Analysis on Vietnam's NDC Reduction Target and Further Decarbonization using AIM/Enduse

Takaharu Ota*1, Tomoki Hirayama*1, Yuko Motoki*1 and Go Hibino*2

*1 Mizuho Research & Technologies, Ltd. (MHRT)
*2 National Institute for Environmental Studies (NIES)

Background

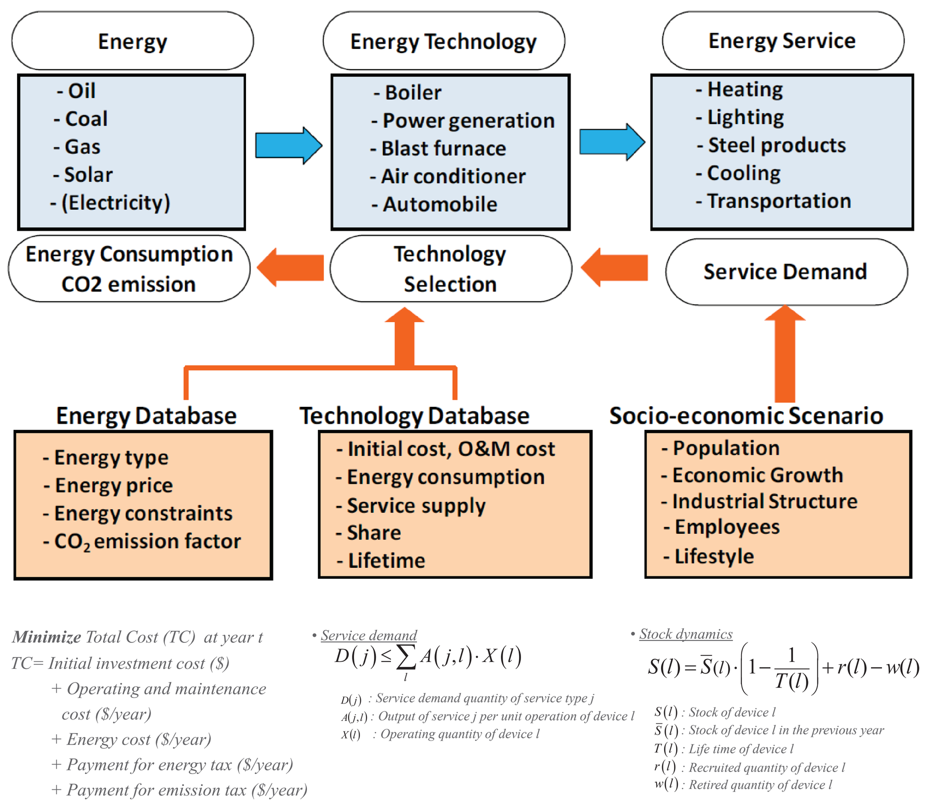
- In Vietnam, the economy has been growing dramatically and GDP growth rate was above 7% in 2018 and 2019, even under the COVID-19 pandemic, still 2.91% in 2020.
- Also CO2 emission is increasing, CO2 emission per capita has doubled in the last 10 years. Vietnam's urgent issue is to reduce emission with maintaining its economic development.
- Vietnam's updated NDC indicates that the emission reduction is increased from 9% to 27% by 2030 with international support under the Article 6th of Paris Agreement.

Purpose

- Exploring the Potentiality CO2 emission reduction in Vietnam by 2030
- Identification of emission pathway and emission peak in Vietnam by 2050
- Consideration of Vietnam's strategies for further decarbonization and contribution of supports from developed countries

Methodology

Model structure of AIM/Enduse



Assumption of countermeasures and service demand

Countermeasure	Detail	Sector	Device	Intensity of countermeasures *				
				TechFixed		Lowcarbon		
				Supply & Demand	Demand only	Low	Middle	High
Renewable	Conversion from fossil fuels to renewables	Power		–	△	△	○	◎
Energy saving	Introduction of high efficiency devices	All		–	–	○	○	◎
Fuel conversion	Conversion from coal and traditional biomass to oil and gas	All		–	–	○	○	◎
Electrification	Introduction of electric device	Building	Heat pump, IH cooking device	–	–	△	○	◎
		Transport	Electric vehicle, Hybrid car	–	–	△	○	◎
CCS	Introduction of CCS	Cement		–	–	△	○	◎
		Power		–	–	△	○	◎
Hydrogen	Introduction of hydrogen device	Transport	Fuel cell vehicle	–	–	–	○	◎

* △, ○ and ◎ are intensities of countermeasures. They mean the intensity is low, middle and high respectively.

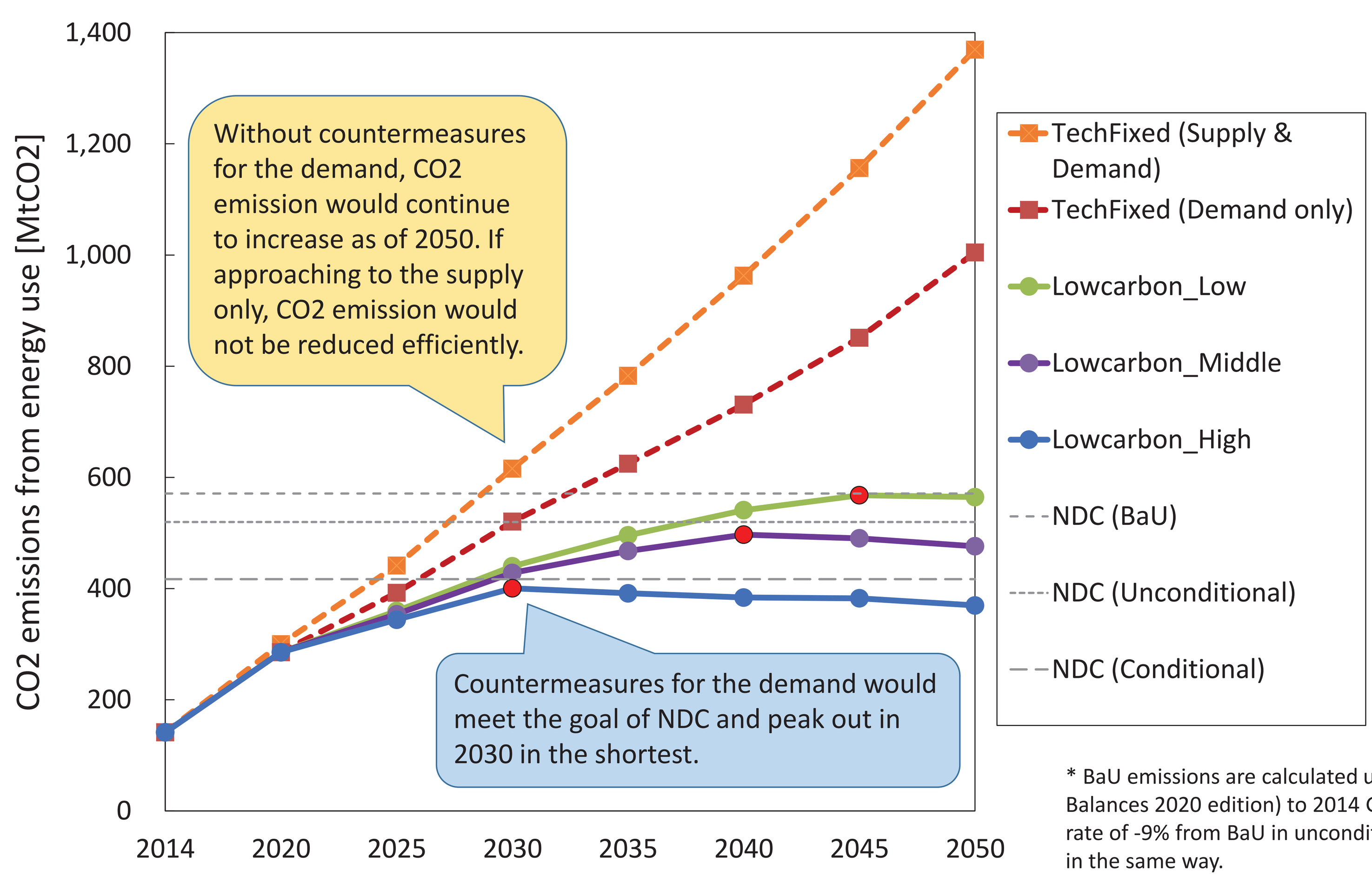
Sector	Unit	2014		2030		2050	
		Service Demand	Index	Service Demand	Index	Service Demand	Index
Steel (production)	Mton	6	100	48	812	64	1,094
Cement(production)	Mton	61	100	140	230	164	269
Other Industry	ktoe	15,072	100	44,495	295	83,468	554

Sector	Unit	2014		2030		2050	
		Service Demand	Index	Service Demand	Index	Service Demand	Index
Residential	ktoe	12,624	100	17,024	135	22,524	178
Service	ktoe	2,472	100	7,298	295	23,118	935
Transport (passenger)	Bpkm	385	100	960	249	1,919	498
Transport (freight)	Btkm	225	100	621	276	2,395	1,064

- Using AIM/Enduse, we estimate CO2 emissions from energy use in Vietnam up to 2050.
  - AIM/Enduse model selects technologies to meet the service demand with minimizing the total cost.
  - TechFixed scenarios are set as BaU, which are subdivided to two, "TechFixd (Supply & Demand)" and "TechFixed (Demand only)".
  - Lowcarbon scenarios are set as countermeasures, which are subdivided to three, "Lowcarbon_Low", "Lowcarbon_Middle" and "Lowcarbon_High" by the intensity of countermeasure and the period of introduction.
  - Refers to Vietnam Population Projection 2014 – 2049 (GSO, 2016) at population, DRAFT PDP8 (MOIT, 2021) at GDP growth rate, and expectancy data by Vietnamese government at energy source, service demand and energy price etc.

Result

Estimated CO_2 emission from energy use in BaU scenario and countermeasure scenario



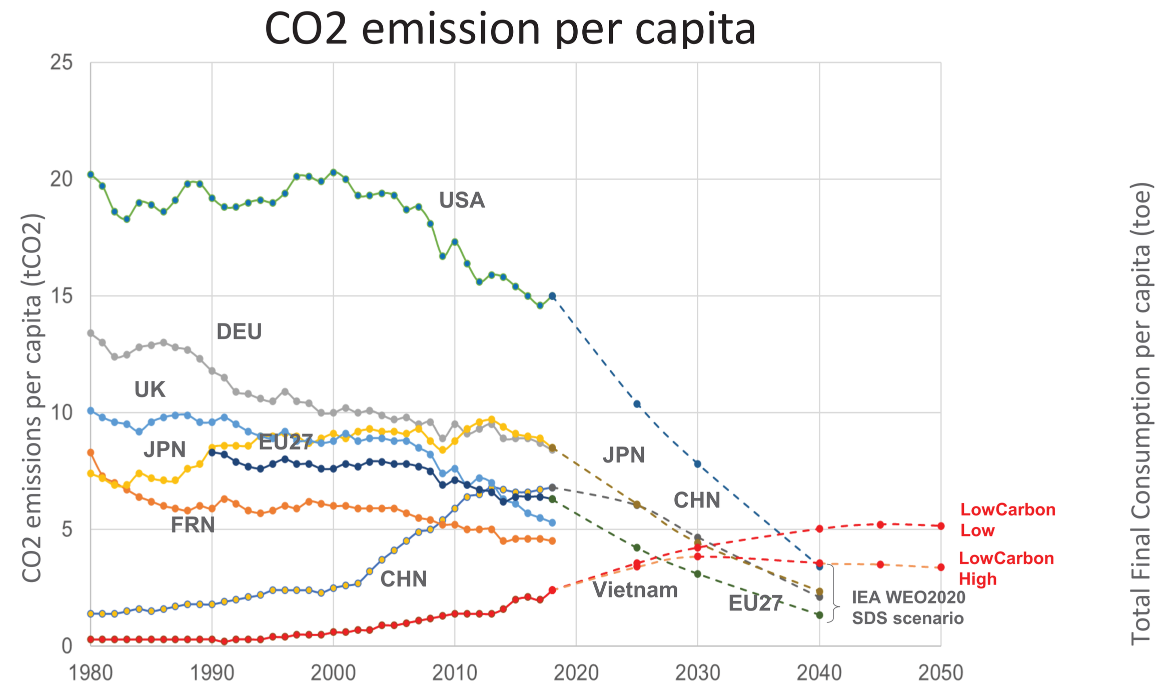
* BaU emissions are calculated using the ratio (84%) of 2014 CO2 emissions from energy use (source: World Energy Balances 2020 edition) to 2014 GHG emissions from energy use (source: updated NDC) considering the reduction rate of -9% from BaU in unconditional NDC. Emissions equivalent to conditional NDC in the figure are also converted in the same way.

- In TechFixed scenarios, CO2 emission would continue increasing as of 2050. Implementing countermeasures fixing the share of both the supply and the demand, it would be a little higher than the goal of NDC(BaU)* in 2030.
- In Lowcarbon scenarios, CO2 emission could peak out by 2050 with countermeasures for the demand.
  - It is almost equivalent to the goal of conditional NDC in 2030 apart from the intensity of the countermeasures or the period of introduction.

- Both CO2 emission per capita and Total final energy consumption per capita are fewer in Vietnam than in developed countries so far. But the gap between them would be little in 2040.

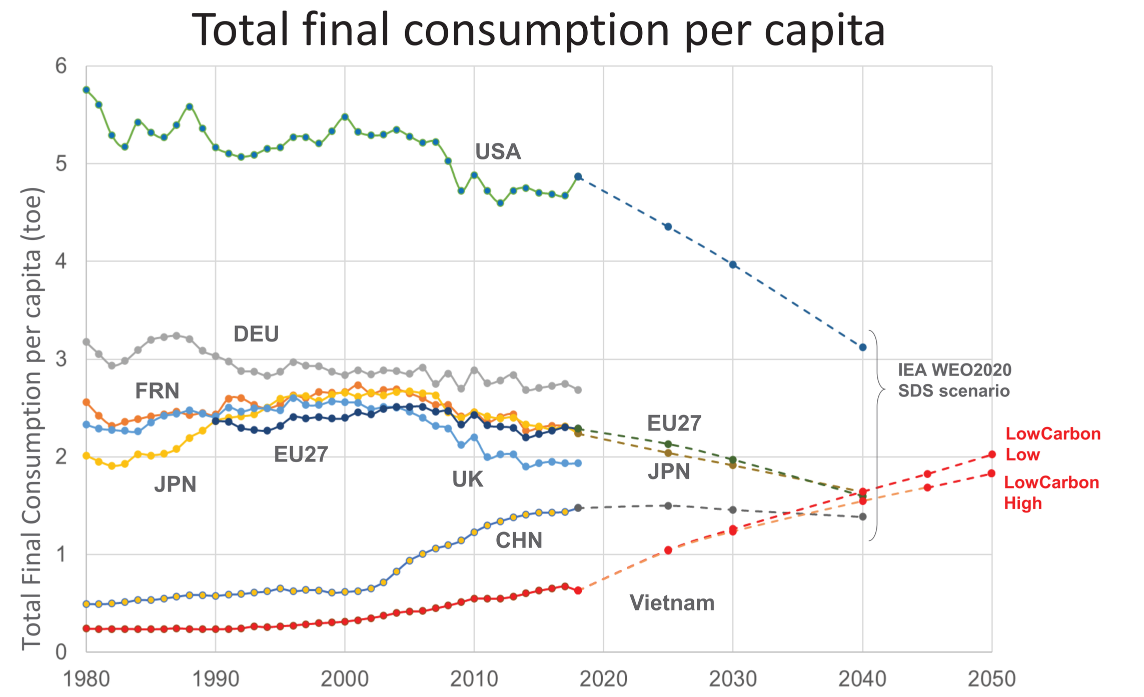
Comparison of CO2 emission and total final consumption per capita with developed countries

CO2 emission per capita



CO2 of CHN, EU27, JPN, USA in 2025, 2030, 2040 from IEA World Energy Outlook 2020 Sustainable Development Scenario
CO2 of Vietnam in 2025, 2030, 2040, 2045, 2050 from this analysis (Lowcarbon Low ~ High)
CO2 from 1980 to 2018 of all countries and region from IEA CO2 emissions.
Population from UN World Population Prospects 2019

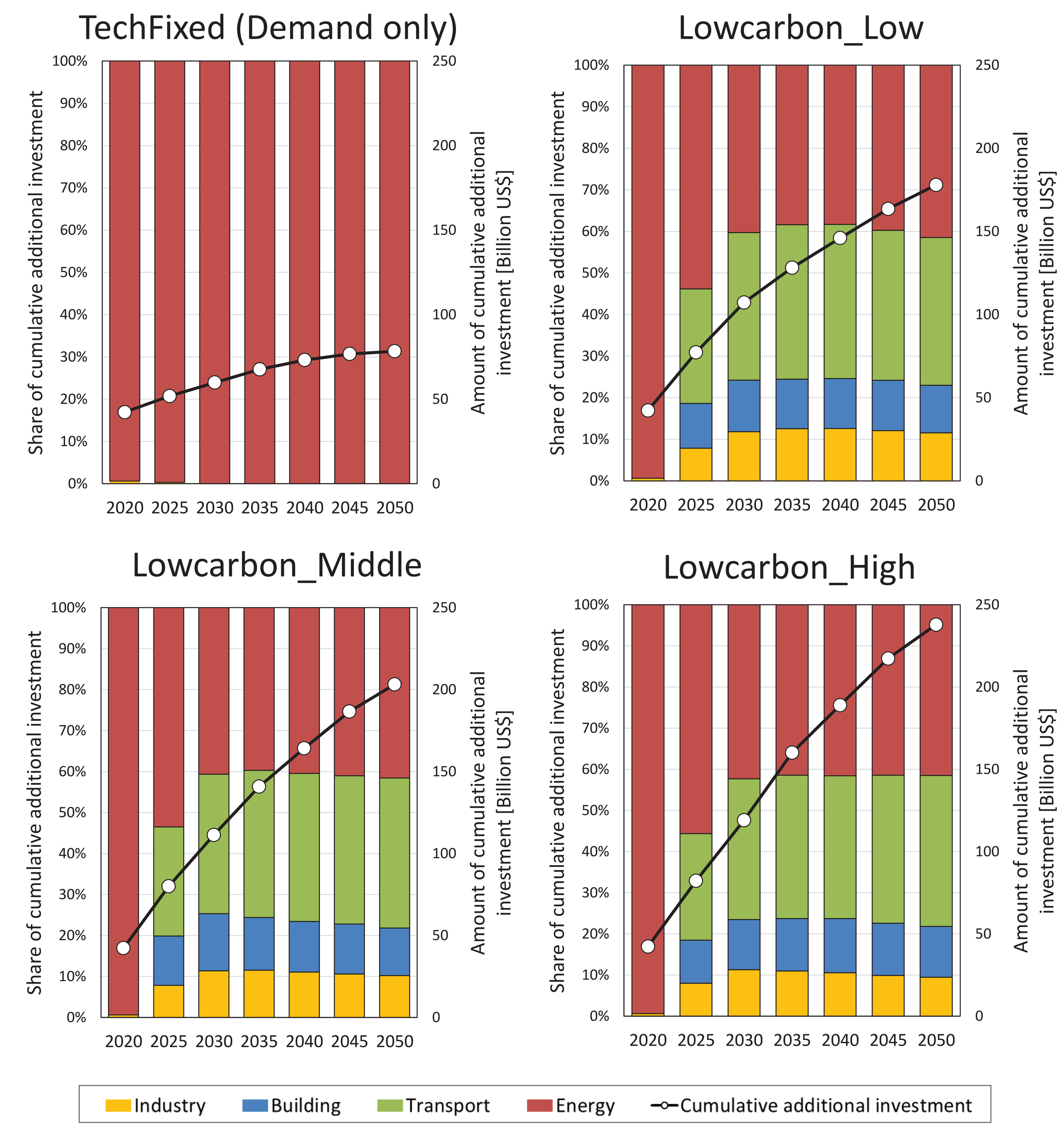
Total final consumption per capita



TFC of CHN, EU27, JPN, USA in 2025, 2030, 2040 from IEA World Energy Outlook 2020 Sustainable Development Scenario
TFC of Vietnam in 2025, 2030, 2040, 2045, 2050 from this analysis (Lowcarbon Low ~ High)
TFC from 1980 to 2018 of all countries and region from IEA energy balances.
Population from UN World Population Prospects 2019

- Implement the strictest countermeasures, the amount of cumulative additional investment is around 240 billion USD, around 1% of total sum of GDP from 2014 to 2050.
- The amount of cumulative additional investment is required especially in energy sector and transport sector.
  - Developed countries could give technical and financial support in energy sector and transport sector.

Estimated cumulative additional cost (compared to TechFixed (Supply & Demand))



Next Step

- Explore more efficient scenarios to drive down emissions toward Net-zero after peaking out.
- Continue to update the technical data and reflect on further analysis of Vietnam, in concert with researchers and policy makers.

Conclusion

- If following Vietnam's current power plan without countermeasures for the demand, CO2 emission would not peak out up to 2050.
- Adopting countermeasures for the demand, with early and broad introduction, CO2 emission could peak out in 2030 and Vietnam could achieve the goal of conditional NDC.
- In Vietnam CO2 emission per capita and total final consumption per capita would be equivalent to or larger than those of developed countries in 2040, which requires Vietnam further climate action to lower its emissions.
- Additional investment to reduce CO2 emissions is needed particularly in energy sector and transport sector in Vietnam, supported by developed countries including Japan.

Acknowledgement : We express our sincere thanks to Mr. Tan, Dr. Lam and Dr. Bao