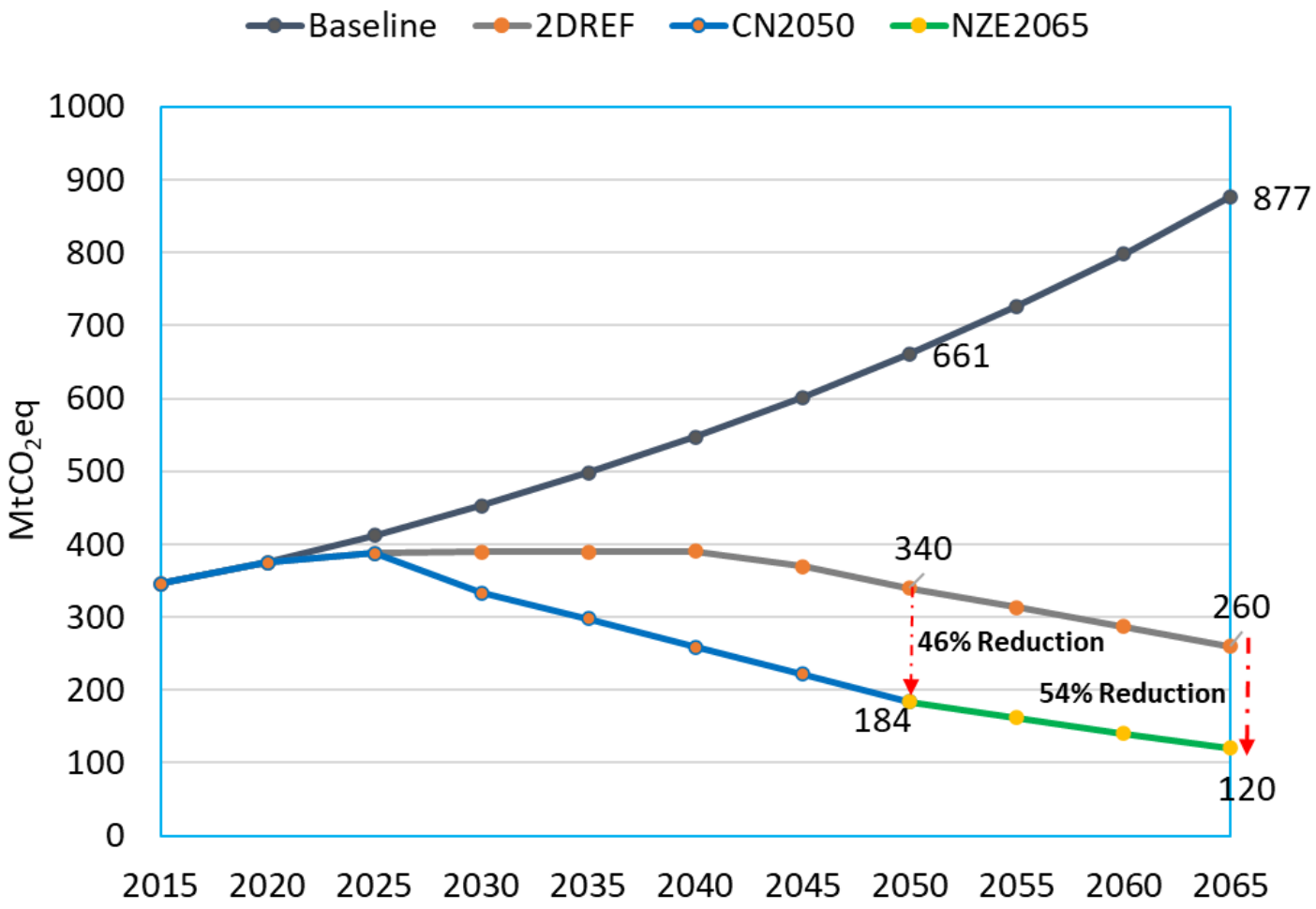
GHG Emissions Trajectory

Baseline scenario: Assumes the continuation of existing climate policies as of 2015, without implementation of any new measures.

Two-degree reference: Aligned with the IPCC's two-degree pathway, under which Thailand is projected to achieve net-zero GHG emissions balancing emissions by sources with removals by sinks by 2090.

Net-Zero emission: Aligned with the IPCC's 1.5-degree pathway, this scenario envisions Thailand reaching net-zero GHG emissions by 2065, with emissions from sources balanced by removals from sinks post-2050.

The LULUCF sector is assumed to contribute a consistent carbon removal of 120 $MtCO_2$ annually from 2037 onwards.

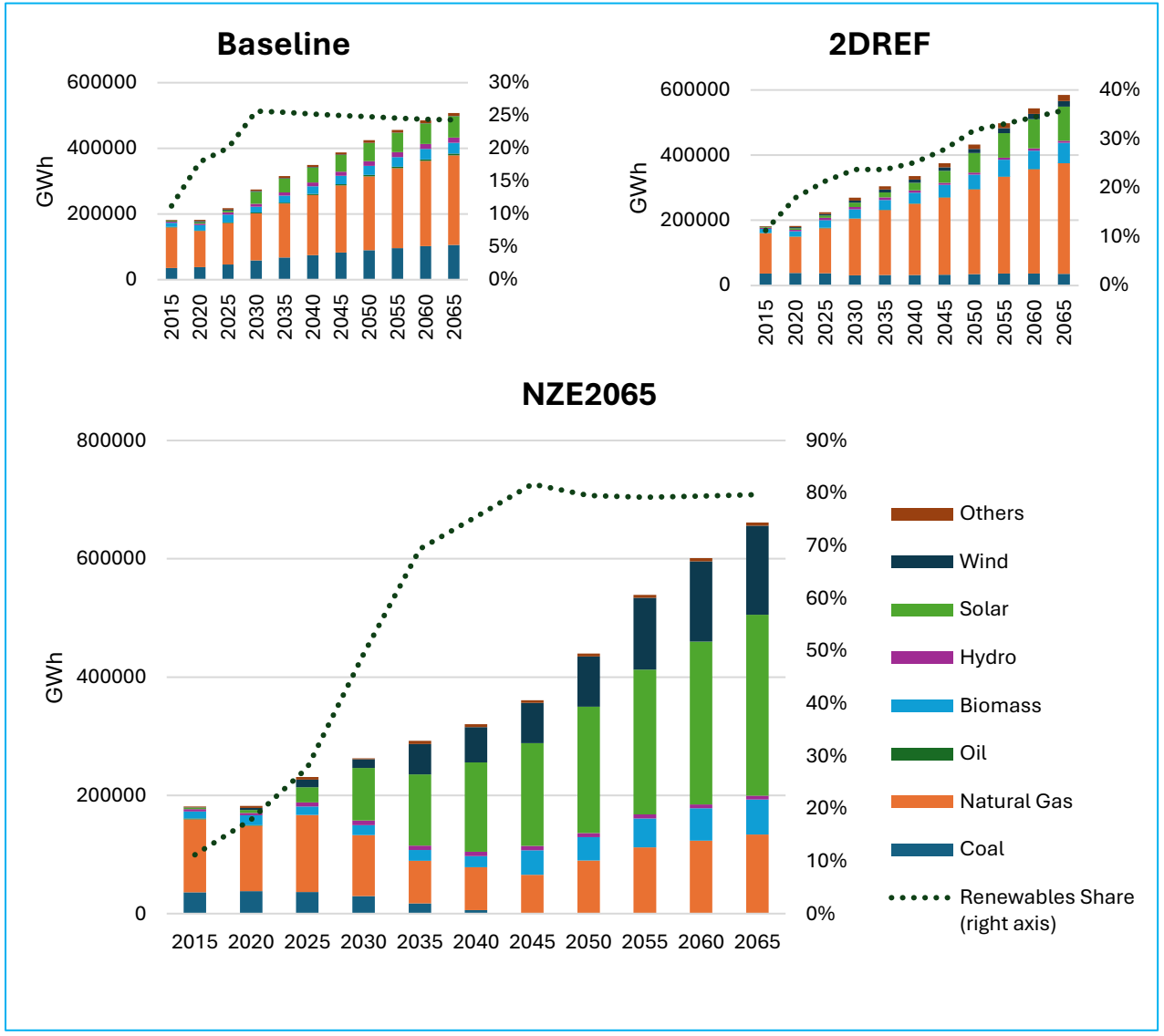


Electricity Generation Mix

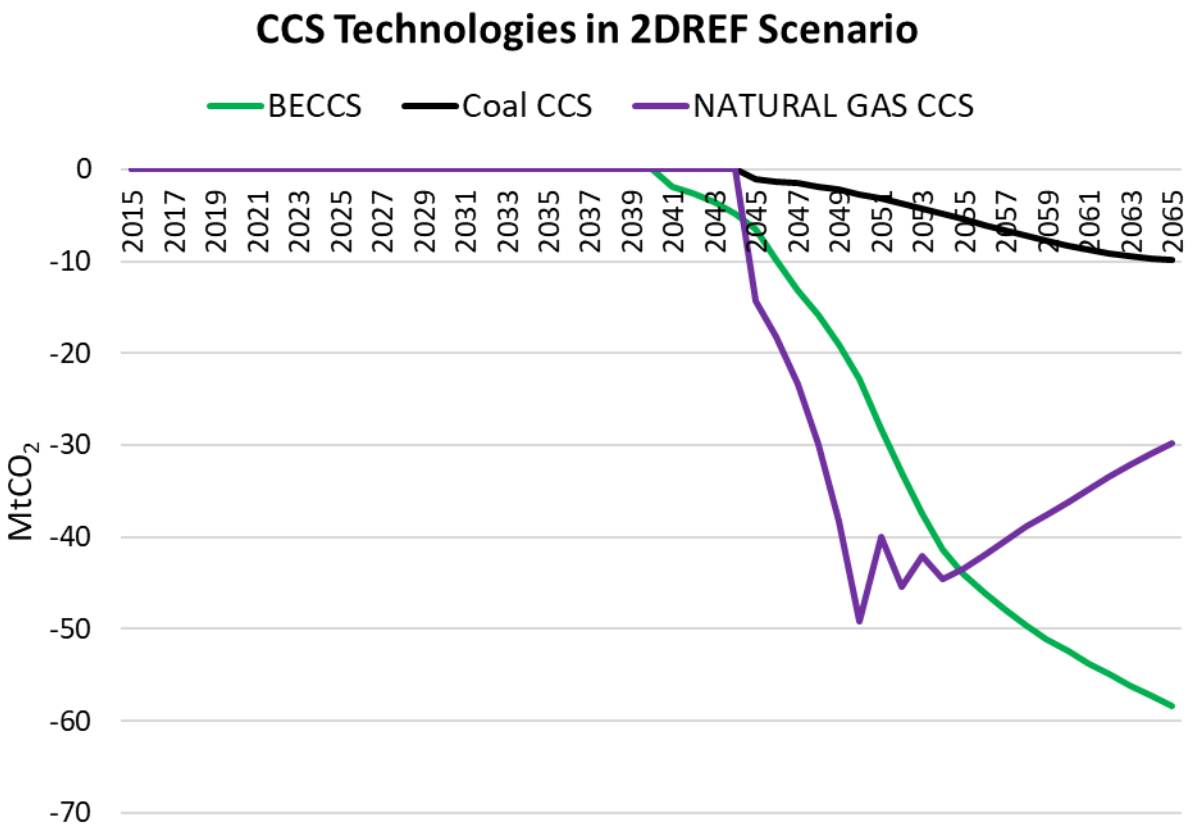
- **Baseline**
  - Natural gas dominant
  - Renewable share increase from 11.2% in 2015 to 24.8% in 2050 & 24.3% in 2065
  - Solar share 1.3% in 2015 to 12.8% in 2065

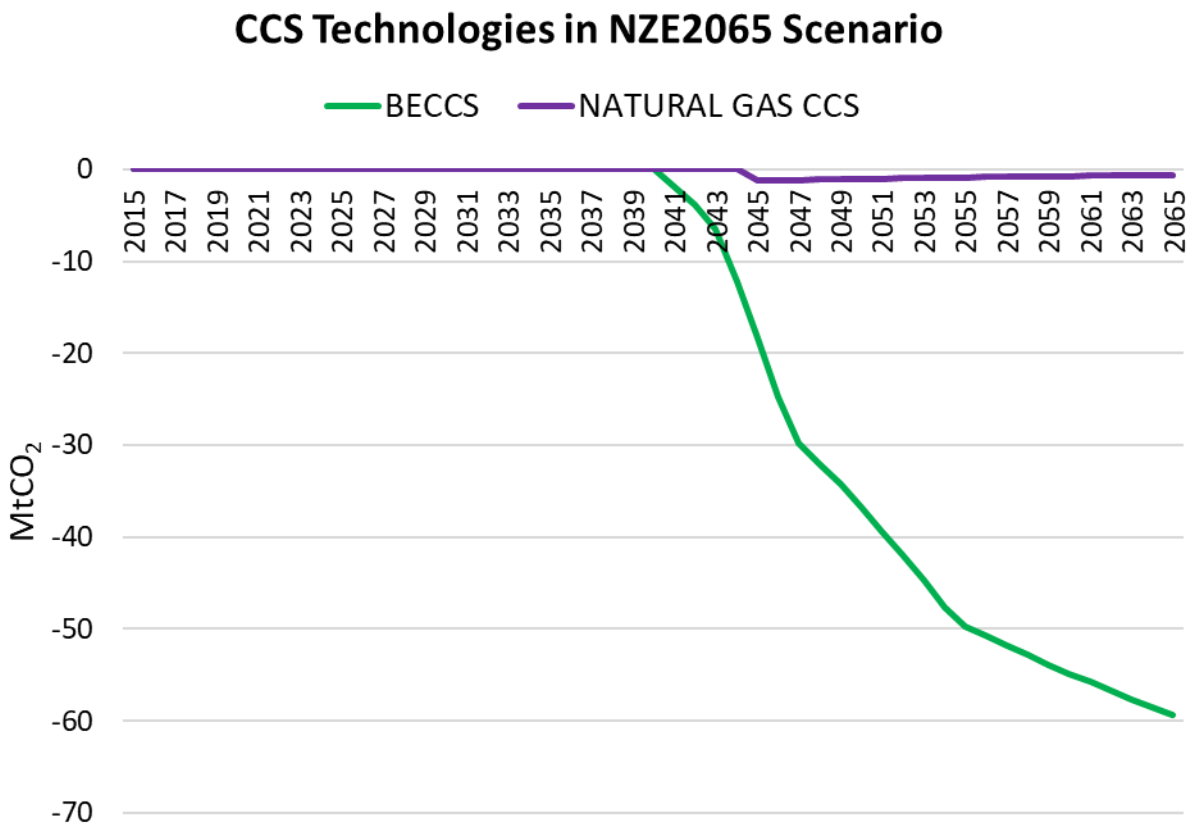
- **2DREF**
  - Renewable share increase to 31.8% in 2050 & 35.8% in 2065
  - Solar share 17.9% in 2065
  - Coal CCS, Natural gas CCS & BECCS

- **NZE2065**
  - Renewable share increase to almost 80% in 2065
  - Solar share 46.2% in 2065, includes both solar with & without battery storage
  - Natural gas CCS & BECCS



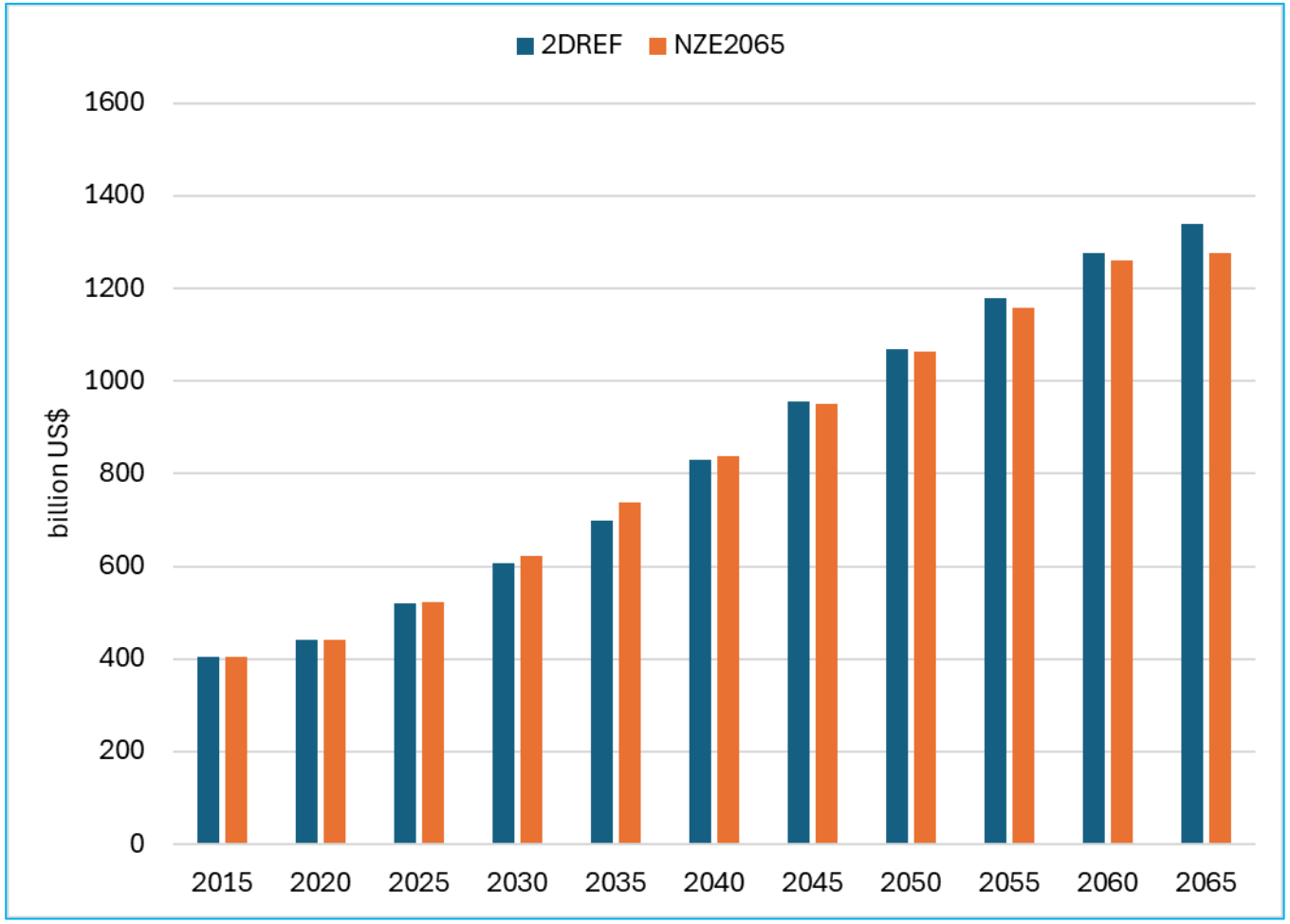
Carbon Capture & Storage Play a Key Role in Carbon Removal in Power Generation





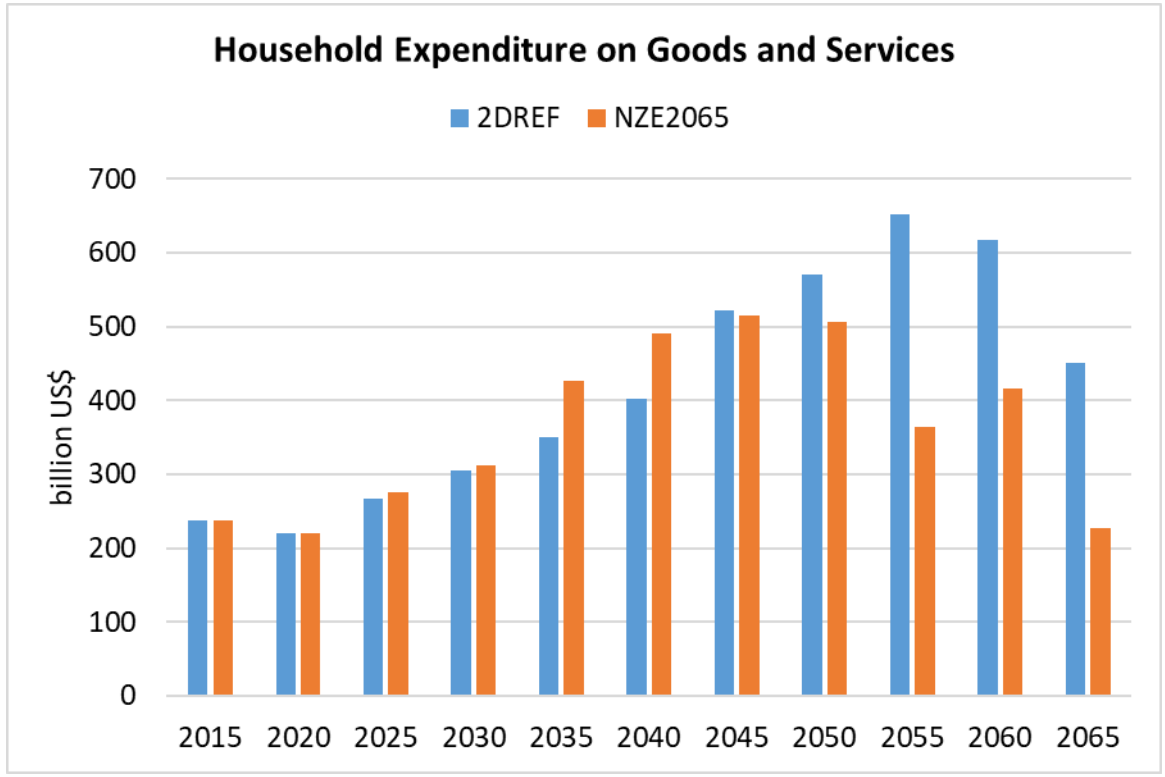
National GDP

Thai economy will experience a GDP gain during 2025-2040 in the NZE2065 scenario while a GDP loss of 0.5% in 2045 to 4.7% in 2065

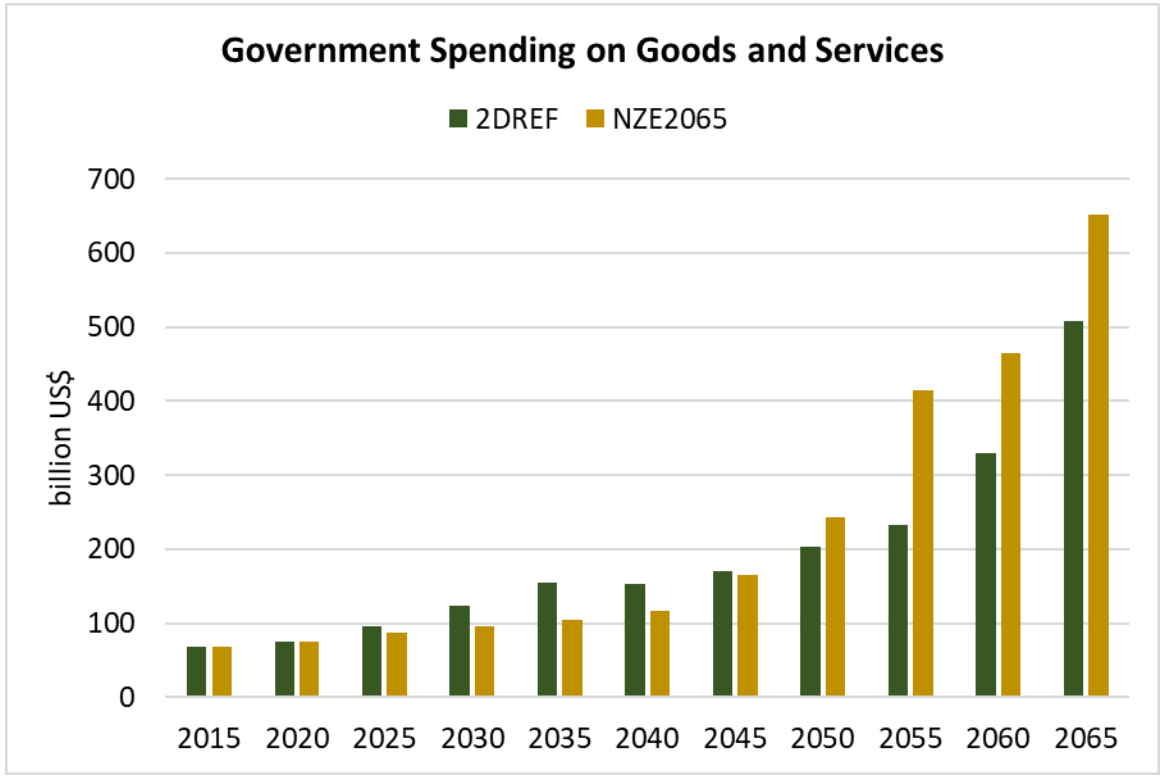


Household and Government Final Consumption Expenditure

Observed negative impact on household consumption, resulting in GDP loss in the NZE2065 scenario

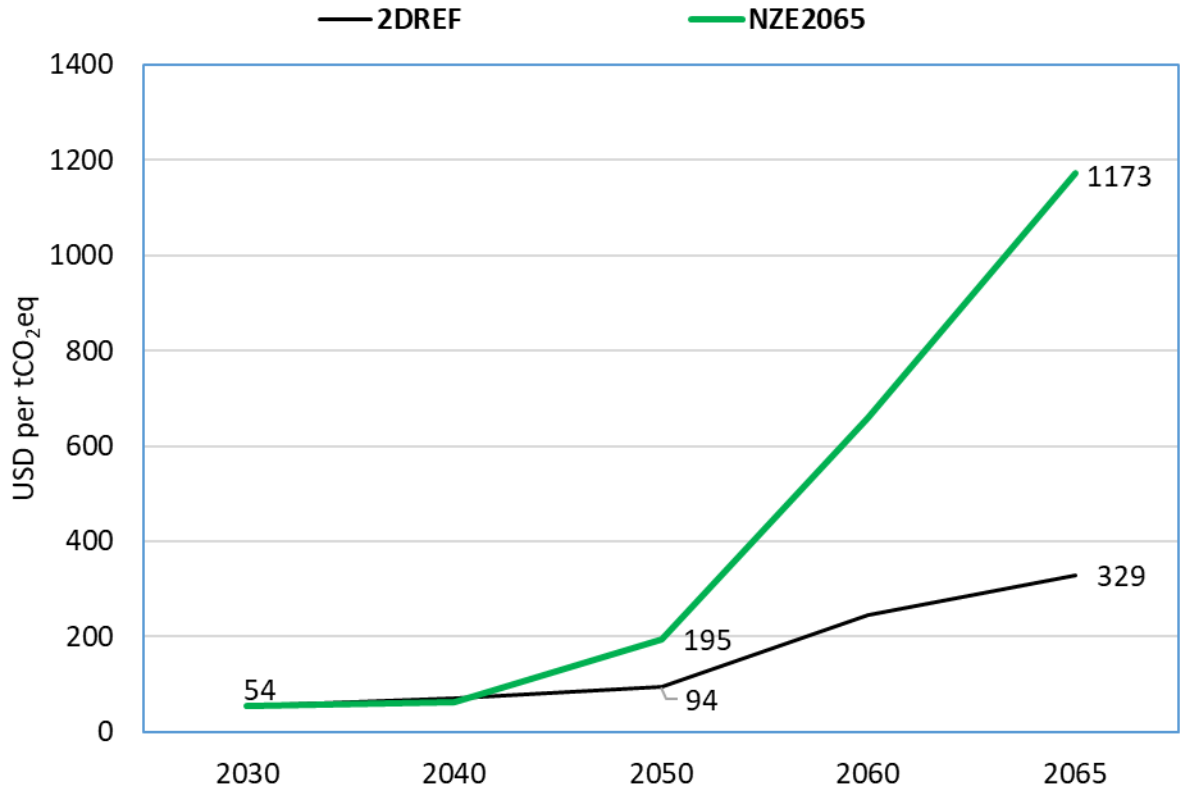


With increasing GHG emission reduction efforts towards achieving NZE2065, consumer spending on goods & services declines due to economic downturns. In contrast, government consumption increases significantly to reach these targets



Price of Carbon Emissions

- Variation in technology choices results in a wide range of carbon prices
- Carbon prices are projected to rise to US$195 per tCO_2eq in 2050 to achieve carbon neutrality
- Price would surge to reach US$1173 per tCO_2eq by 2065 to achieve the net-zero GHG emissions target



Concluding Remarks

- A multi-pronged strategy is essential for Thailand to achieve its climate targets. Our findings support the following policy actions:
  - **Invest in Mass Transit:** Prioritize and accelerate investments in rail & water-based public transport to drive modal shifts. This is the most cost-effective foundation for decarbonization.
  - **Accelerate Technology Adoption:** Implement robust incentives (subsidies, tax credits) for EVs & FCVs, coupled with charging & hydrogen infrastructure development.
  - **Decarbonize the Power Grid:** Coordinate transport policy with energy policy to ensure that the electricity powering EVs is clean
  - **Accelerate Deployment of Renewable Energy-based Power Generation:** Prioritize policy instruments promoting rapid expansion of renewable electricity generation
  - **Deployment of CCS & BECCS technologies :** Strategic policy measure to promote the implementation of CCS & BECCS in Thailand
  - **The potential increase in employment from green jobs could offset some of the associated economic losses**

THANK YOU

谢谢　ຂອບໃຈ　TERIMA KASIH　どうもありがとう