ภาพอนาคตพลังงานไทยเพื่อความยั่งยืน 2050

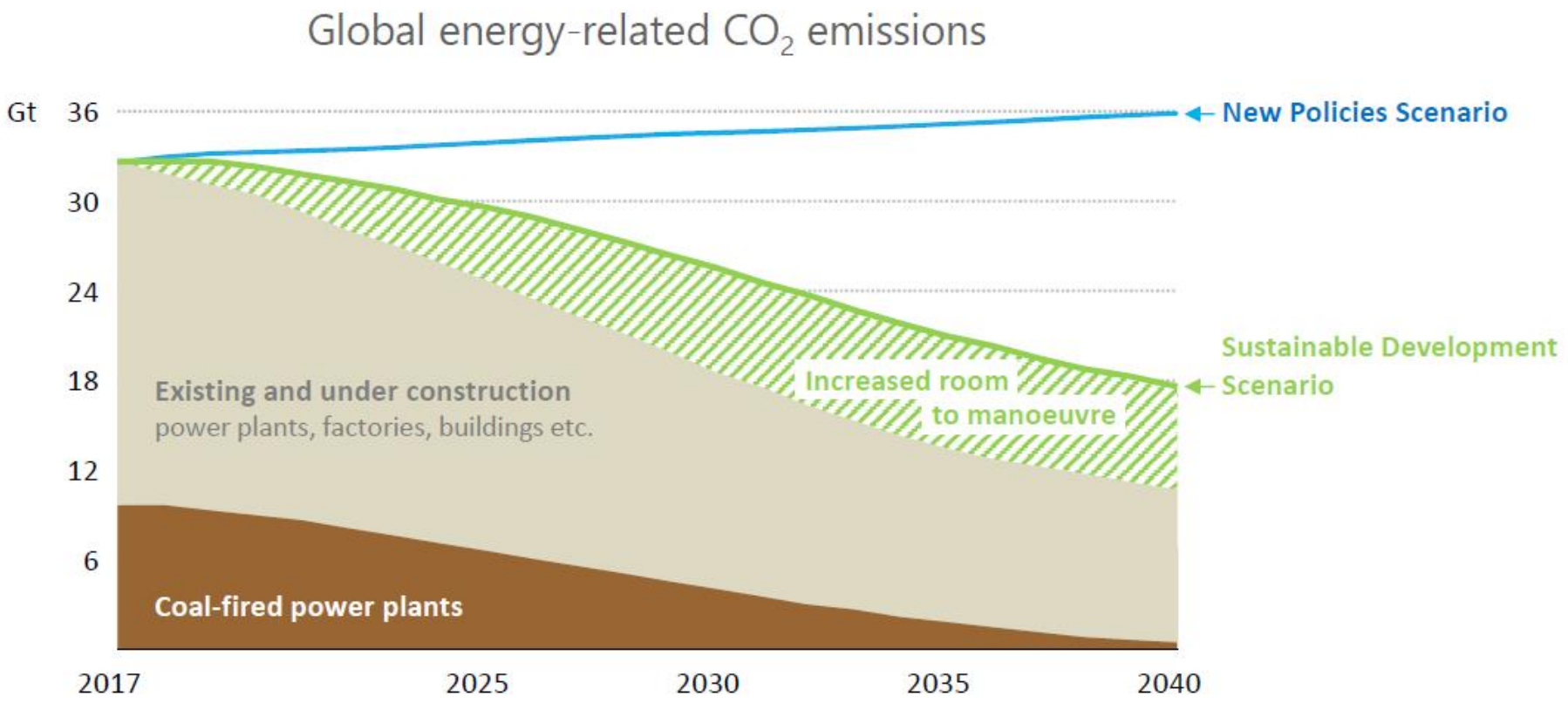
Thailand Energy Scenario towards Sustainability 2050


SUSTAINABLE DEVELOPMENT GOALS
1 NO POVERTY
2 ZERO HUNGER
3 GOOD HEALTH AND WELL-BEING
4 QUALITY EDUCATION
5 GENDER EQUALITY
6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE, JUSTICE AND STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS
SUSTAINABLE DEVELOPMENT GOALS

Source: UNDP

The IEA's Sustainable Development Scenario (SDS) to 2040

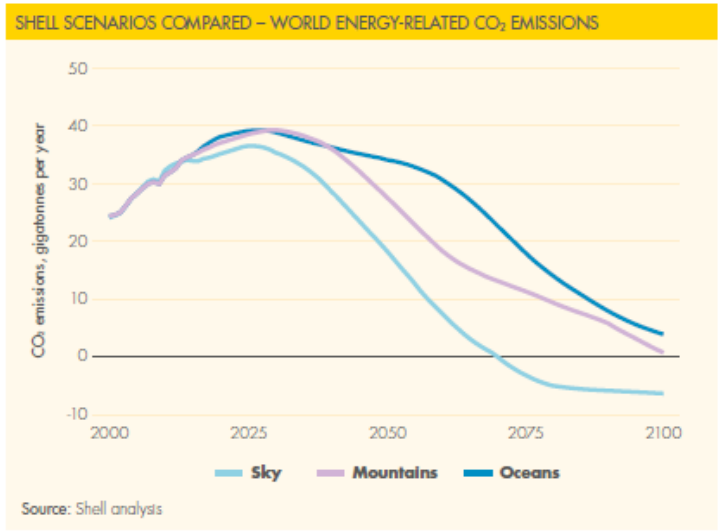
The IEA's SDS outlines a major transformation of the global energy system, showing how the world can change course to deliver on the three main energy-related SDGs simultaneously – Energy security, Environment, Social (improve living standard)

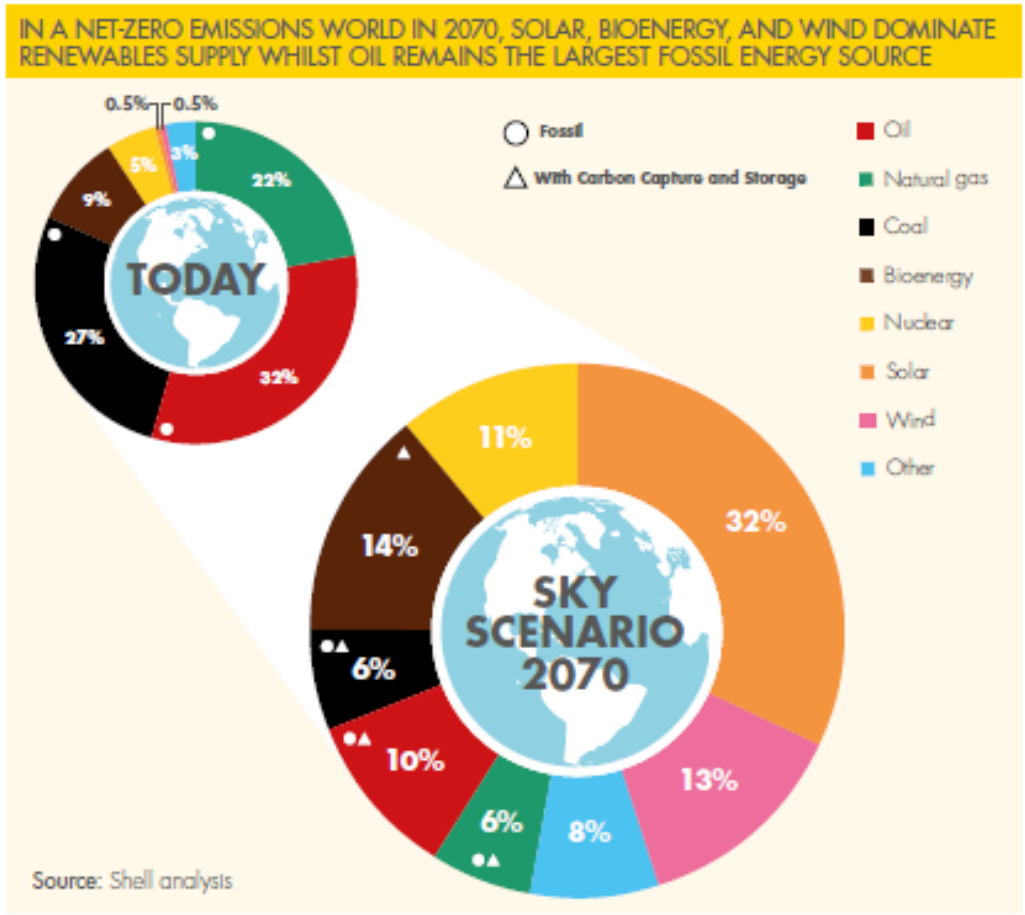


Source: IEA

The Shell's Sky Scenario to 2070

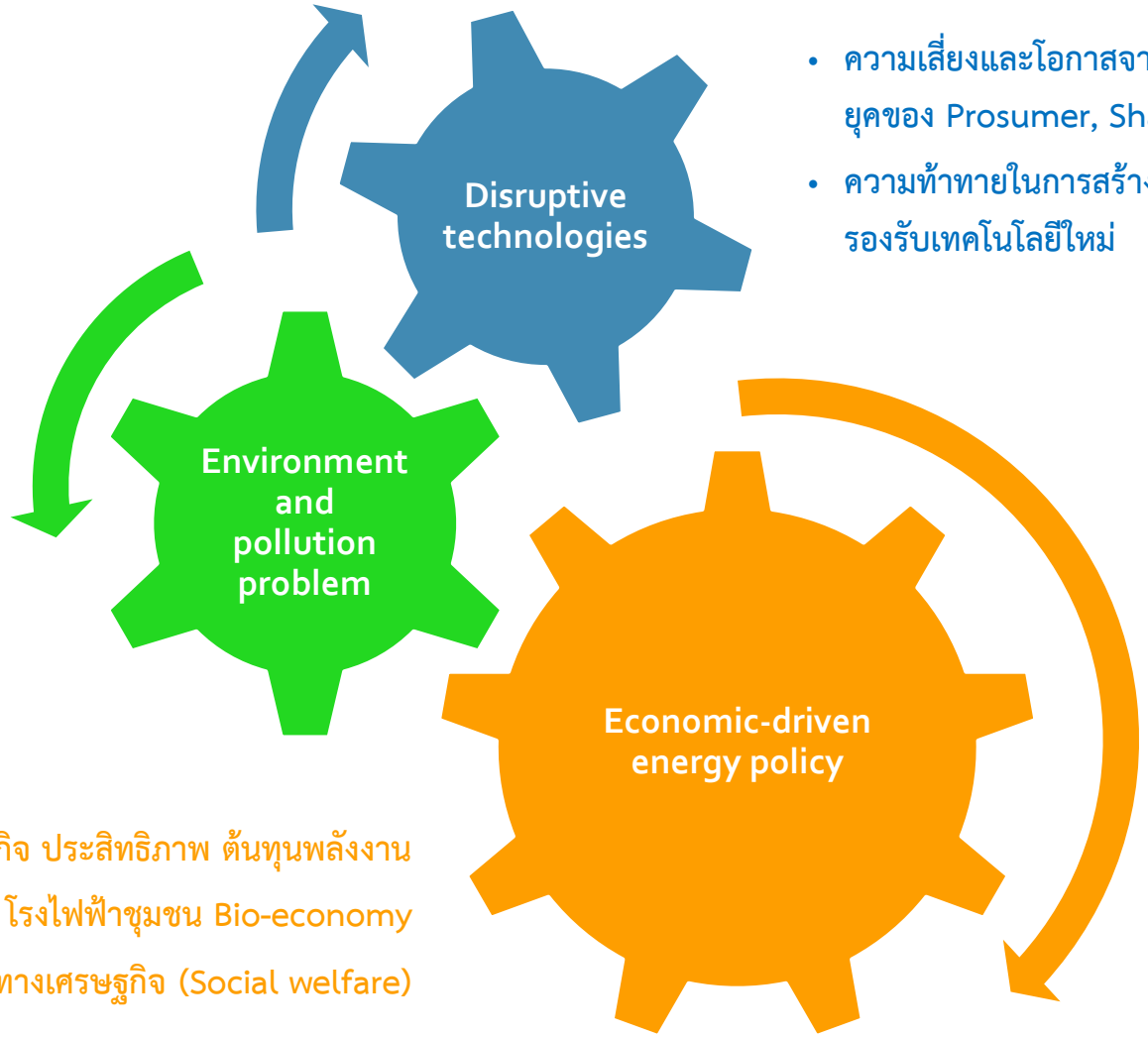
The ***Sky*** scenario illustrates a technically possible, but challenging pathway for society to achieve the goals of the Paris Agreement. ***Sky*** builds on previous Shell scenarios publications and is our most optimistic scenario in terms of climate outcomes.





Source: Shell

ประเด็นท้าทายด้านพลังงานของประเทศไทย

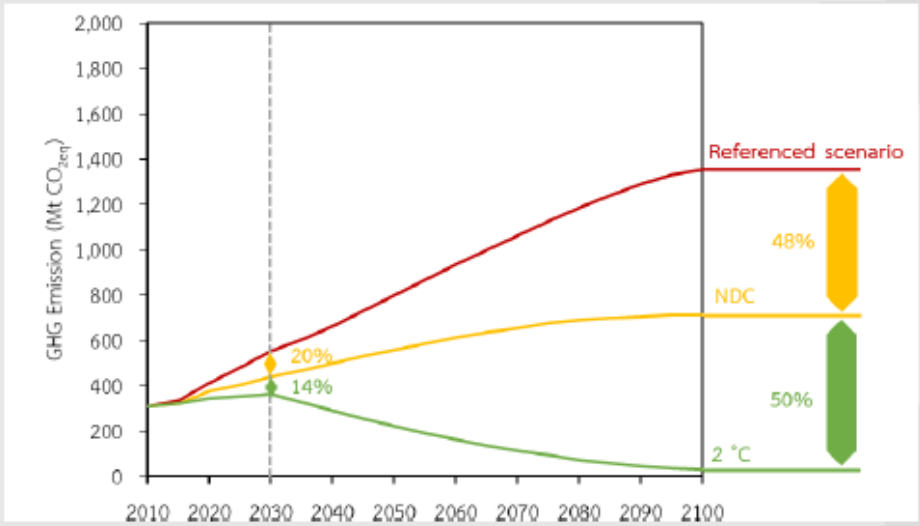


- ความเสี่ยงและโอกาสจากการเปลี่ยนแปลงเทคโนโลยี สู่ยุคของ Prosumer, Sharing economy
- ความท้าทายในการสร้างความยืดหยุ่นของระบบไฟฟ้ารองรับเทคโนโลยีใหม่

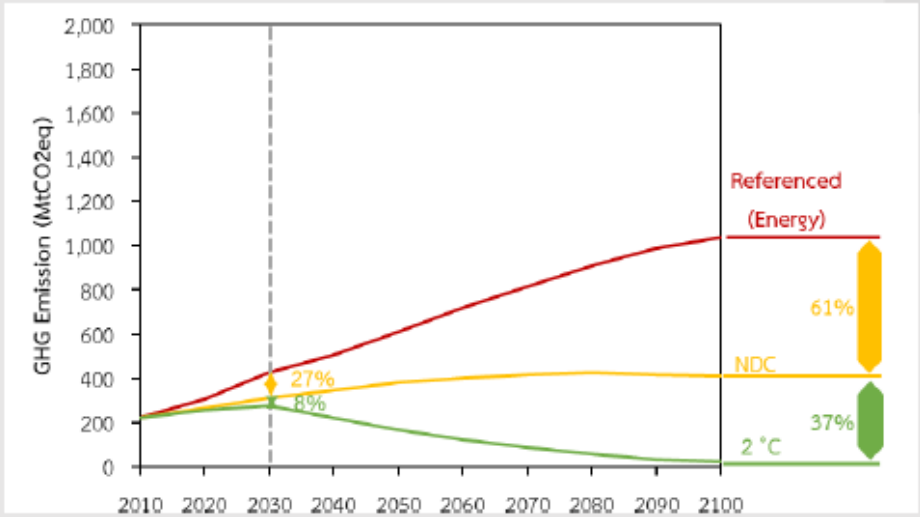
- ปัญหามลพิษทางอากาศจากพลังงาน
- ความต้องการลด GHG
- โอกาสจากการนำเทคโนโลยีพลังงานเพื่อลดปัญหาด้านขยะและสิ่งแวดล้อม

- ความสามารถในการแข่งขันทางเศรษฐกิจ ประสิทธิภาพ ต้นทุนพลังงาน
- การสนับสนุนนโยบายด้านการเกษตร เช่น โรงไฟฟ้าชุมชน Bio-economy
- การลดความเหลื่อมล้ำทางเศรษฐกิจ (Social welfare)

Shared Climate Policy Assumption (SPAs)



- การปล่อยก๊าซ ในปัจจุบันของประเทศไทยคิดเป็นร้อยละ 0.90 ของระดับของโลก
- REF: ระดับการปล่อยก๊าซใช้สมมติฐาน NDC ของประเทศไทย (2010-2030)
- NDC: การดำเนินมาตรการของ NDC โดยมีเป้าหมายการลดร้อยละ 20 (2010-2030), เปรียบเทียบสัดส่วนการลดก๊าซของโลกและของประเทศ (2031-2100)
- 2°C: เปรียบเทียบจากข้อมูลสัดส่วนระดับการปล่อยก๊าซในปัจจุบันของประเทศไทย (ร้อยละ 0.9) และเป้าหมาย 2 °C

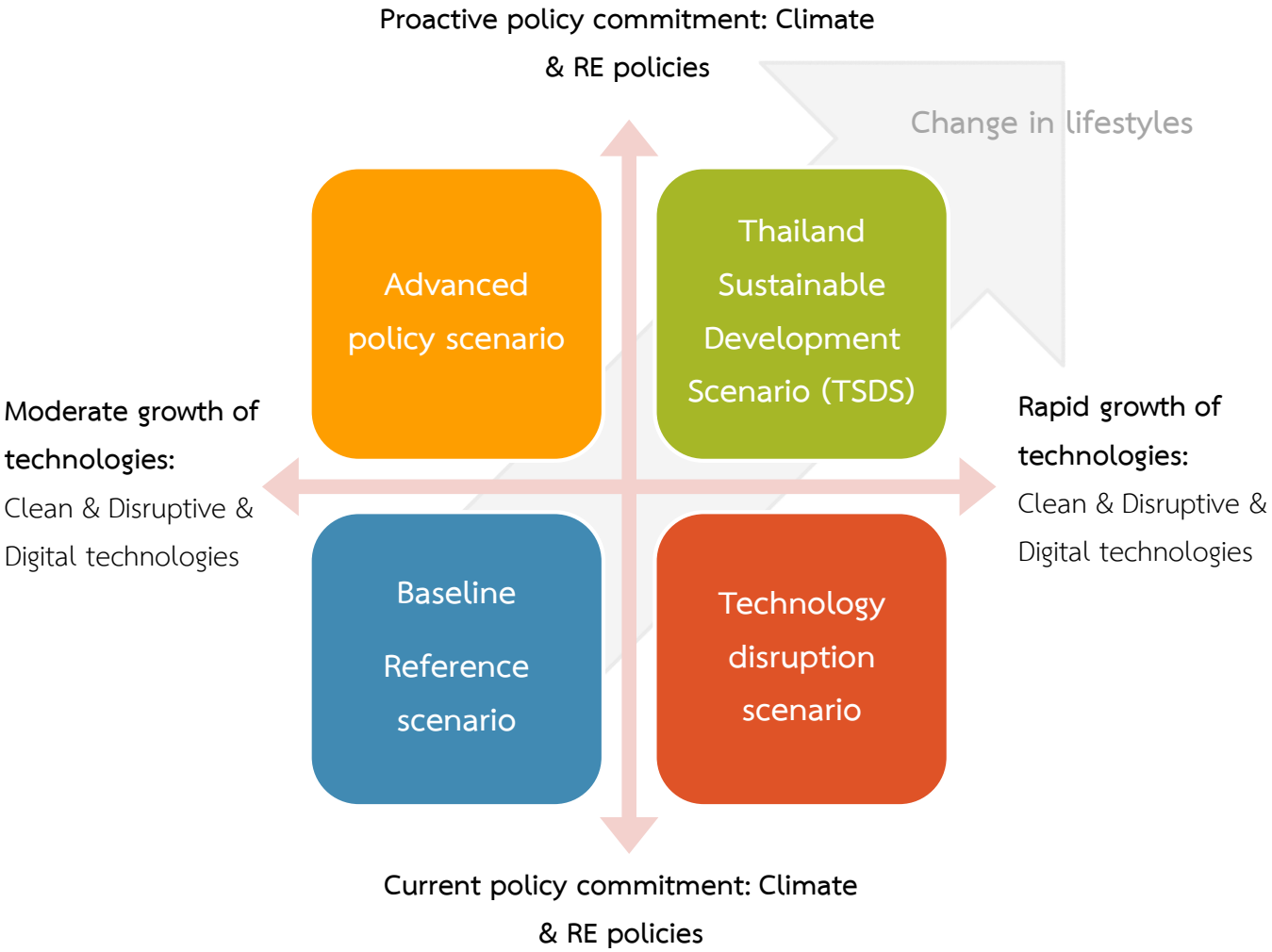


- การปล่อยก๊าซของสาขาพลังงานเท่ากับร้อยละ 76.74 (2030)
- REF: ระดับการปล่อยก๊าซใช้สมมติฐาน NDC ในสาขาพลังงานของประเทศไทย (2010-2030)
- NDC: การดำเนินมาตรการของ NDC ในสาขาพลังงาน (2010-2030), เปรียบเทียบสัดส่วนการลดก๊าซของประเทศ (2031-2100)
- 2°C: เปรียบเทียบจากข้อมูลสัดส่วนระดับการปล่อยก๊าซของสาขาพลังงาน (ร้อยละ 76.74) และเป้าหมาย 2 °C

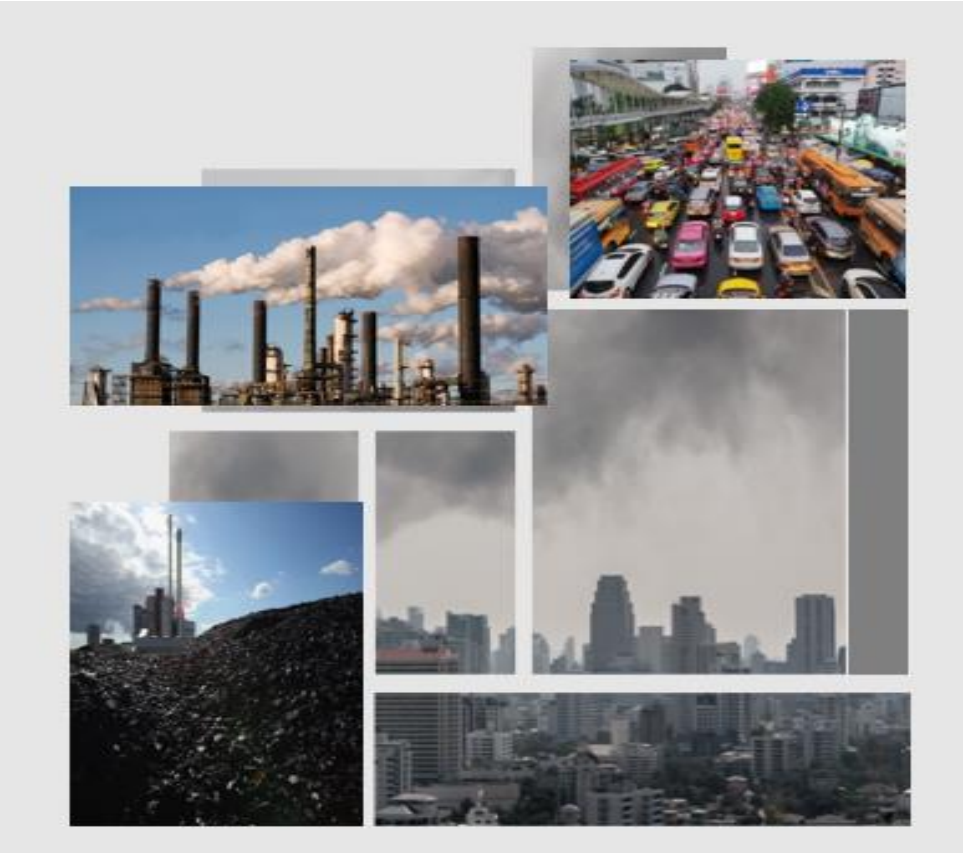
ONEP, TGO, SIIT, Sep 2019

ปัจจัยวิกฤติและภาพอนาคตพลังงานไทย 2050

ปัจจัยวิกฤติ (Critical uncertainty)



CLOUD scenario



People lifestyle is changing gradually in accordance to digitalization trend.

Clean & potential tech disruption are growing so fast, but still can not take the majority.

No significant structural changes in economy, industry, energy business.

Impact on pollution & GHG emission is getting worst.

International regulation with env. concern come in force.

Current policies on clean & smart energy come in place based on energy security.

CLEAR scenario

People is changing their lifestyle with seriously concern on environment. Digitalization become indispensable.

Self-sustain & prosumer are the majority of transformation

Clean & tech disruption is accelerated within near future ahead, and become one of the crucial role for energy system in 2050

Economic is driven mainly by new S-curve. Bio & Circular economies are growing.

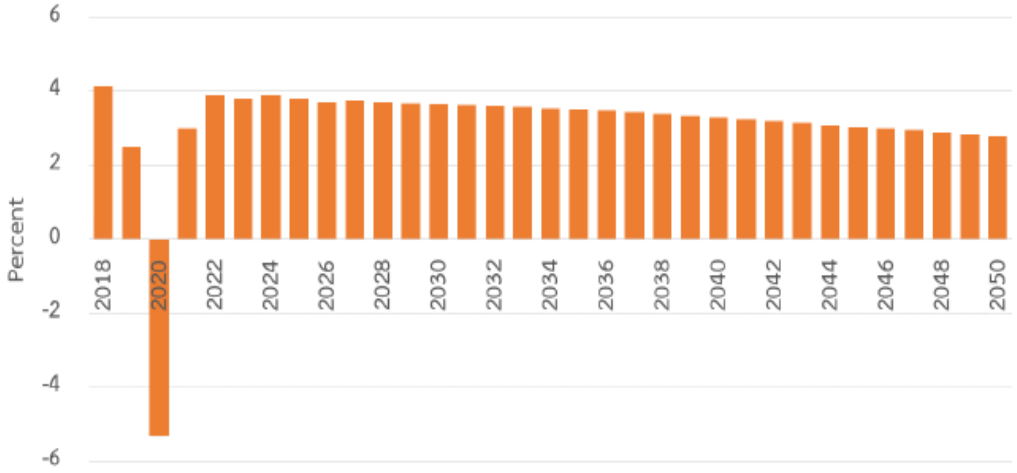
Energy business is moving toward market competition.

Pollution problem could be relieved.

Negative impact on climate change could be extended.

Sustainability & 2DC target become the priority for national policy.

Economic outlook



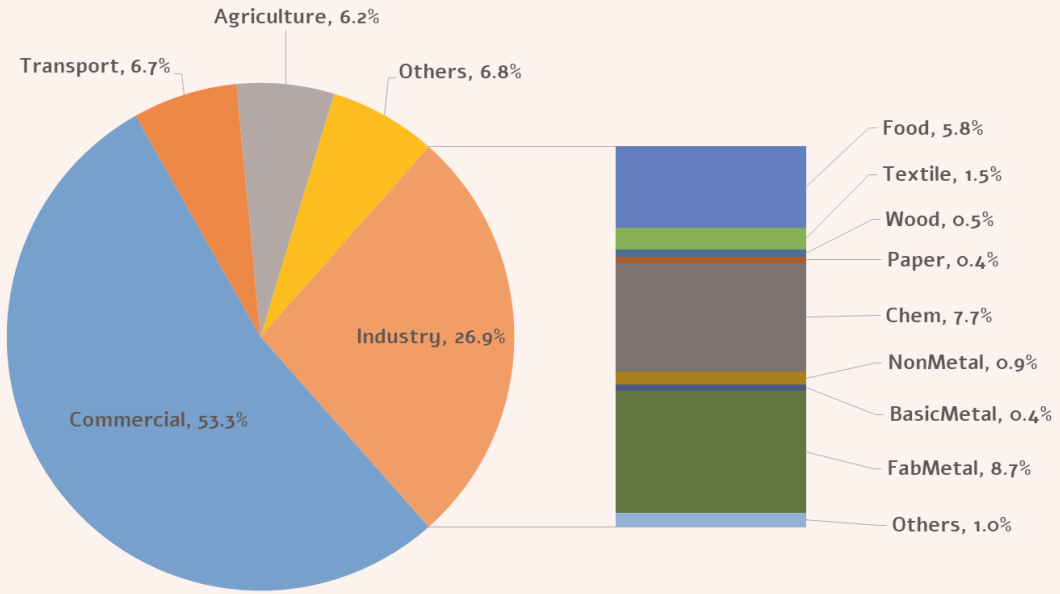
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
GDP Growth [%]	4.2	2.5	-5.3	3.0	3.9	3.8	3.9	3.8	3.7	3.8	3.7	3.7	3.6	3.6	3.6	3.6	3.5

	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
GDP Growth [%]	3.5	3.5	3.4	3.4	3.3	3.3	3.2	3.2	3.1	3.1	3.0	3.0	2.9	2.9	2.8	2.8

ปี พ.ศ. (ค.ศ.)	การเติบโตของ GDP	ลักษณะของข้อมูล	แหล่งข้อมูล
2018 – 2019	2.5%	ข้อมูลจริง	สำนักงานสภาพัฒนาการเศรษฐกิจและสังคมแห่งชาติ
2020	-5.3%	ข้อมูลพยากรณ์	ธนาคารแห่งประเทศไทย (ข้อมูล ณ วันที่ 25 มีนาคม 2563)
	-8.1%	ข้อมูลพยากรณ์	ธนาคารแห่งประเทศไทย (ข้อมูล ณ วันที่ 25 มิถุนายน 2563)
	-3.2 ถึง -7.2%	ข้อมูลพยากรณ์	SCB Economic Intelligent Center (ข้อมูล ณ วันที่ 2 เมษายน 2563)
2021	3%	ข้อมูลพยากรณ์	ธนาคารแห่งประเทศไทย (ข้อมูล ณ วันที่ 25 มีนาคม 2563)
2016 – 2050	2.6%	ข้อมูลพยากรณ์	PricewaterhouseCoopers International Limited PWC (ข้อมูล ณ ปี 2560)

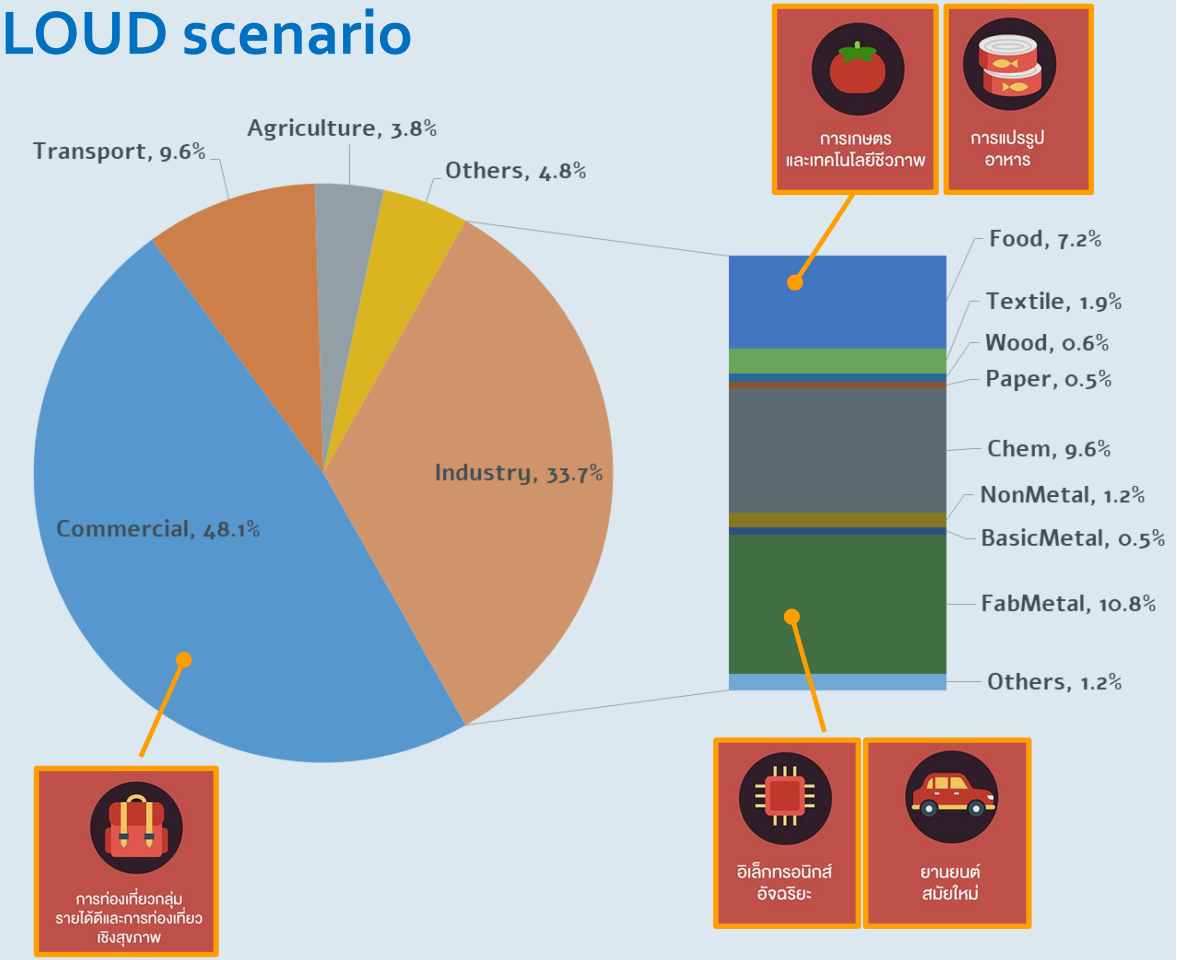
Economic restructuring

Current @ 2018

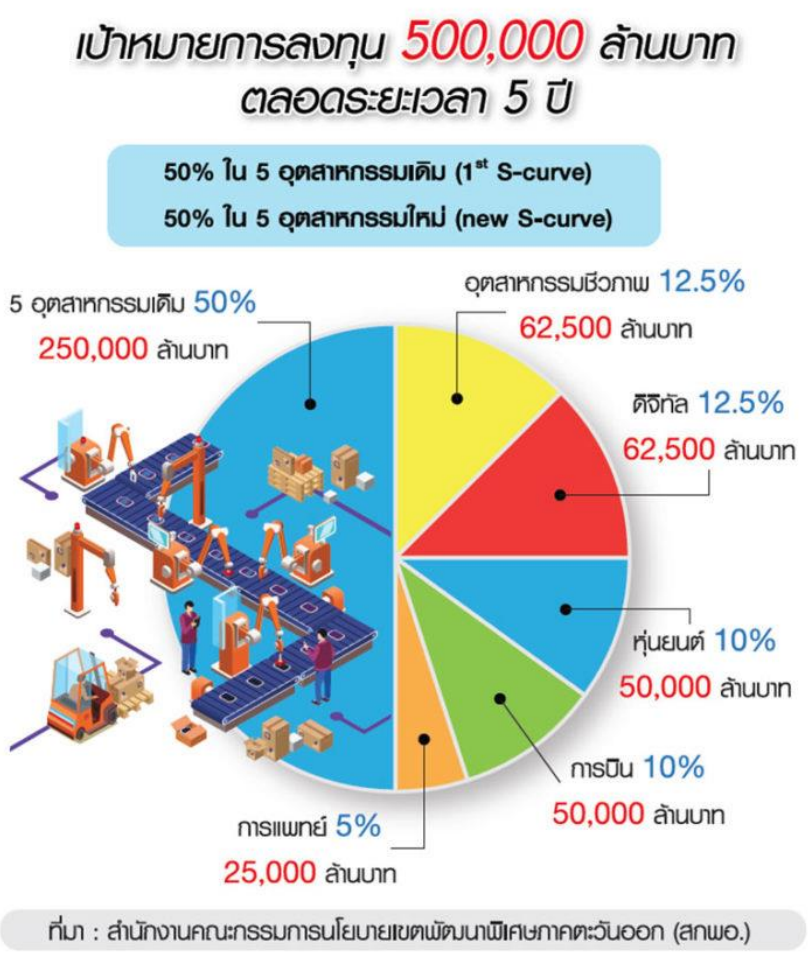


Source: NESDB

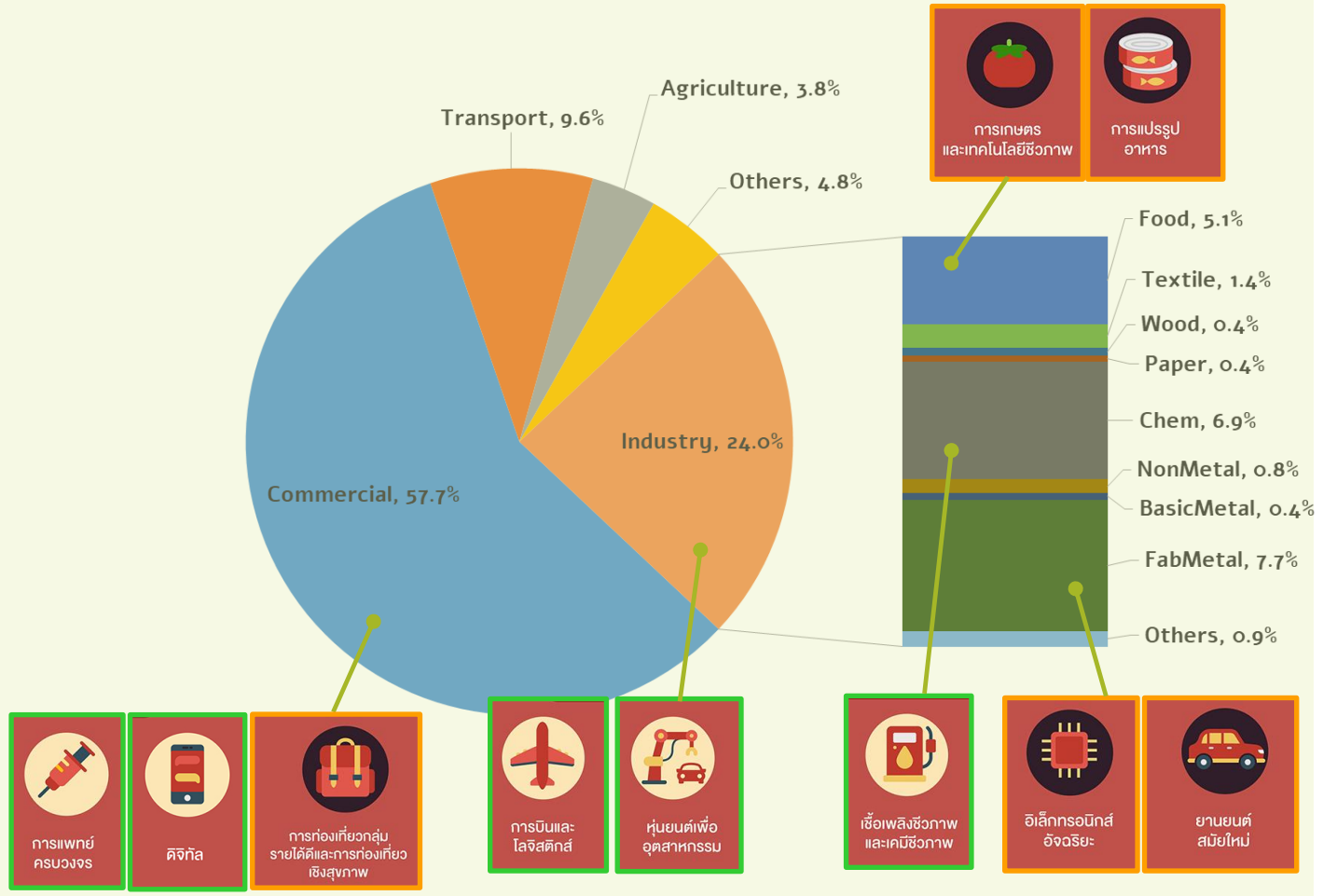
CLOUD scenario



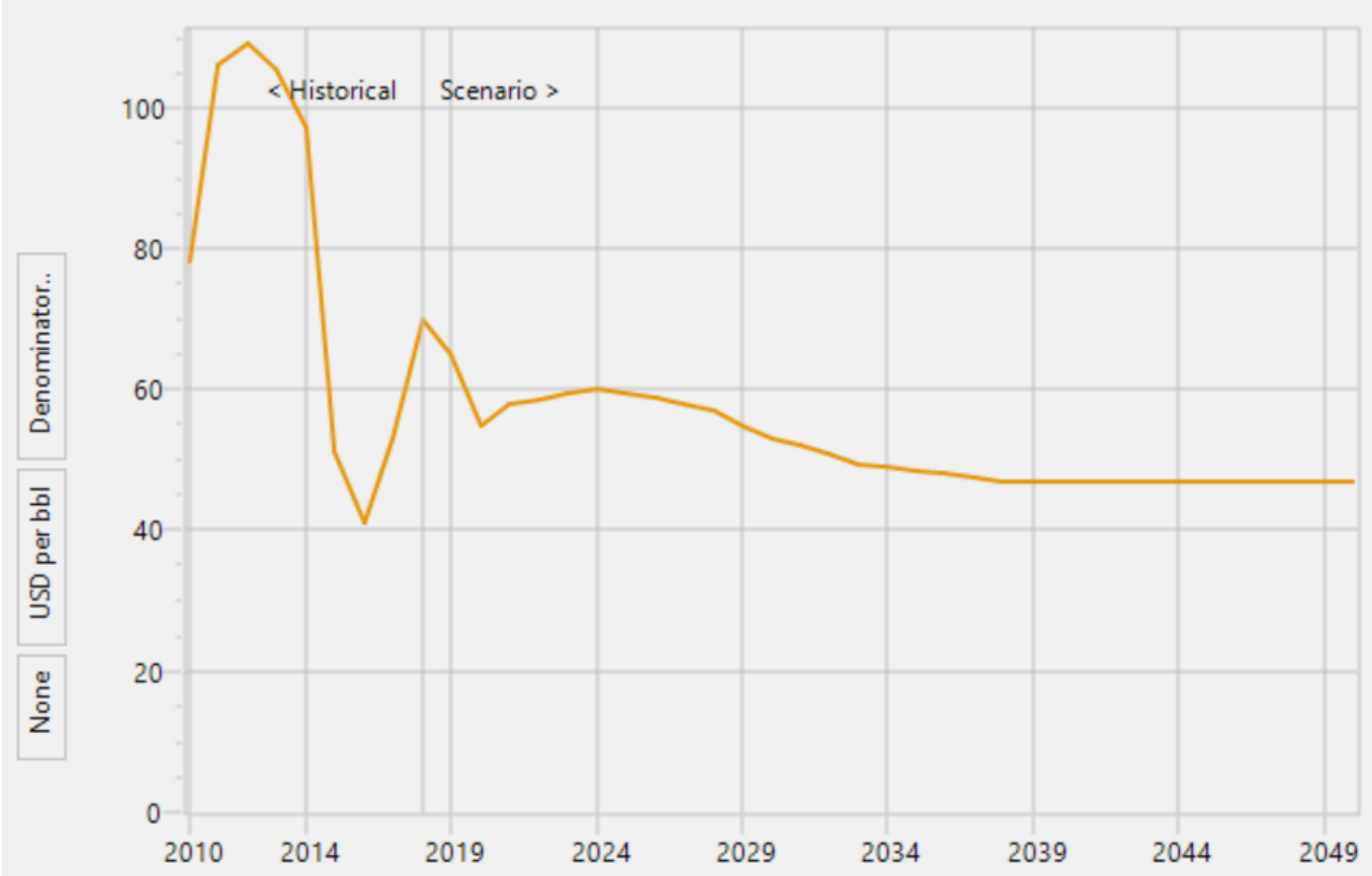
Economic restructuring



CLEAR scenario



Crude price assumption



Source: PTT, Dubai ref.

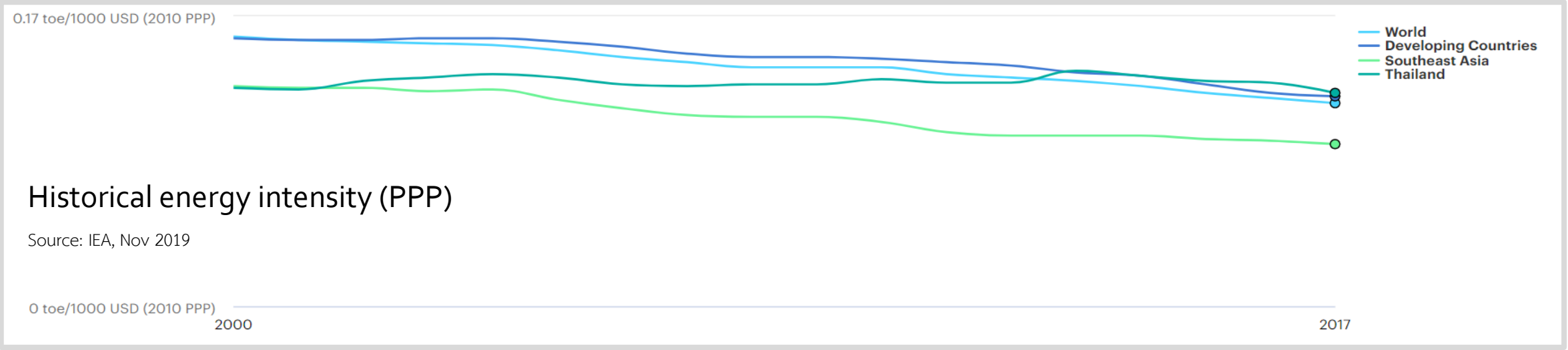
Energy efficiency

CLOUD scenario:

- No change in economic structure
- Sectoral energy intensity = -1.5 % p.a.
- 20% building stock penetration of BEC @ 2050
- ICE efficiency improvement

CLEAR scenario:

- Moving toward high value & low energy intensive sector
- Sectoral energy intensity = -2.9 % p.a.
- 40% penetration of low carbon stock building (BEC+HEP+ECON+NZEB) @ 2050
- ICE efficiency improvement plus mode shift
- Load curve optimization



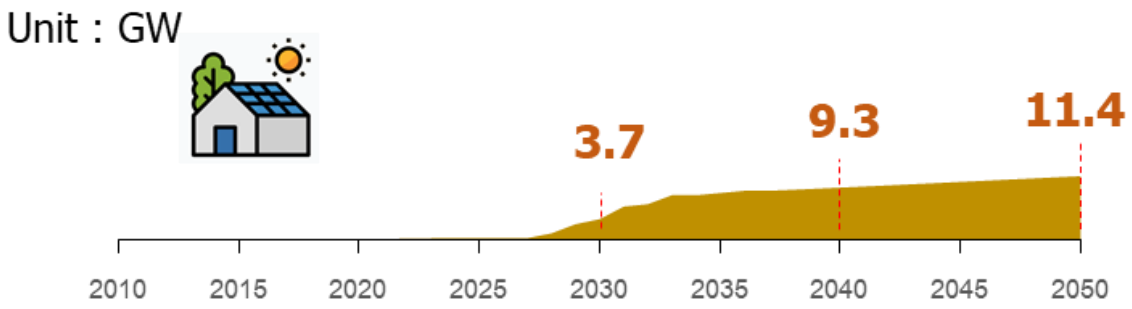
Historical energy intensity (PPP)

Source: IEA, Nov 2019

Sufficient economy: Prosumer

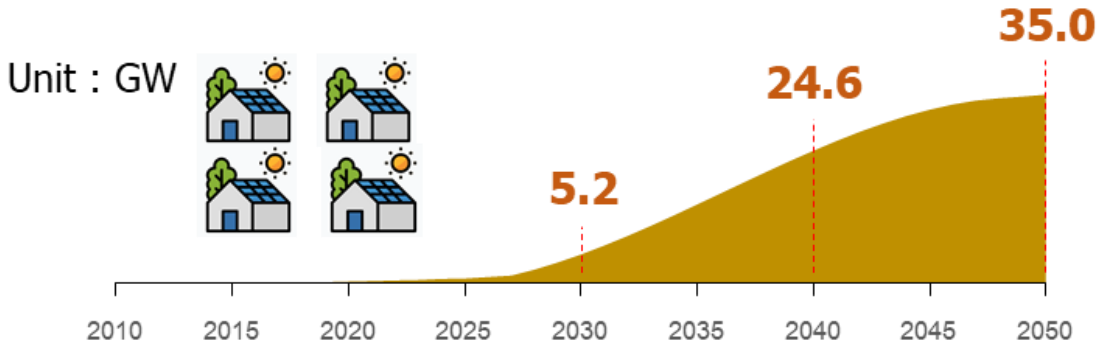
CLOUD scenario:

- DPV > 11.4 GW @ 2050
- Single buyer + unlock trading regulation
- DPV application in large & medium factory & building
- DG in industrial estate



CLEAR scenario:

- DPV + P2P + ESS > 35 GW @ 2050
- Trading platform
- DPV application in SML factory, building & household
- DG in industrial estate and community



Source: PDP2018 rev 1, TDRI & ERI for EGAT study (2019)

Sufficient economy: Demand response

CLOUD scenario:

- DR potential > 500 MW in 2050
- Semi-auto DR
- Time-based pricing, e.g. critical peak pricing
- Load aggregator model

CLEAR scenario:

- DR potential > 1,250 MW in 2050
- Automated & Smart DR
- Real-time pricing
- Customer-provision model

Source: EPPO & ERI (2019)

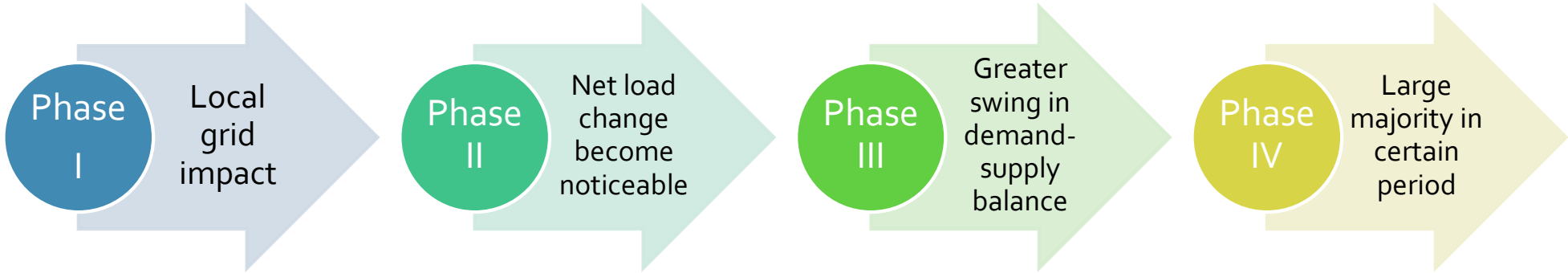
Renewable energy: VRE

CLOUD scenario:

- Higher VRE approaching phase III (20% share)
- Improved power system flexibility
  - ✓ Optimized operation
  - ✓ Semi-automated DR
  - ✓ Utilities scale ESS

CLEAR scenario:

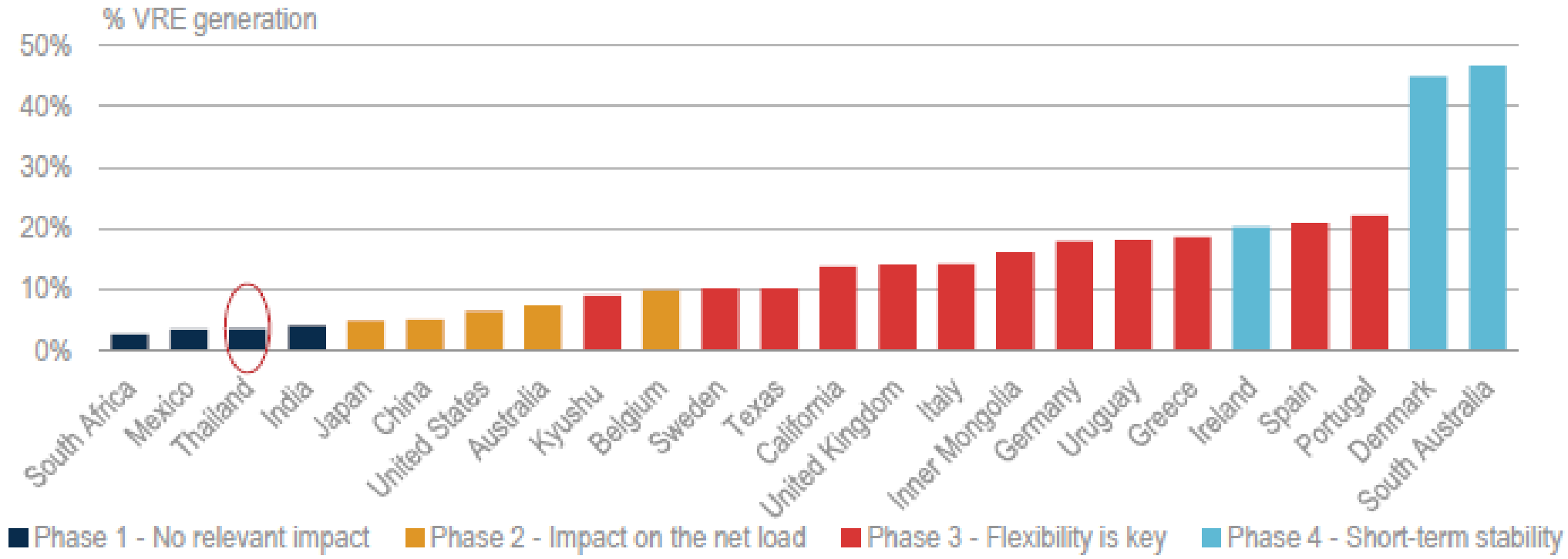
- Very high VRE approaching phase IV (30% share)
- High level of power system flexibility
  - ✓ Power trade
  - ✓ Automated DR
  - ✓ Grid flexibility
  - ✓ Energy storage + V2X



Source: IEA-EGAT RE integration 2019

Renewable energy: VRE

Evolution of system flexibility & VRE penetration



Source: IEA-EGAT RE integration 2019

Bio-economy

CLOUD scenario:

- Maximize use of biofuel – feedstock supply constraint
- Mandate E10-20: Supply potential for Ethanol
- Mandate B10+: Supply potential for Biodiesel

CLEAR scenario:

- Value-creation, balance of energy & non-energy use
- Maintain E20, B10 blend with high rate of EV growth
- Surplus E100&B100 can be used for high-value economy

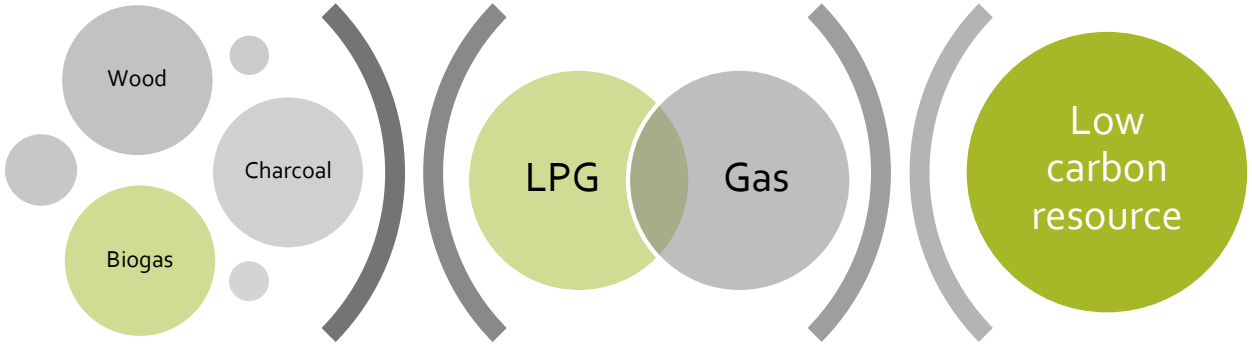
Clean cooking

CLOUD scenario:

- Modernization of cooking fuel
- Shifting from traditional fuel to LPG & electricity

CLEAR scenario:

- Moving toward low emission & low carbon option
- Shifting from traditional fuel to LPG, electricity& food-waste biogas
- Traditional wood approaching to zero @ 2050



Low pollution & emission

CLOUD scenario:

- Targeting of RE & EE in minimize GHG emission
- Biofuel in transportation
- Low growth of electric vehicle in transportation
- Lower GHG emission in power sector

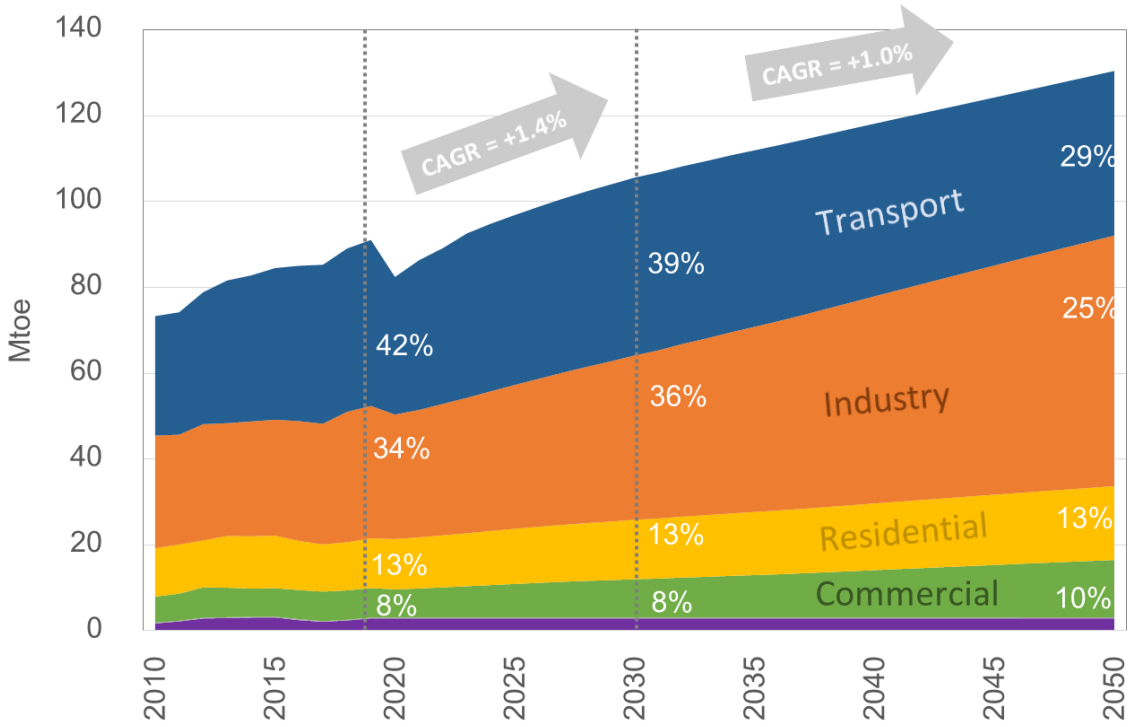
CLEAR scenario:

- Strictly regulation on pollution control
- Polluter pays principle to initiate lifestyle change
- Disruption of electric LDV, MC, Bus, Truck in transportation
- Decarbonization in power sector
- Much more projects on waste-to-energy

Final energy demand

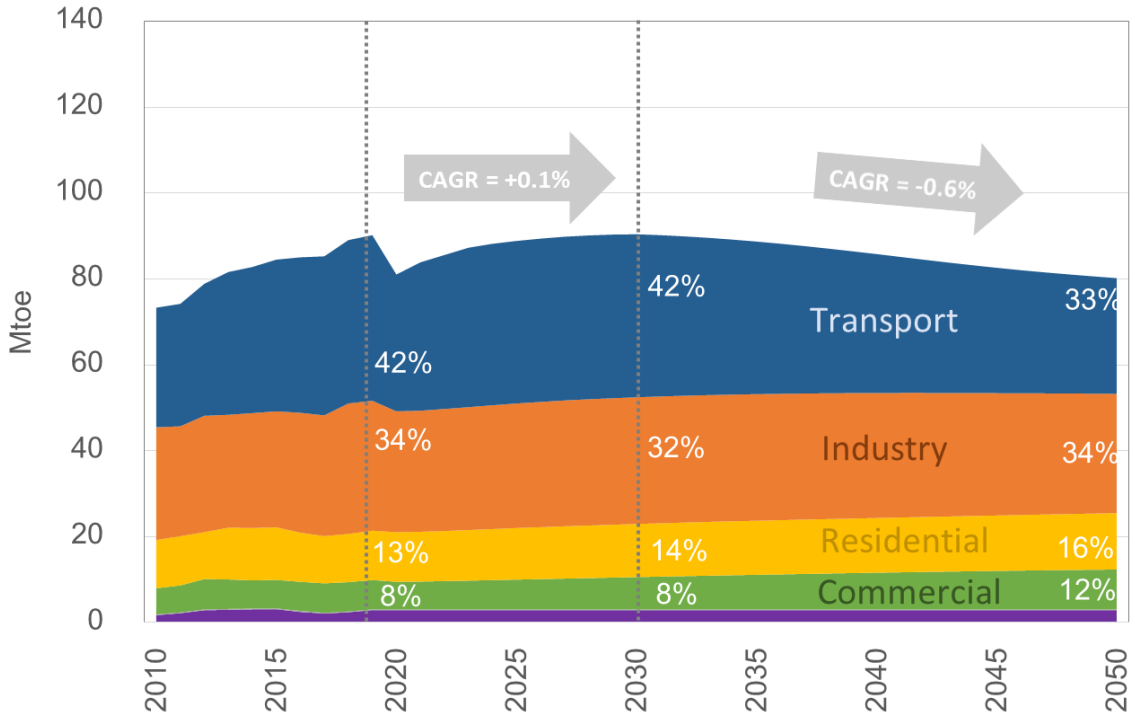
CLOUD scenario:

- Energy demand is growing, slower than GDP growth.
- Energy consumption in industrial and transport sectors take majority, driven by EEC & production-based economy.



CLEAR scenario:

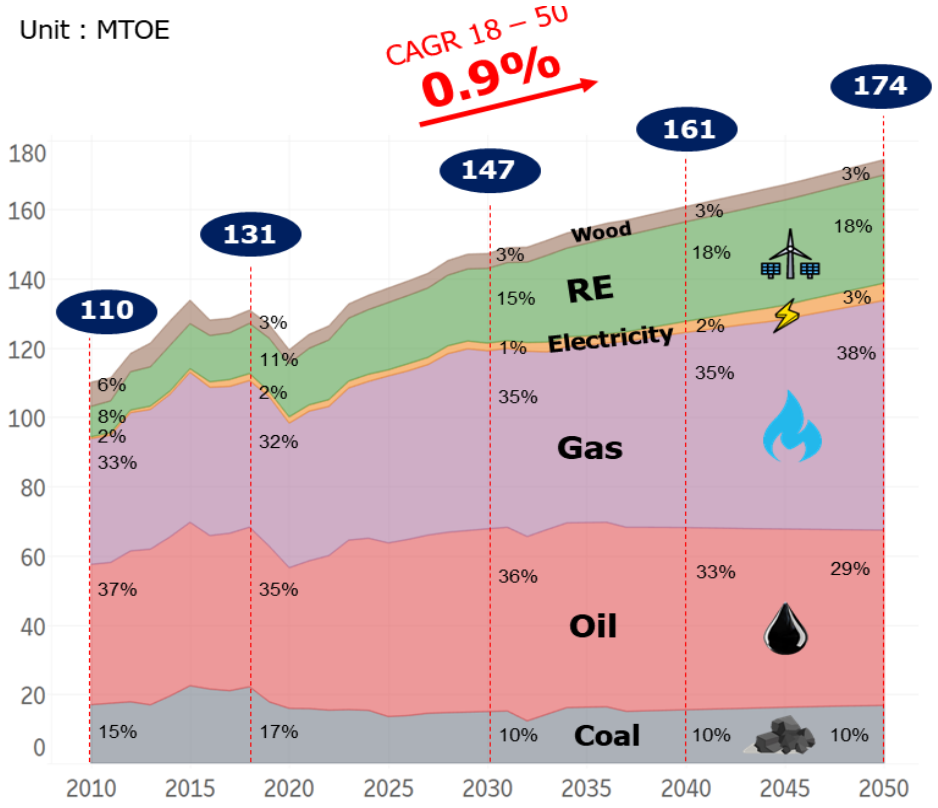
- Lower energy demand is driven by economic restructuring and intense energy efficiency push.
- Peak demand is expected in 2030



Total Primary Energy Supply (TPES)

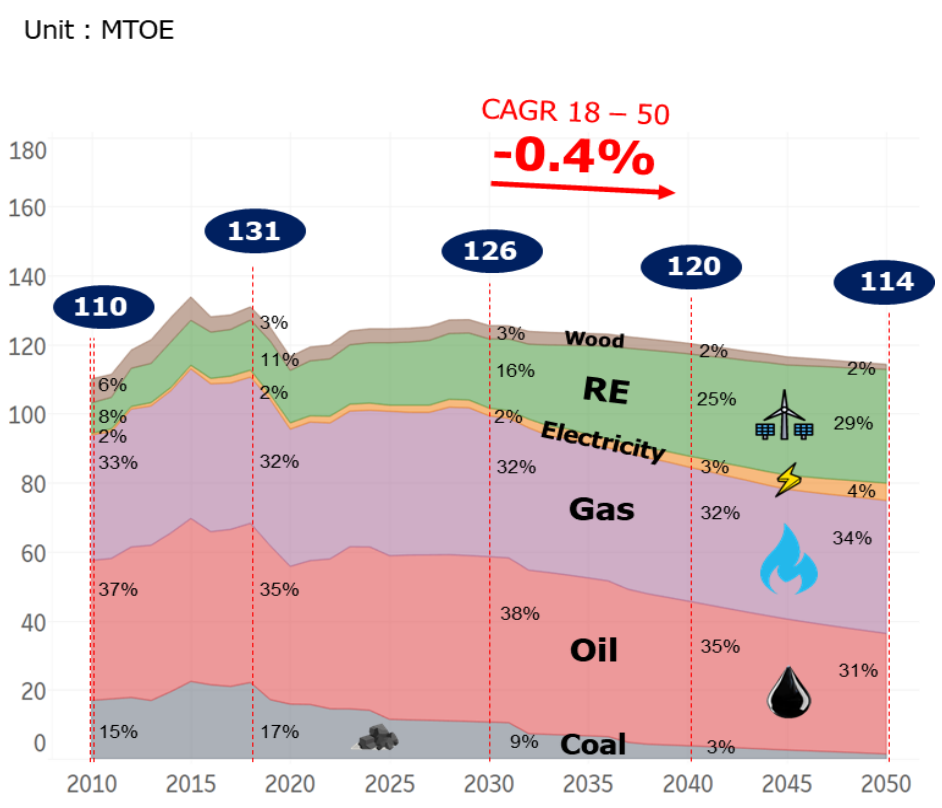
CLOUD scenario:

- TPES keeps growing according to demand.
- Fossil Fuels remain a significant portion of energy mix.
- Gas & RE overtaking oil & coal.



CLEAR scenario:

- Decoupling of economic v.s energy is obviously seen.
- Gas & RE dominate fuel-mix (63% @ 2050)
- Coal phases out, approaching zero @ 2050 / Oil declines



Transportation: Drivers and trends

Smart Mobility

Next-generation automotive

ที่มาภาพ : www.daimler.com/case/en/

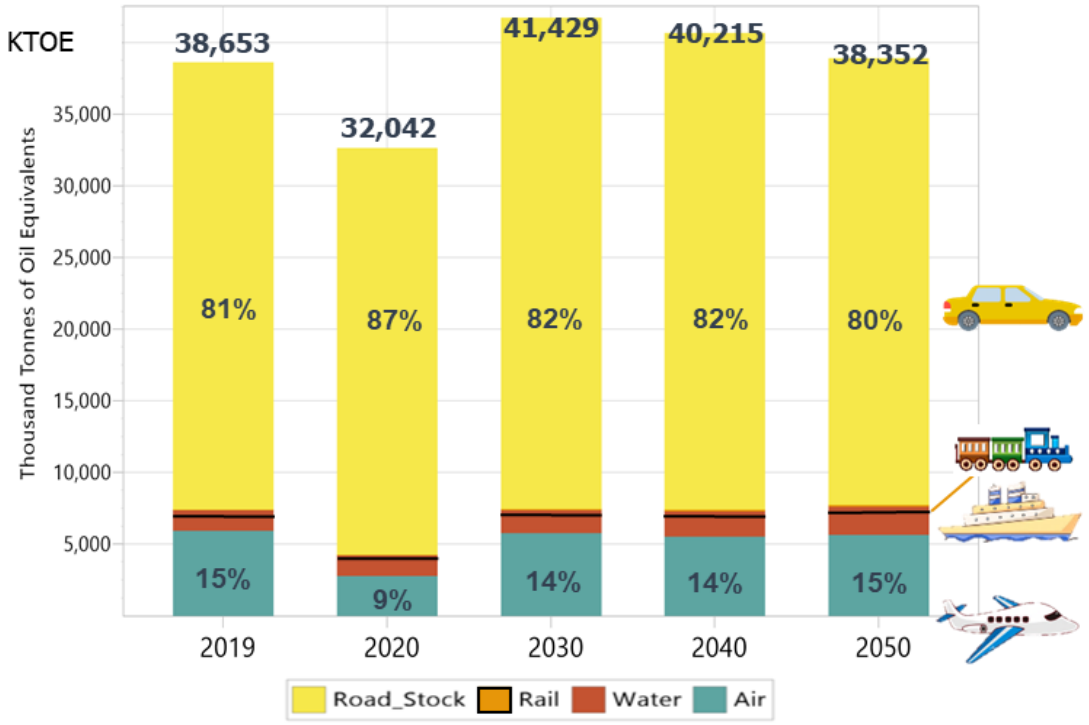
CORSIA

Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)

Transportation

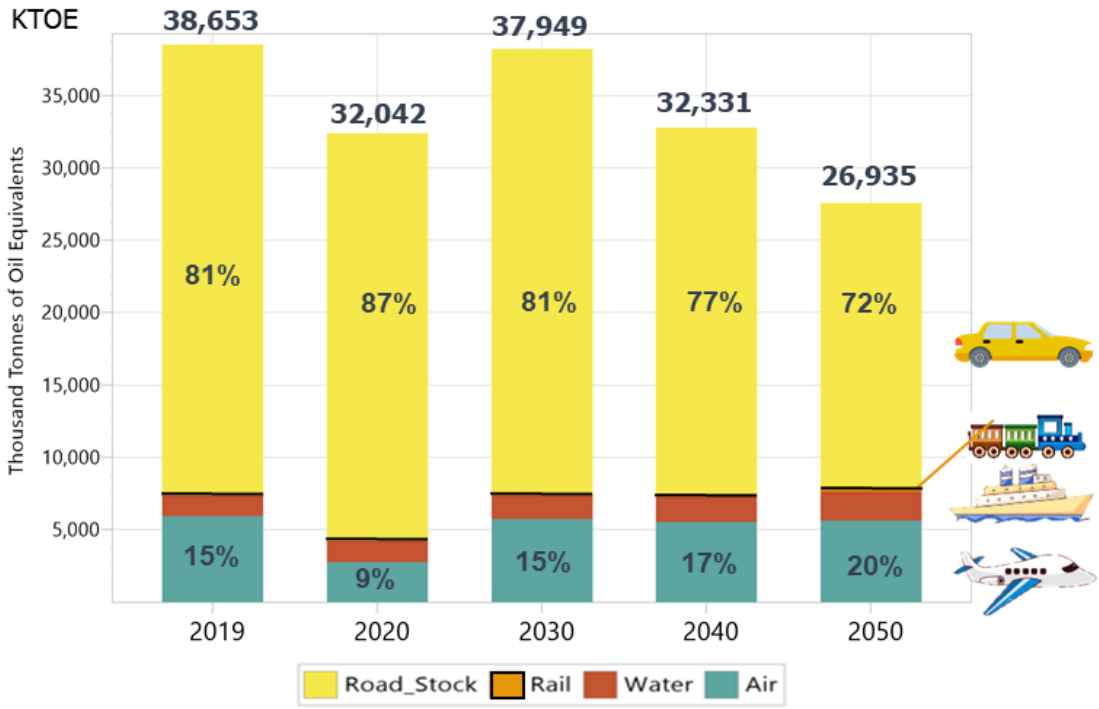
CLOUD scenario:

- Energy demand stays flat caused by saturated purchased power, slow down of VKT and improvement of fuel economy.



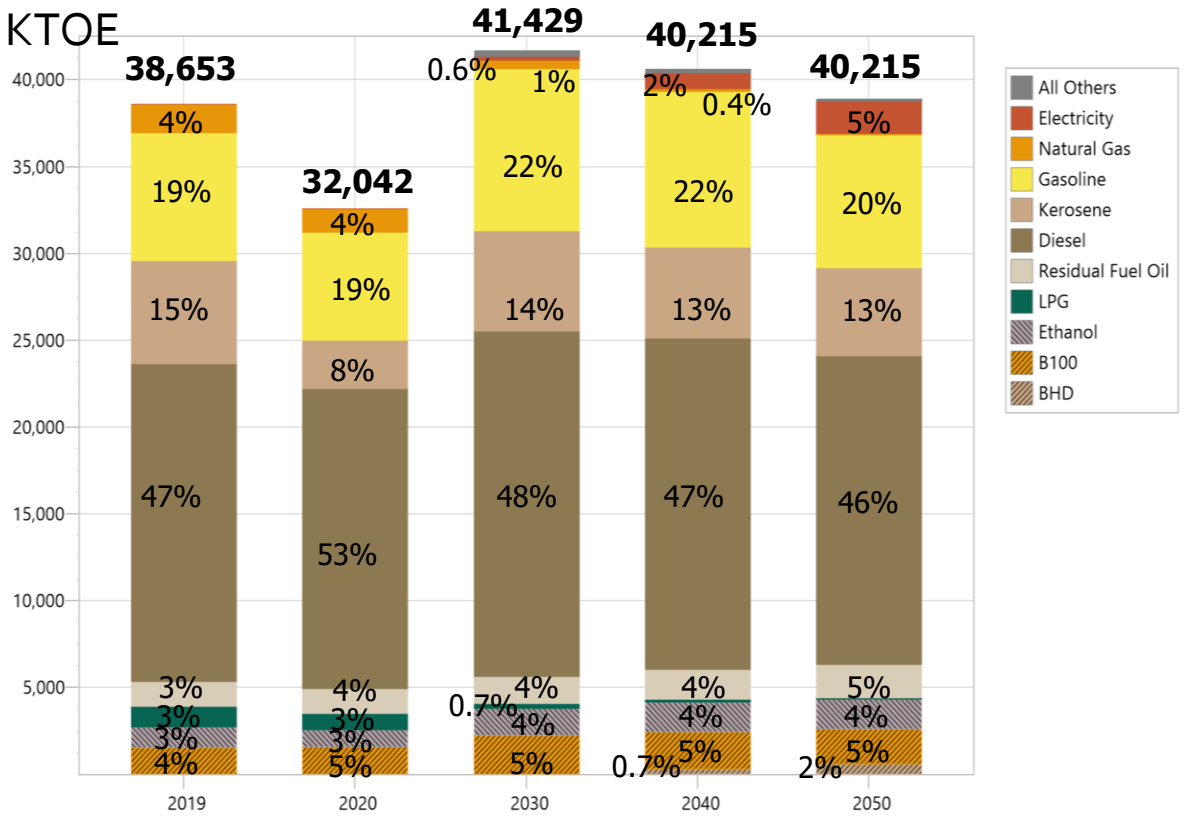
CLEAR scenario:

- Energy demand declines with additional effects of sharing mobility, public transport & electric vehicle

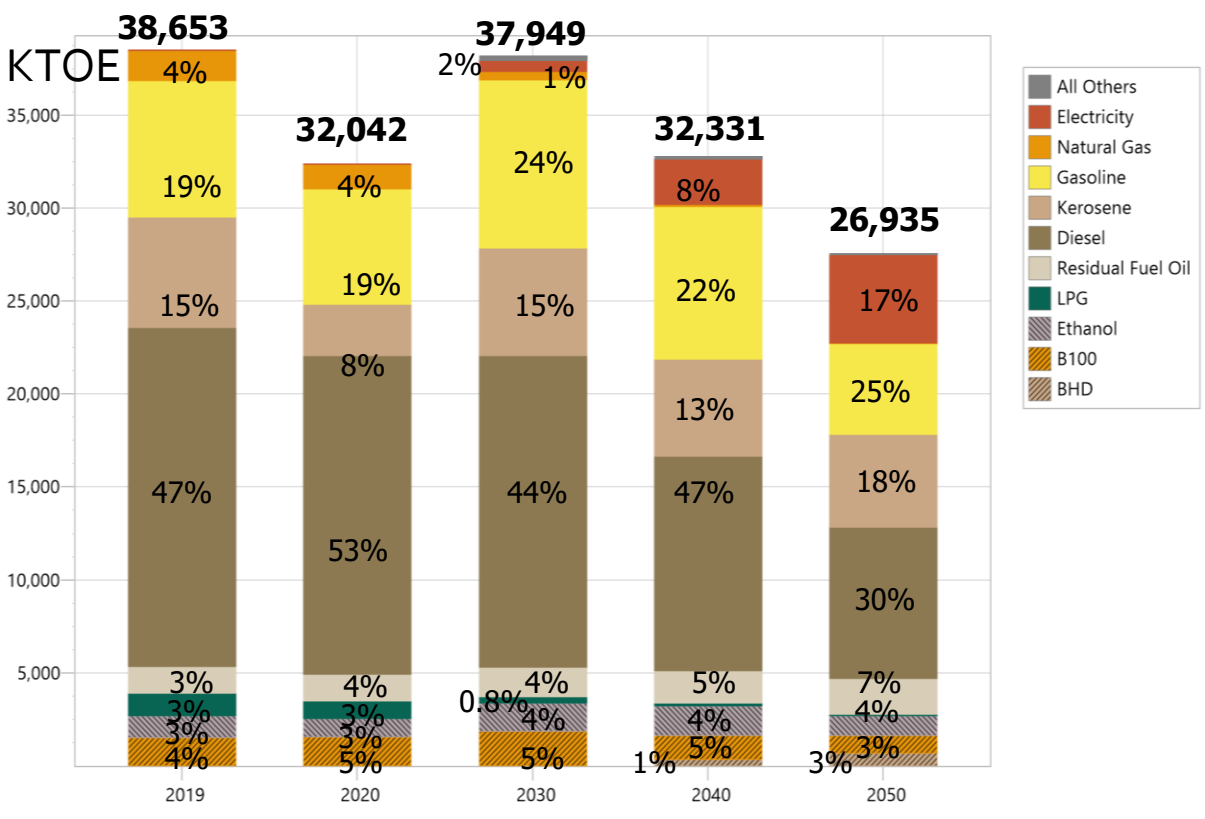


Transportation

CLOUD scenario:

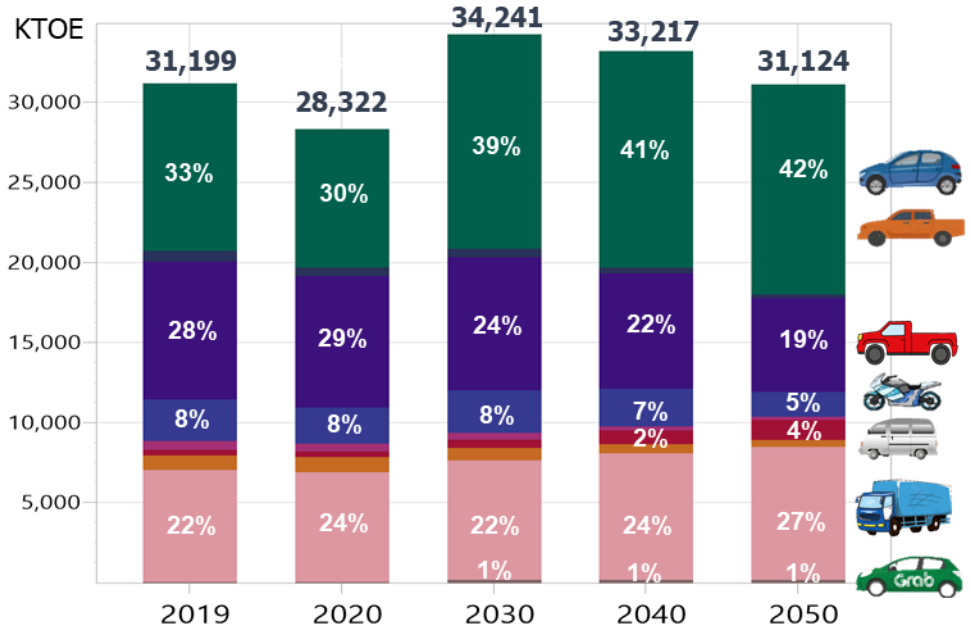


CLEAR scenario:

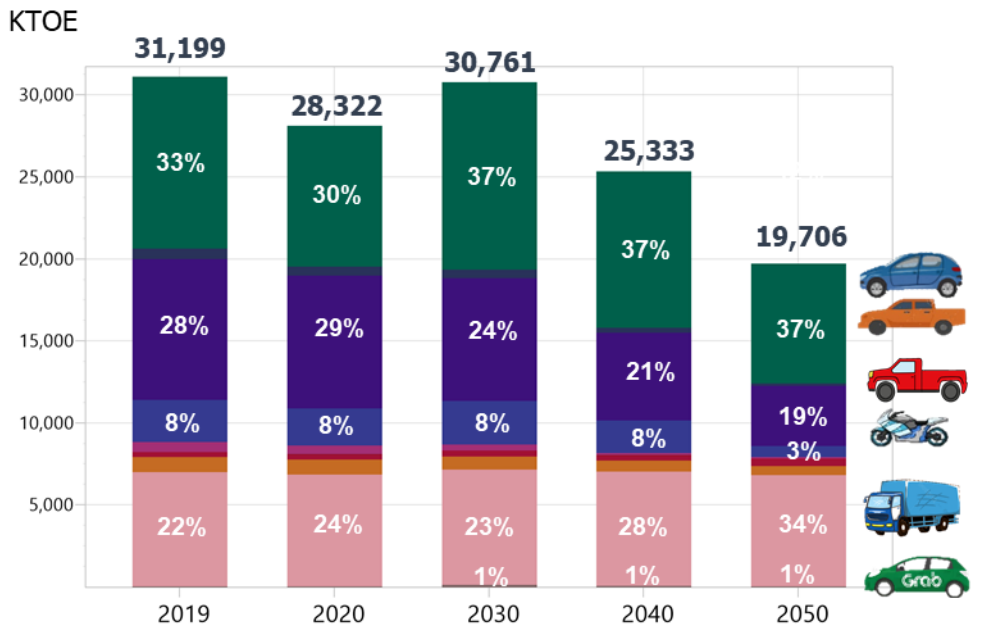


Road transportation

CLOUD scenario:

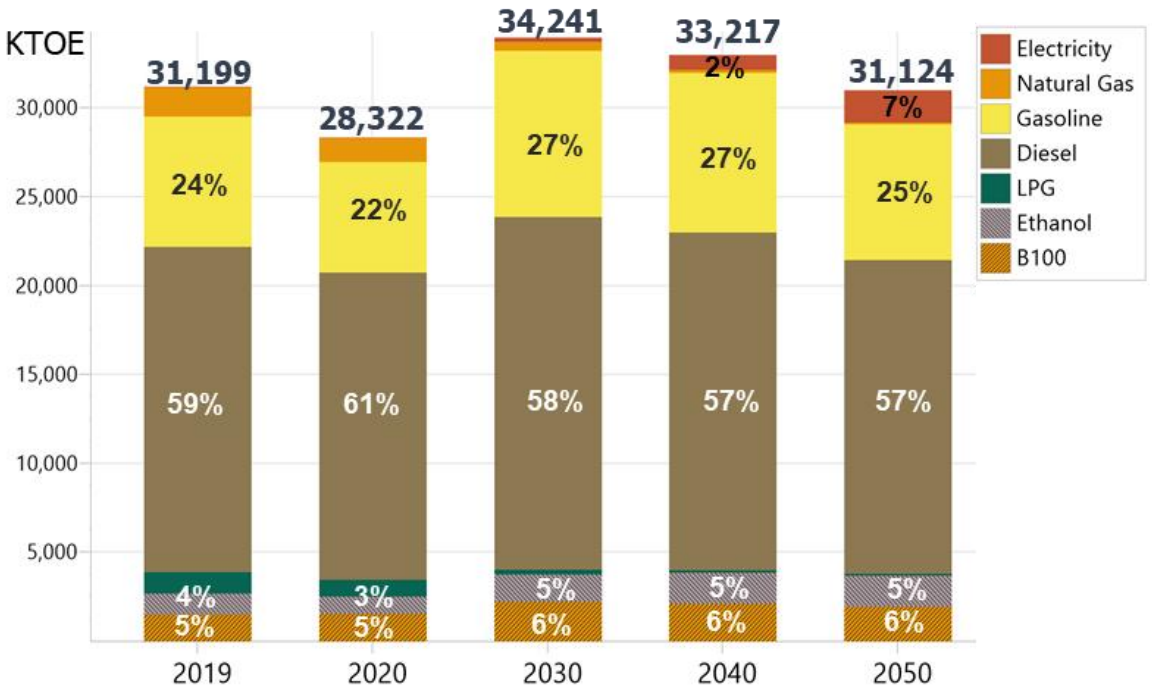


CLEAR scenario:

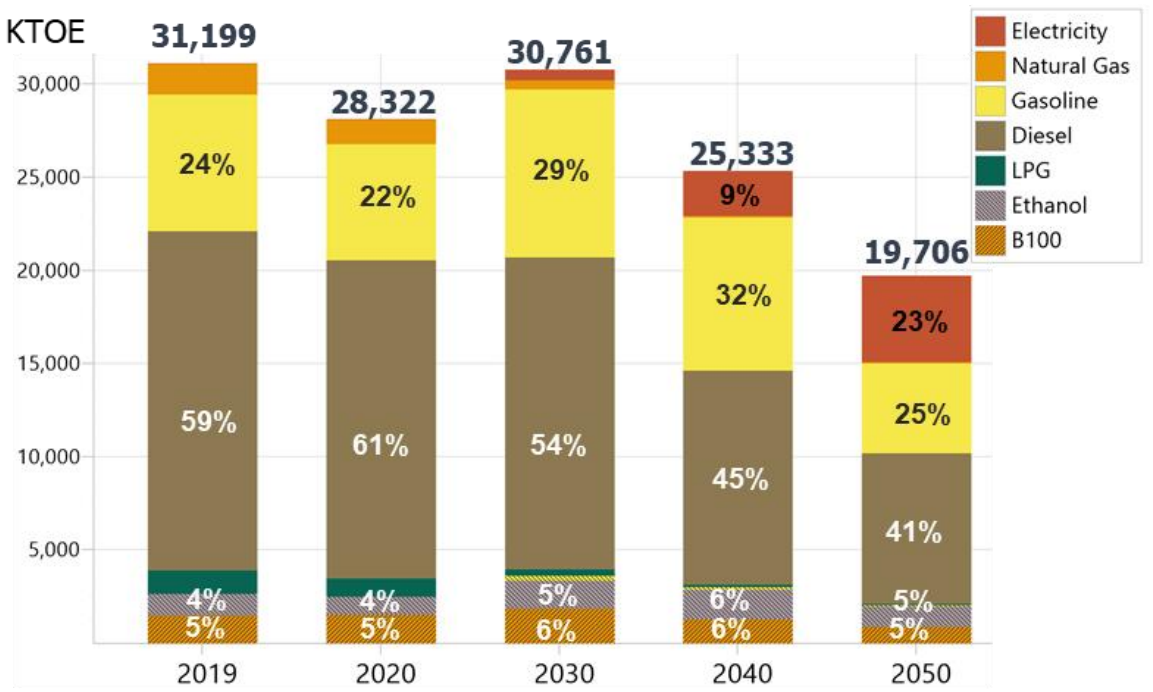


Road transportation

CLOUD scenario:



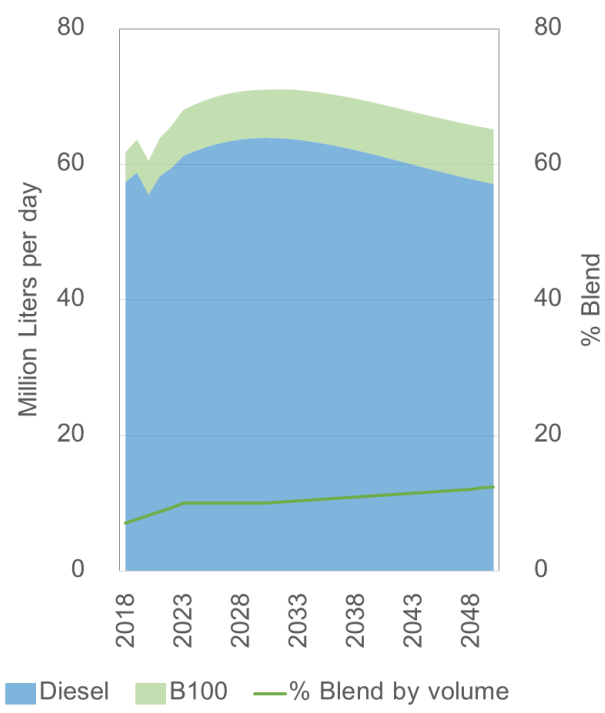
CLEAR scenario:



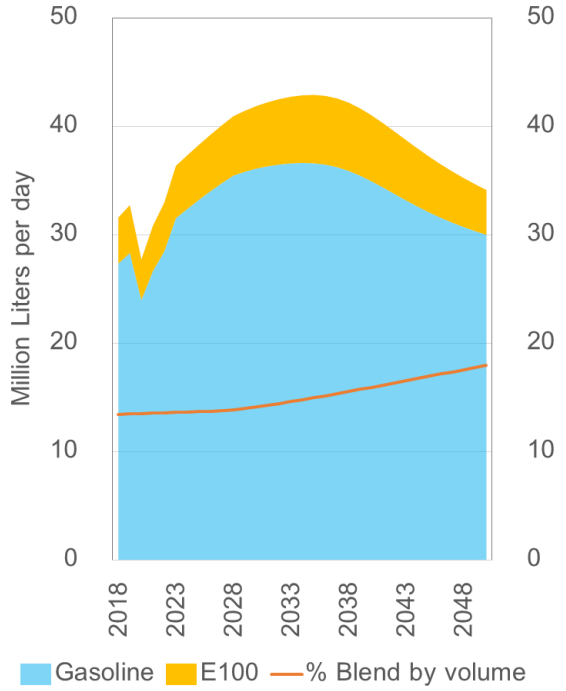
Biofuel in transportation

CLOUD scenario:

Bio-diesel

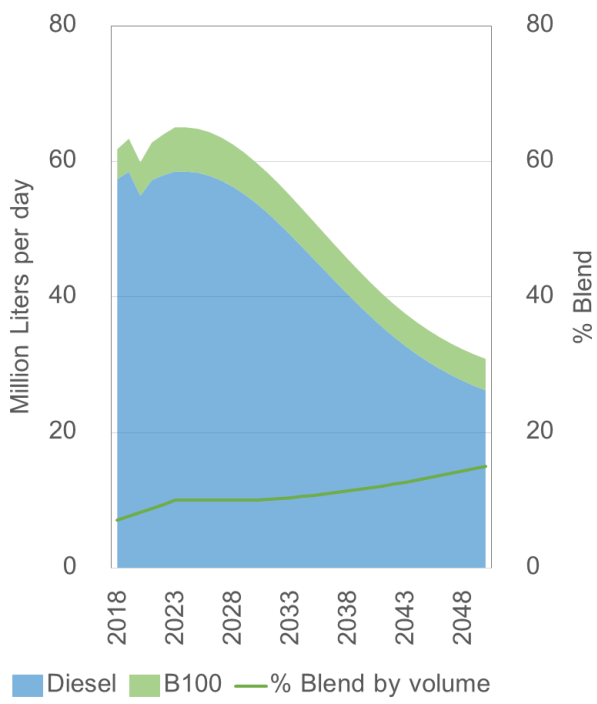


Ethanol

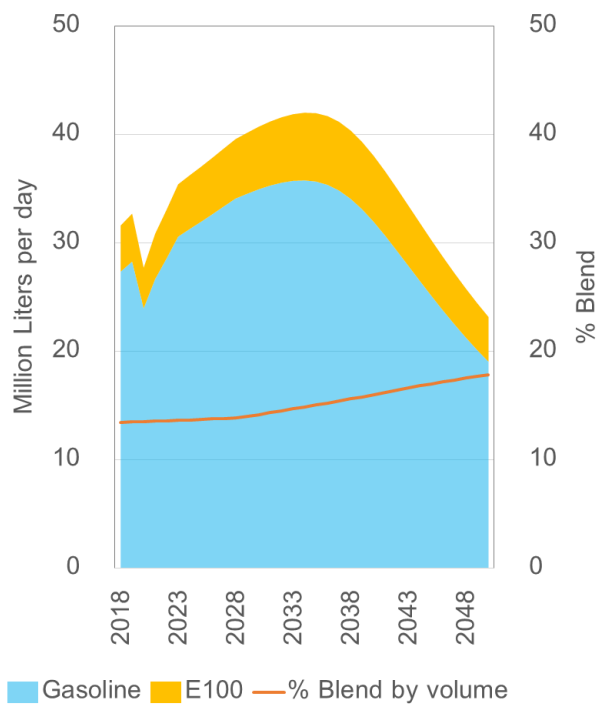


CLEAR scenario:

Bio-diesel

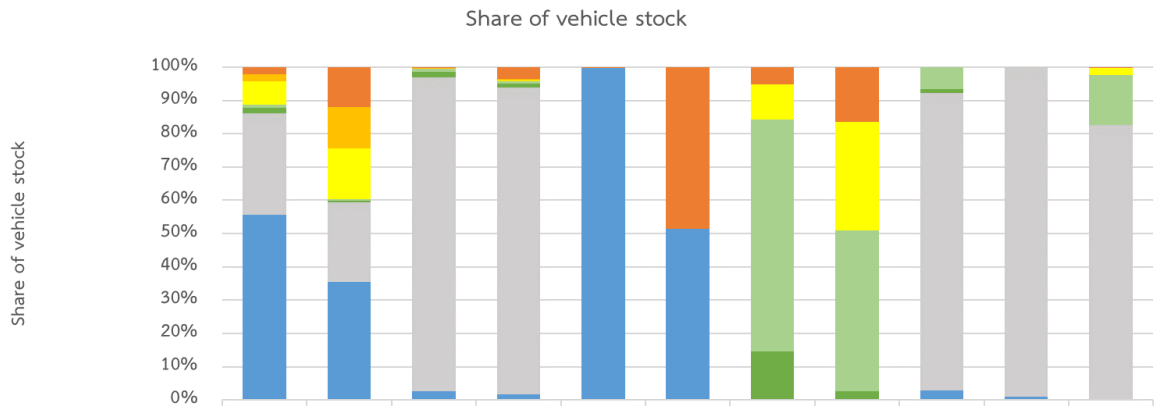


Ethanol



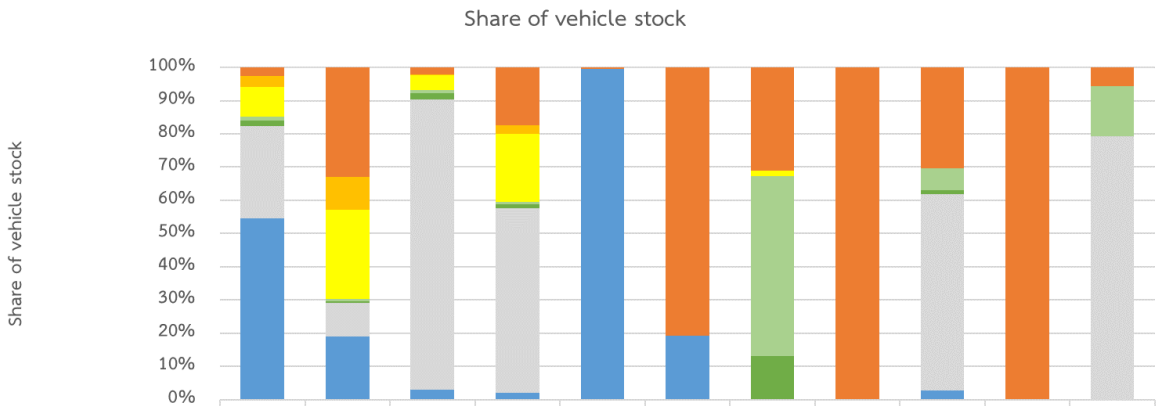
Electric vehicle stock in road transport

CLOUD scenario:



Vehicle stock (1000 units)	Private Car		Pick-up Truck		Motorcycle		Taxi		Commercial Car		Bus
	2030	2050	2030	2050	2030	2050	2030	2050	2030	2050	2030
BEV	315	2,527	19	271	60	13,084	4	9	0	0	0
PHEV	298	2,601	18	40			0	0			
HEV	1,013	3,190	7	23			8	17	0	0	2
CNG	166	110	68	49			55	25	7	0	18
LPG	227	92	121	100			11	1	1	0	0
Diesel n Biodiesel	4,468	4,996	7,478	7,298			0	0	98	288	99
Gasoline n Gasohol	8,105	7,466	208	135	23,226	13,876	0	0	3	3	0

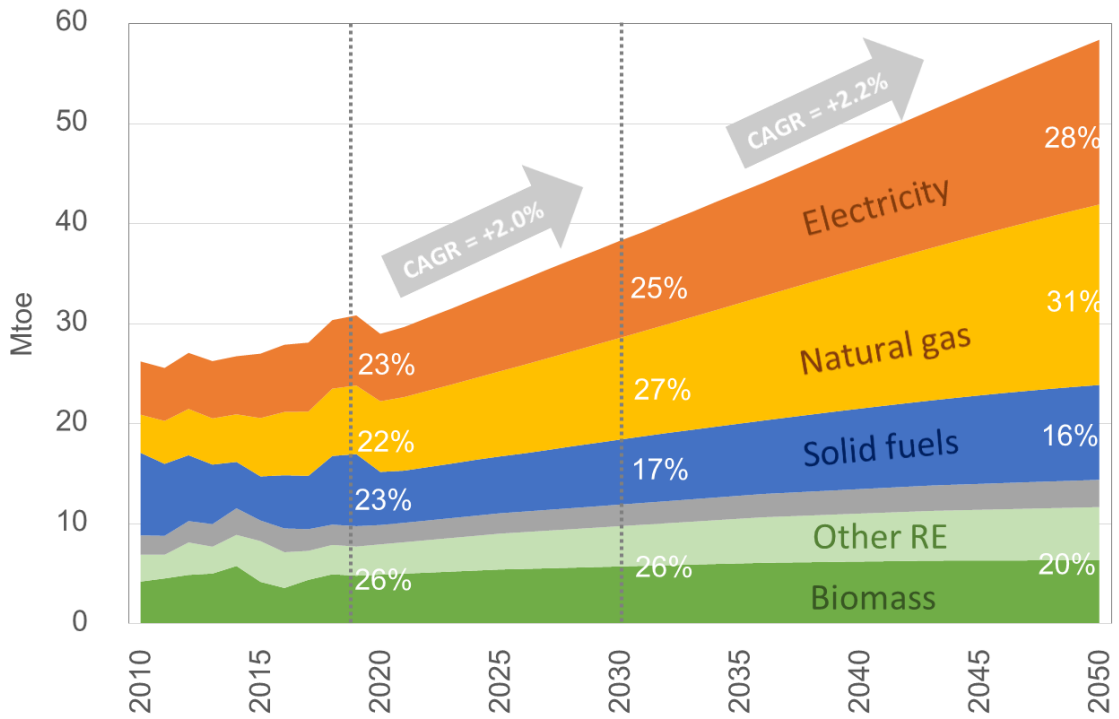
CLEAR scenario:



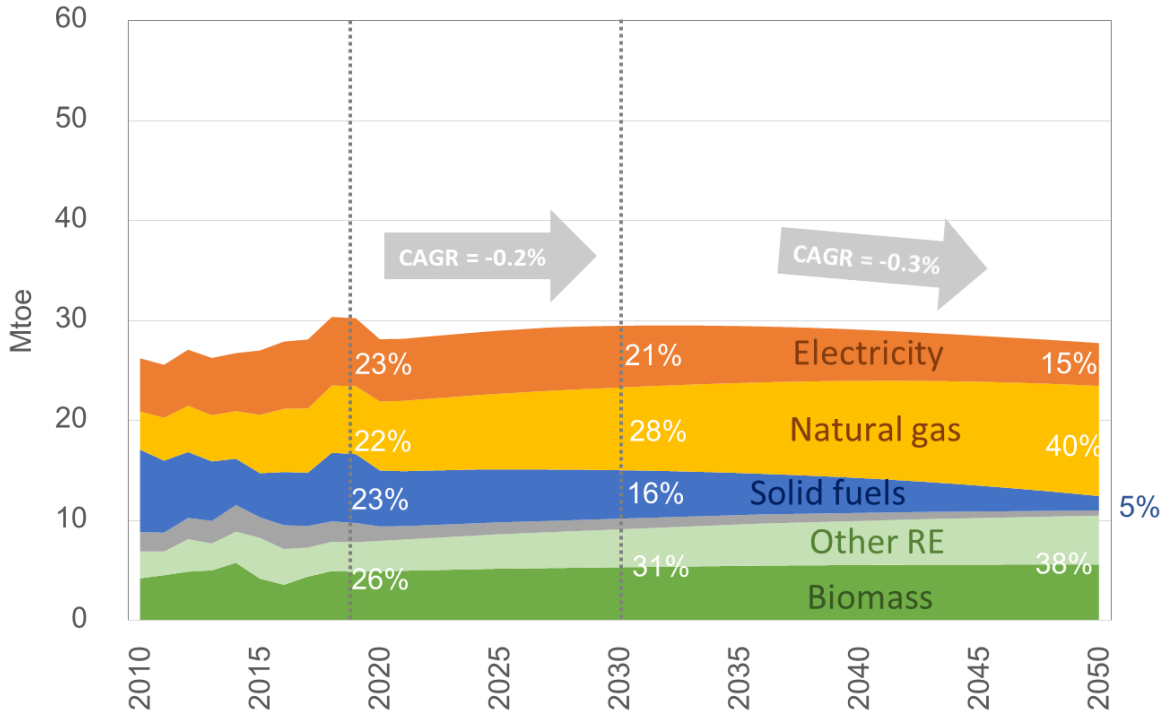
Vehicle stock (1000 units)	Private Car		Pick-up Truck		Motorcycle		Taxi		Commercial Car		Bus
	2030	2050	2030	2050	2030	2050	2030	2050	2030	2050	2030
BEV	389	6,909	157	1,374	94	21,806	24	52	33	291	7
PHEV	453	2,091	23	205			0	0			
HEV	1,327	5,628	351	1,620			1	0	0	0	0
CNG	183	120	90	68			43	0	7	0	18
LPG	238	99	139	89			10	0	1	0	0
Diesel n Biodiesel	4,058	2,147	6,920	4,410			0	0	65	0	95
Gasoline n Gasohol	7,944	3,982	236	151	23,193	5,153	0	0	3	0	0

Industrial sector

CLOUD scenario:



CLEAR scenario:



Biomass | Renewables | Oil Products | Solid Fuels | Natural Gas | Electricity

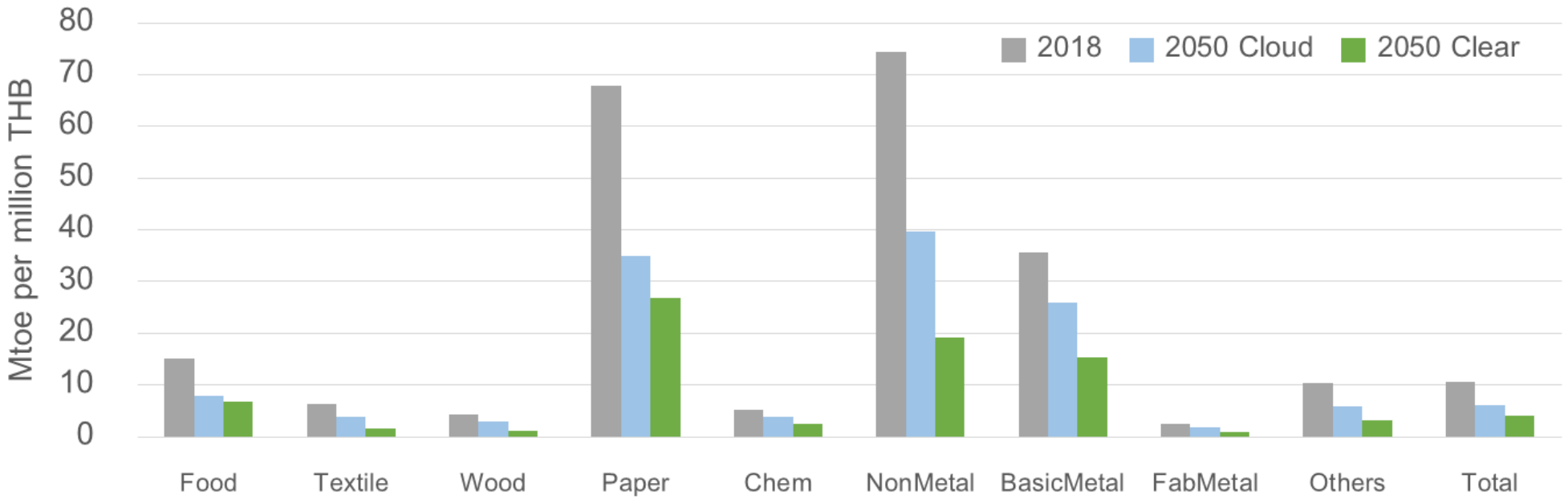
Industrial sector

CLOUD scenario:

- First S-curve is the driver for the future industry
- EE is improved, driven by better technologies.
- EMS & RE are the keys for GHG mitigation

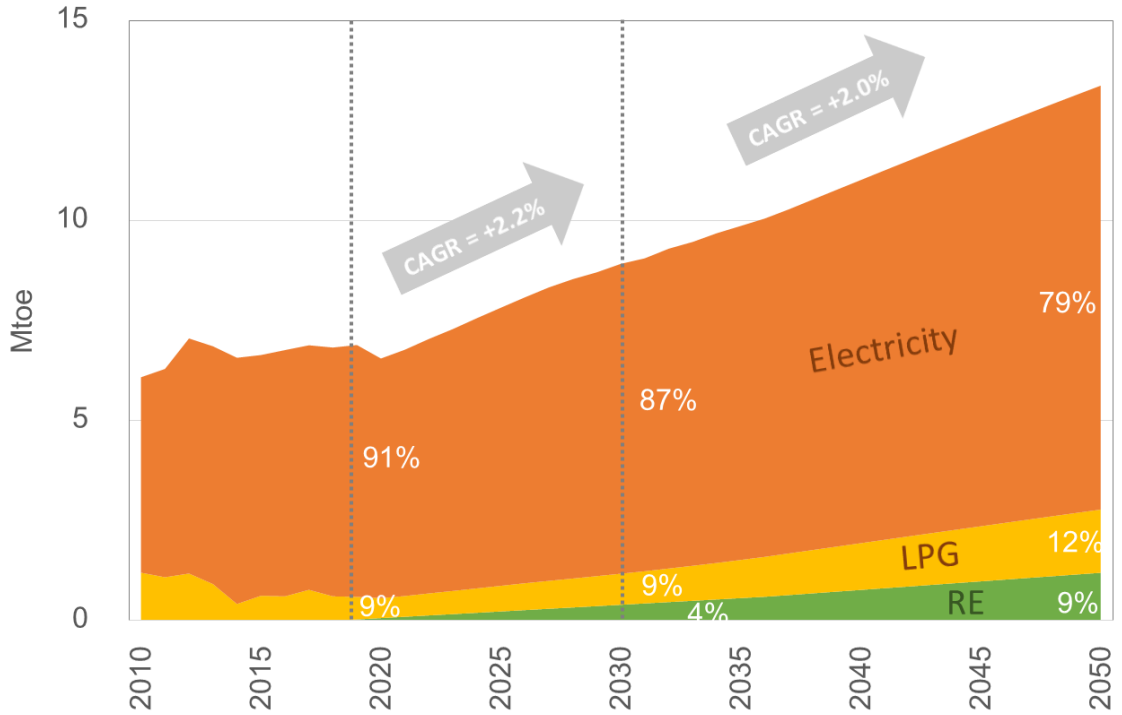
CLEAR scenario:

- First & New S-curve are combined.
- EE is accomplished by restructuring (e.g. product switching to higher value & lower energy intensity), EMS, FEMS & Process optimization

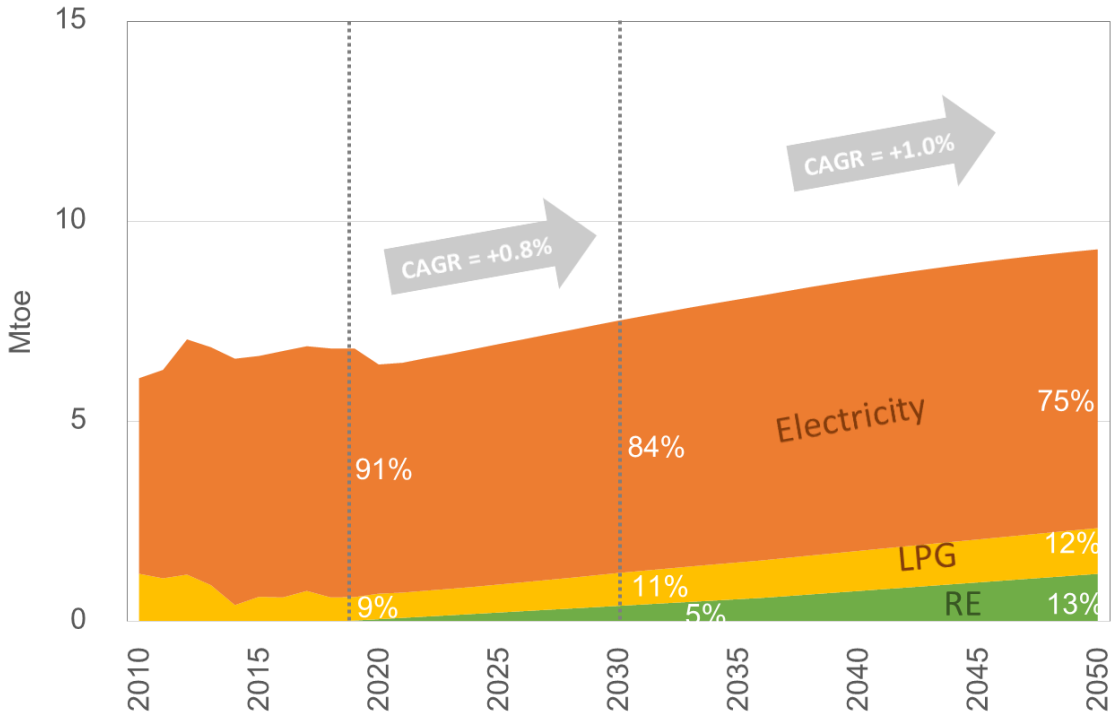


Commercial building

CLOUD scenario:



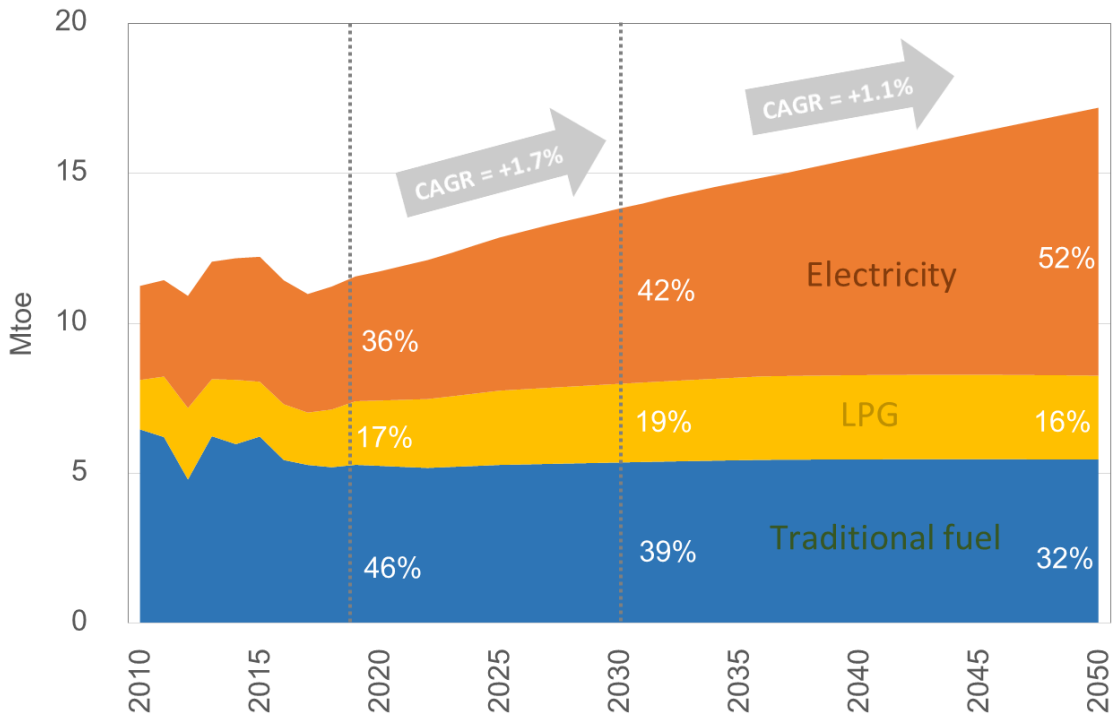
CLEAR scenario:



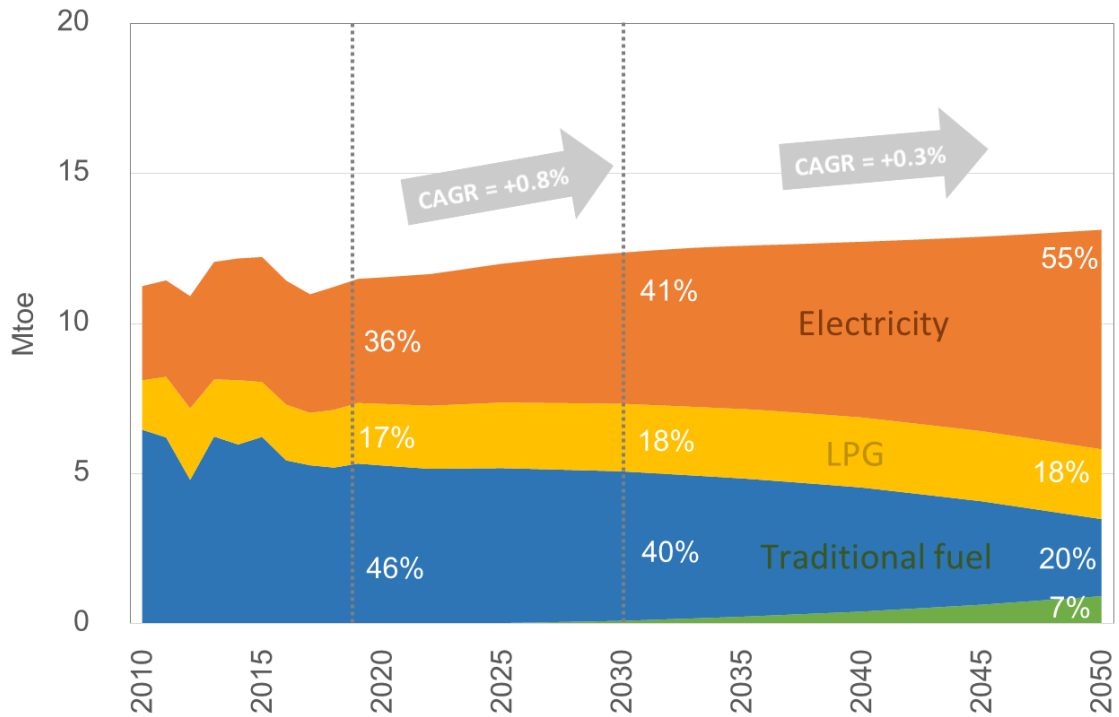
RE LPG Electricity

Residential sector

CLOUD scenario:



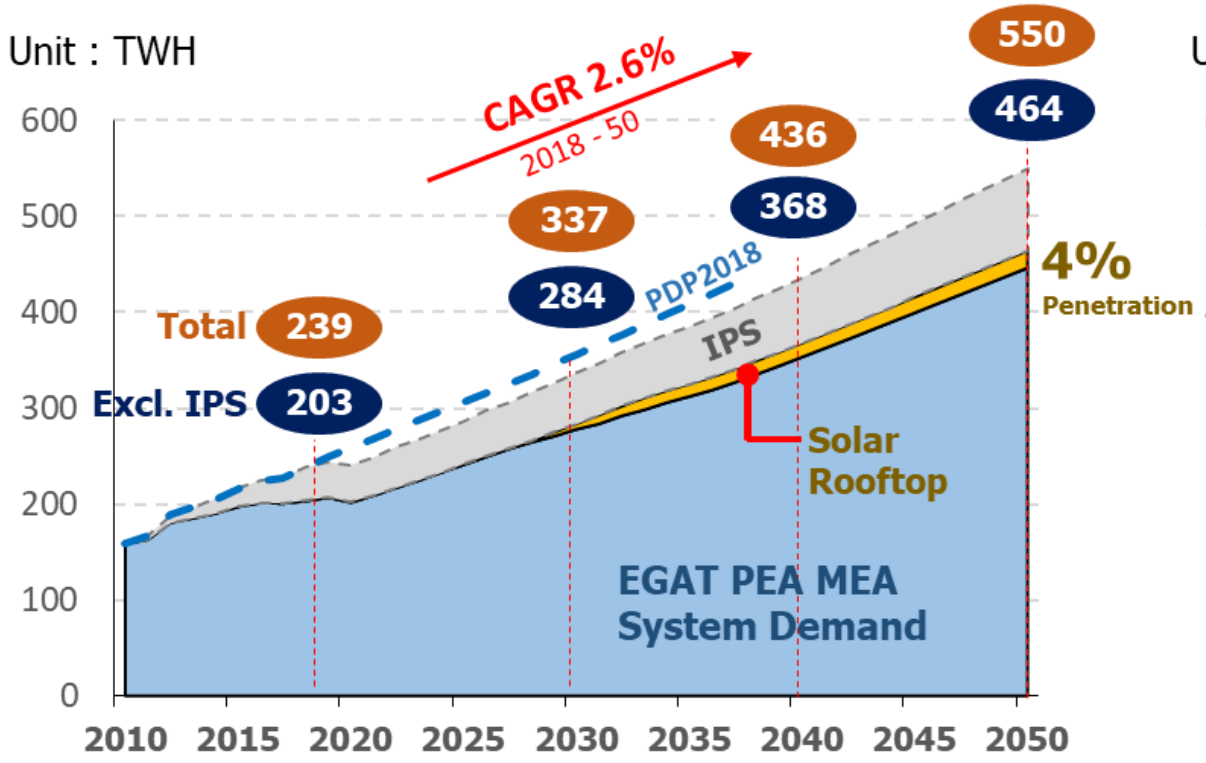
CLEAR scenario:



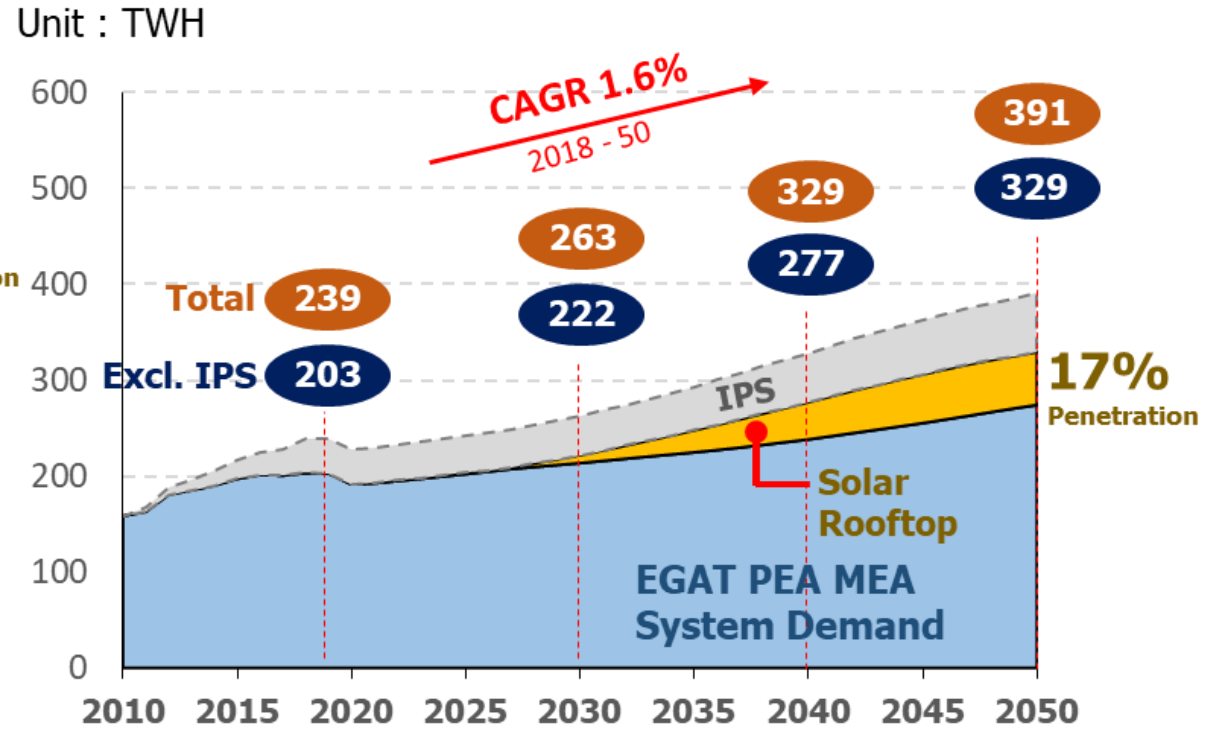
New RE | Traditional fuel | LPG | Electricity

Electricity demand

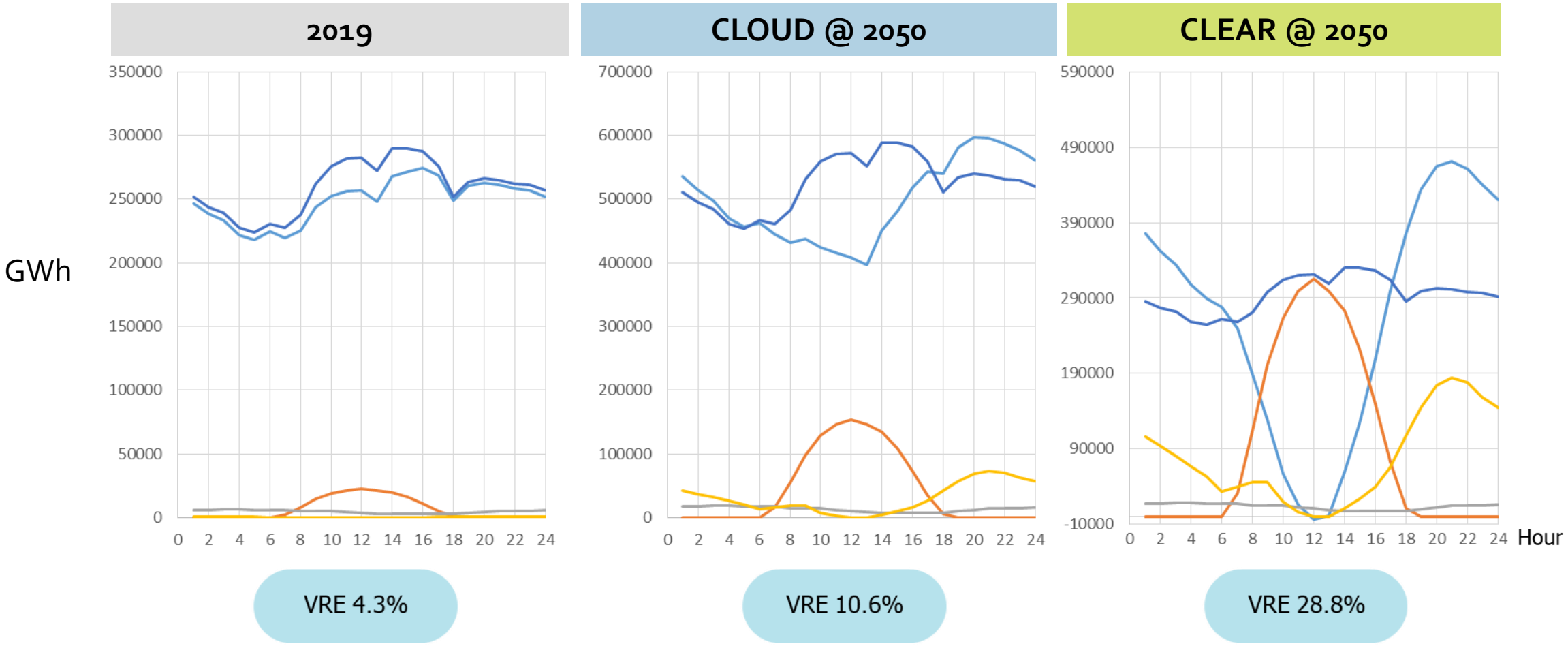
CLOUD scenario:



CLEAR scenario:



Daily load curve



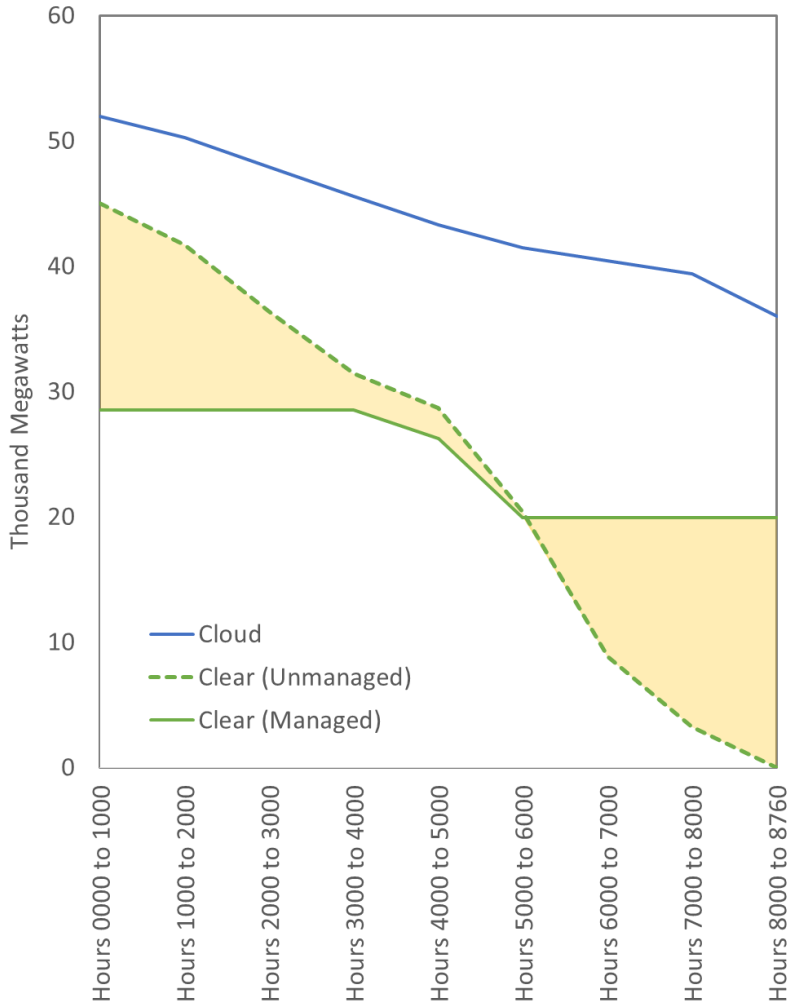
Load duration curve

CLOUD @ 2050

- Power capacity development is required to ensure security and reliability.
- VRE penetration is limited by system flexibility constraint.

CLEAR @ 2050

- Better load management and power dispatching performance with high penetration of VRE.
- Minimize the requirement of new power capacity



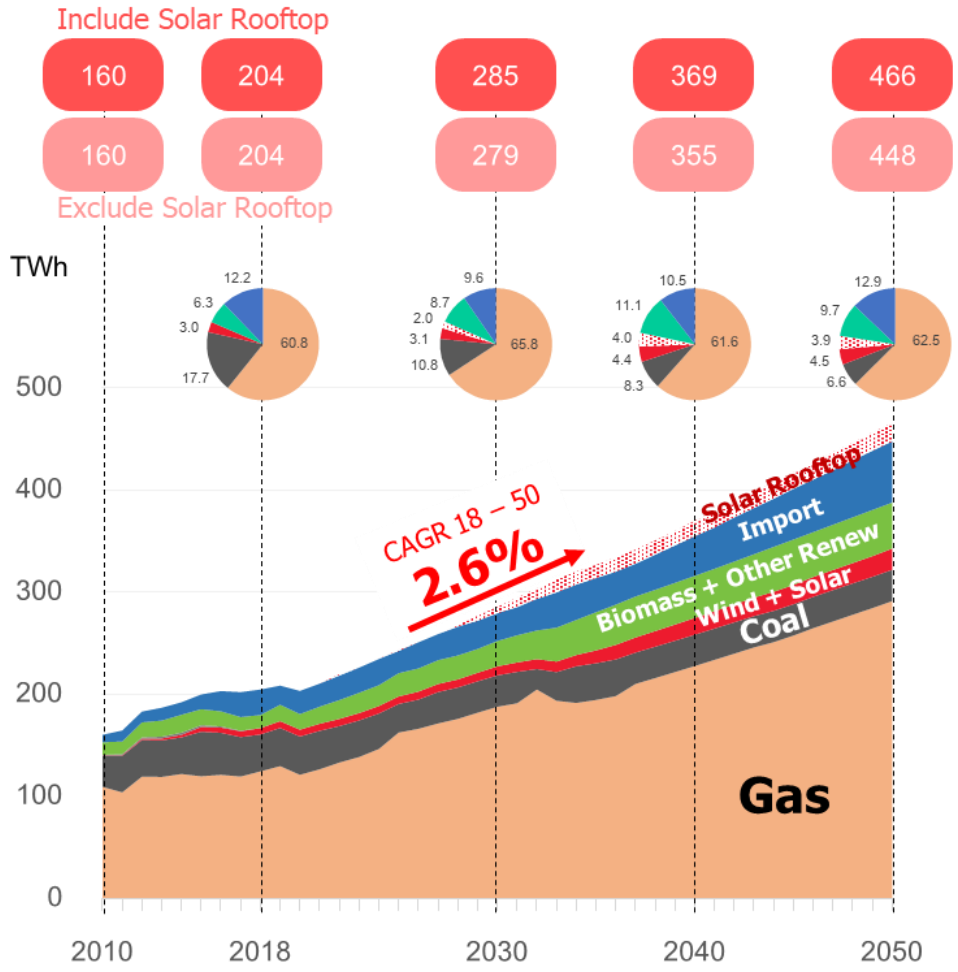
Flexibility requirement
89,420 MWh/D

Flexibility options

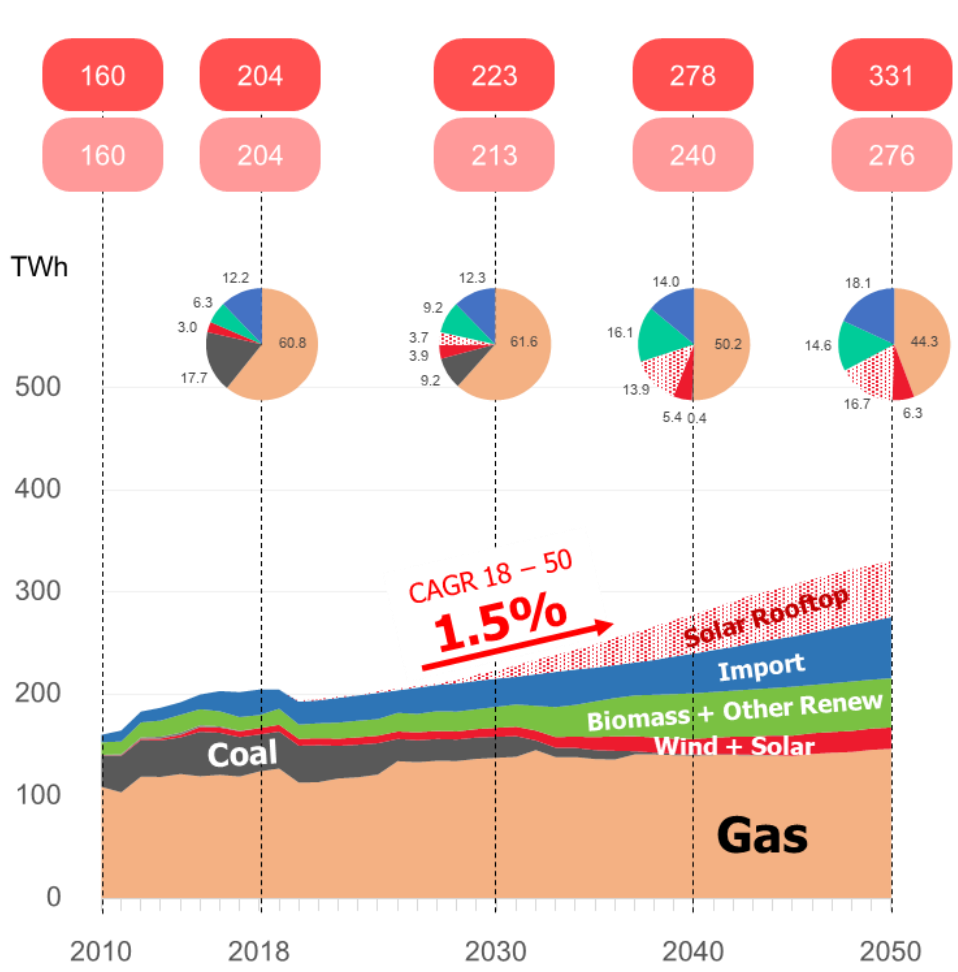
1. Improve operation
2. Demand response
3. Grid infrastructure
4. Fast ramping supply
5. Energy storage

Power: Generation

CLOUD scenario:



CLEAR scenario:

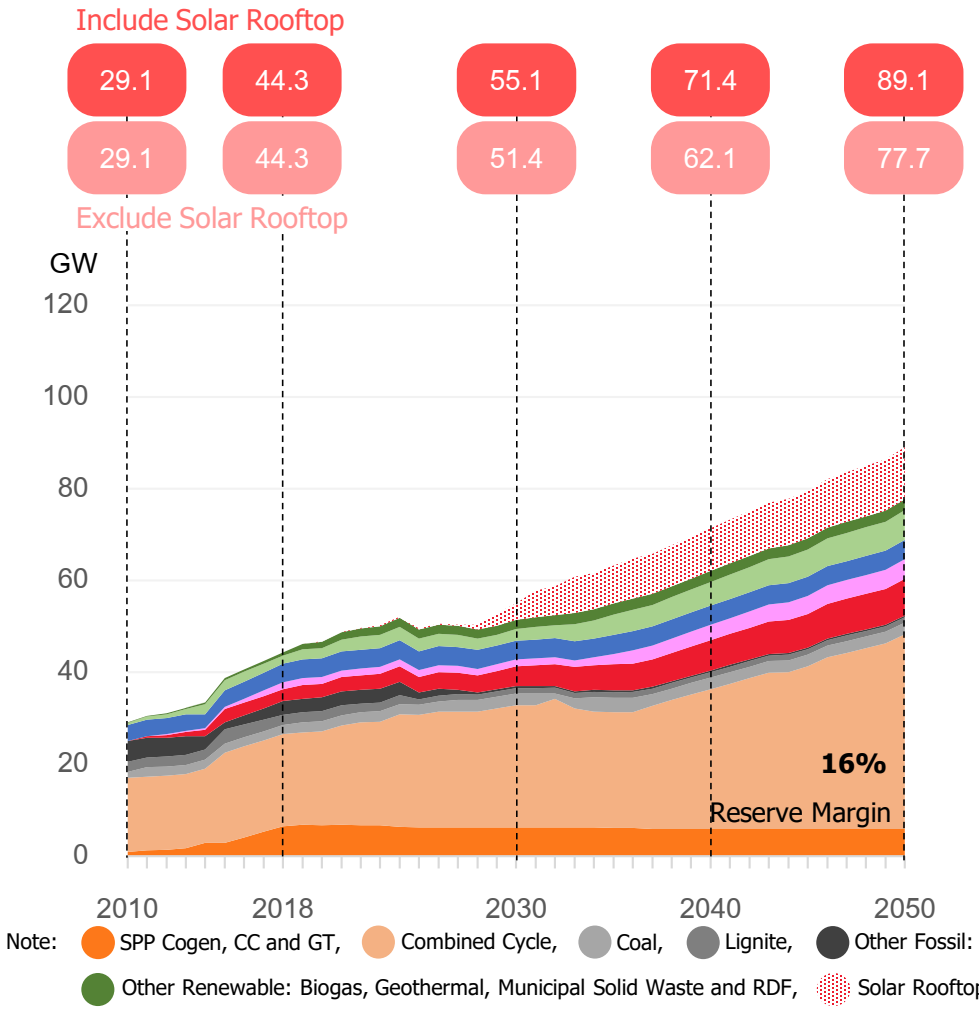


Note: Natural Gas, Coal, Solar and Wind, Biomass and Other Renewable : Biogas, Geothermal and Municipal Solid Waste, Net Import, Solar Rooftop

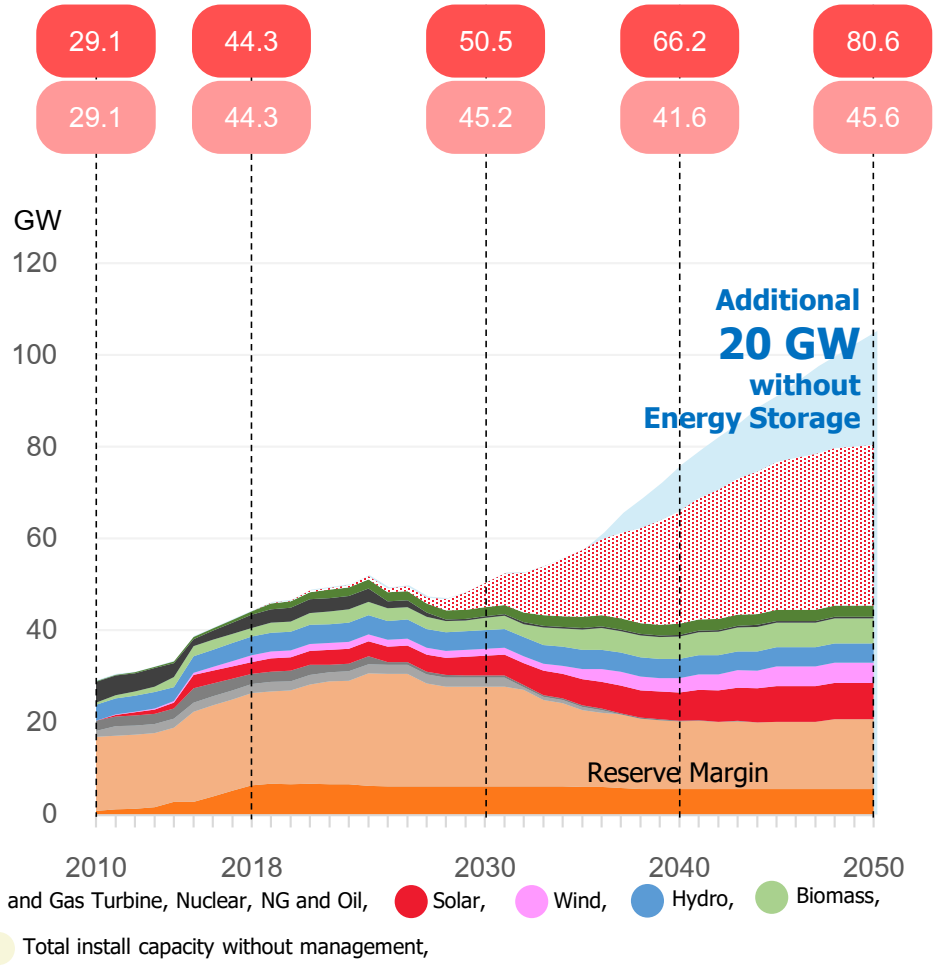
Energy efficiency 4000MW from PDP2018 already incorporated electricity demand and not included in this chart.

Power: Capacity

CLOUD scenario:

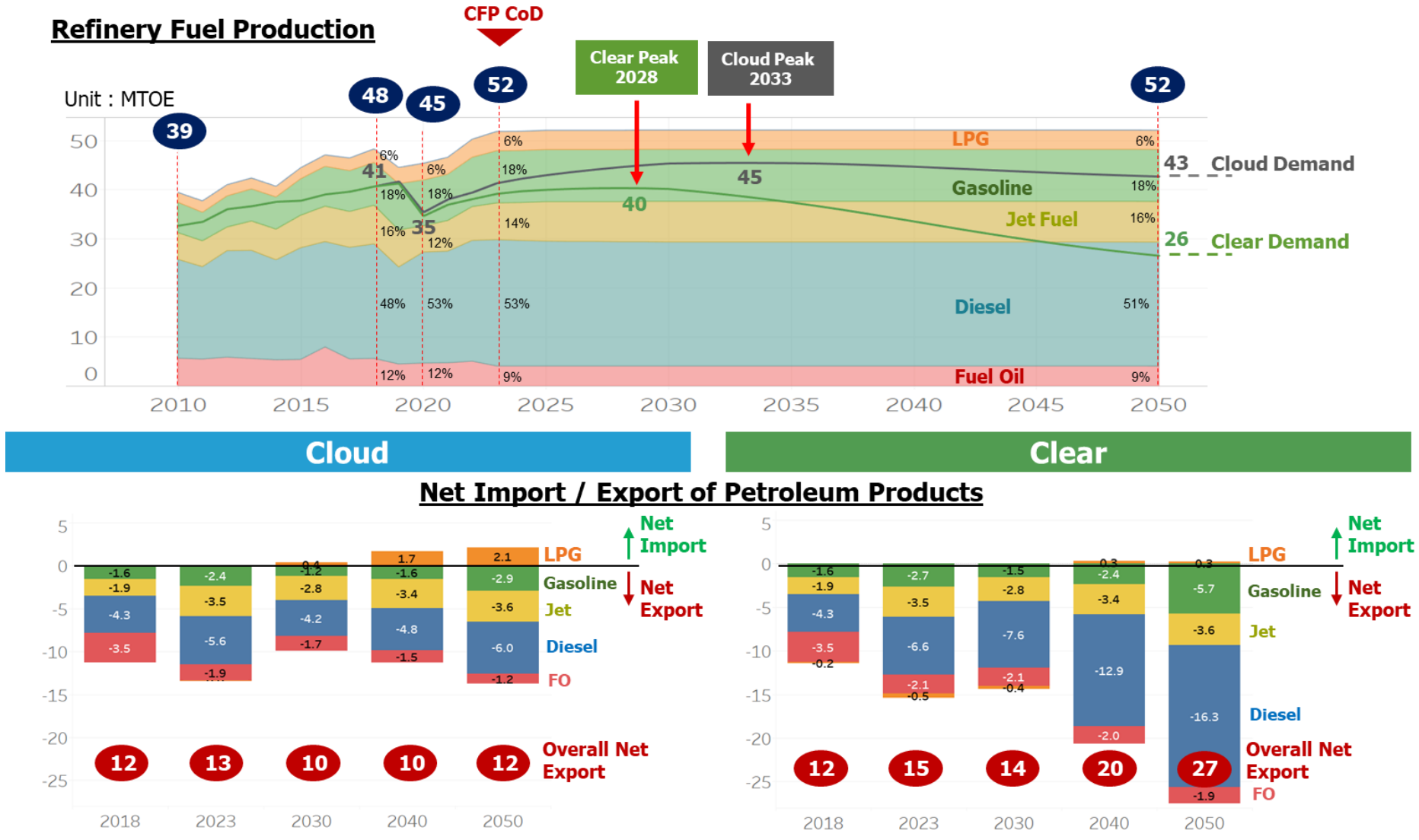


CLEAR scenario:



Note: SPP Cogen, CC and GT, Combined Cycle, Coal, Lignite, Other Fossil: Diesel and Gas Turbine, Nuclear, NG and Oil, Solar, Wind, Hydro, Biomass, Other Renewable: Biogas, Geothermal, Municipal Solid Waste and RDF, Solar Rooftop, Total install capacity without management,

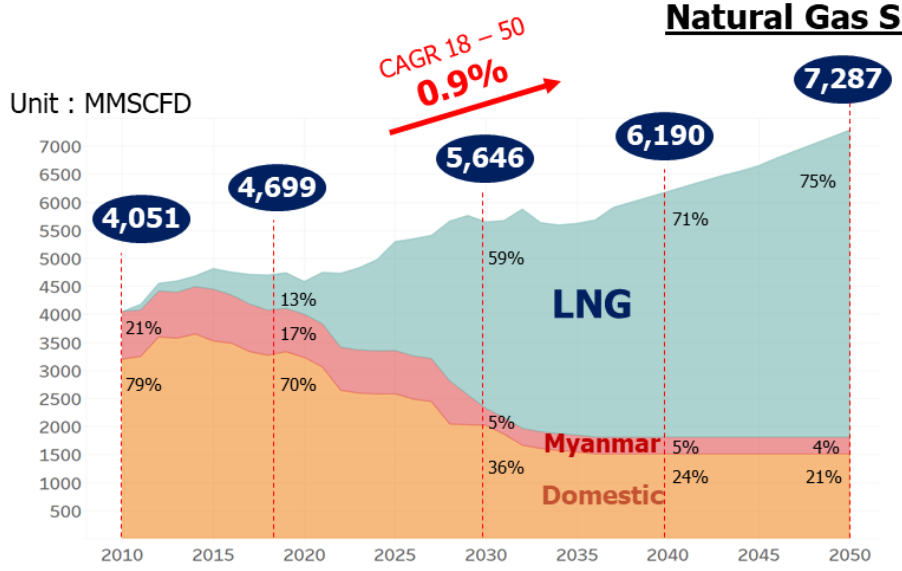
Oil: Refinery



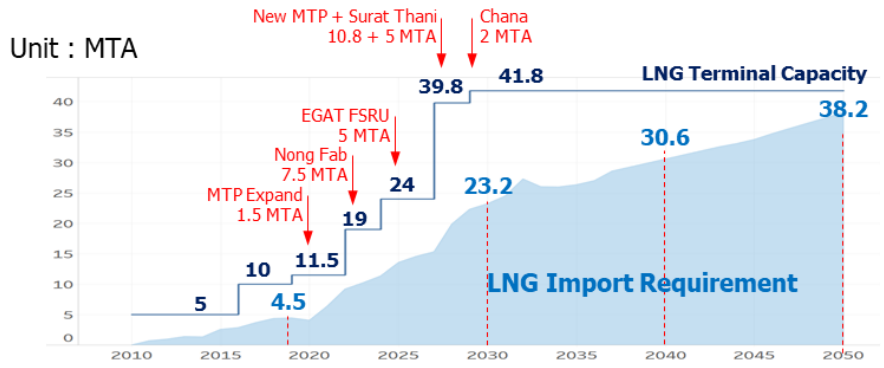
Natural gas supply

CLOUD scenario:

Natural Gas Supply by Source

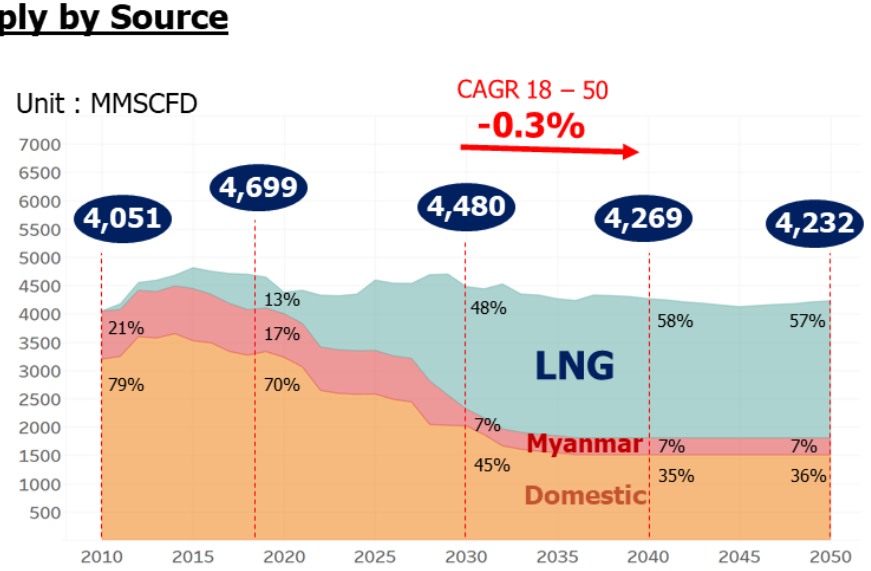


LNG Import Requirement VS Planned Terminal Capacity

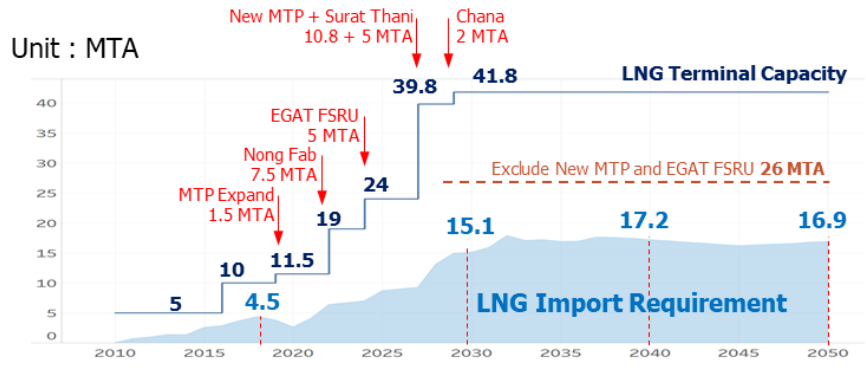


CLEAR scenario:

Natural Gas Supply by Source

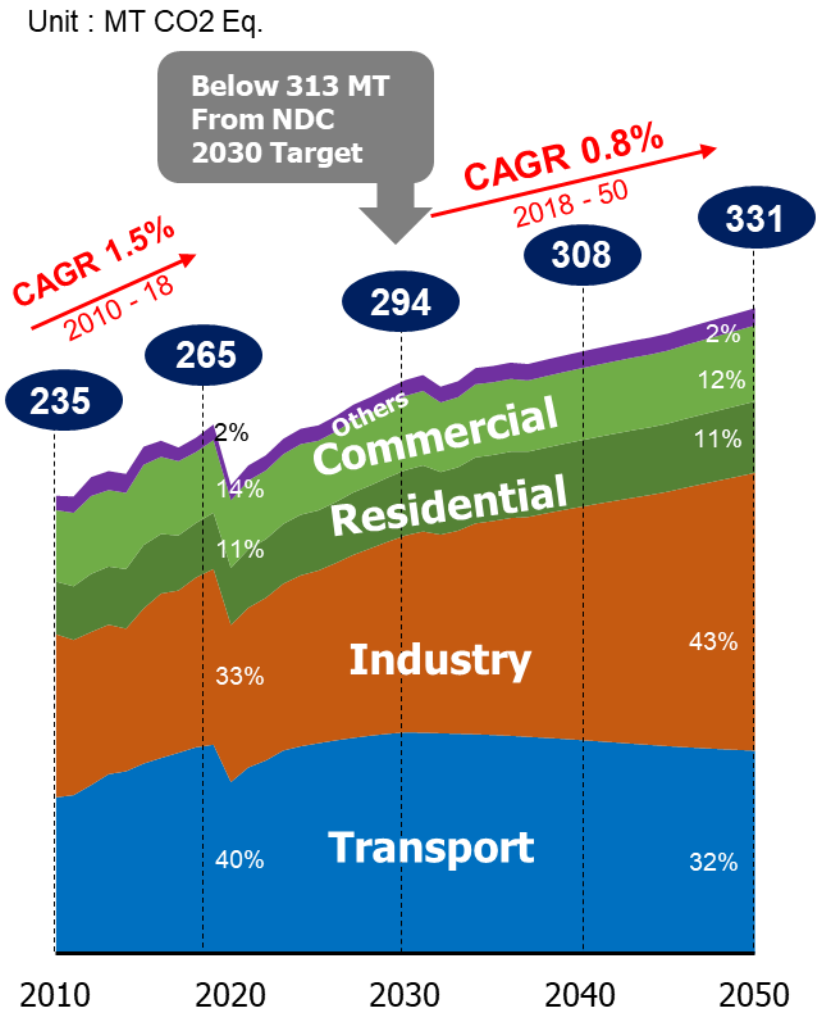


LNG Import Requirement VS Planned Terminal Capacity

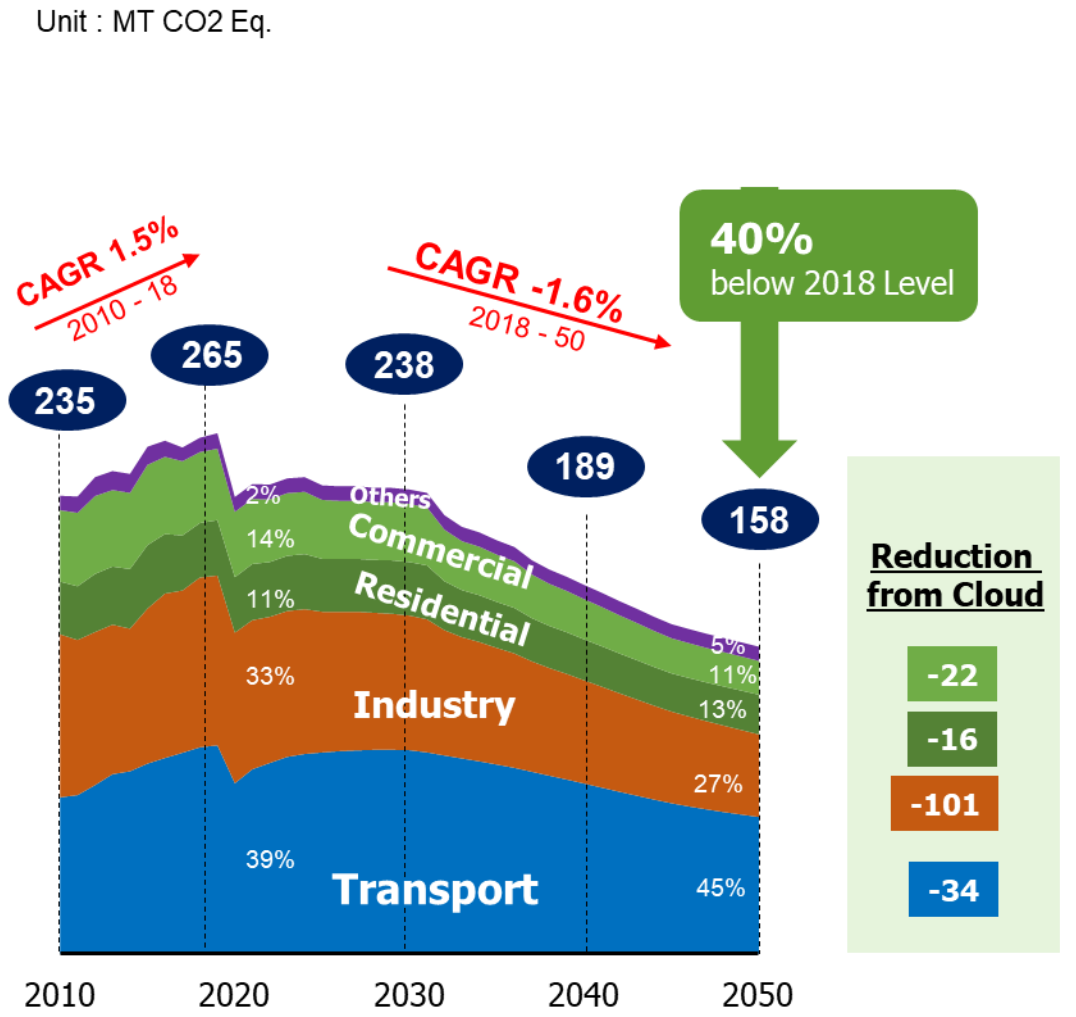


Energy-related GHG emission

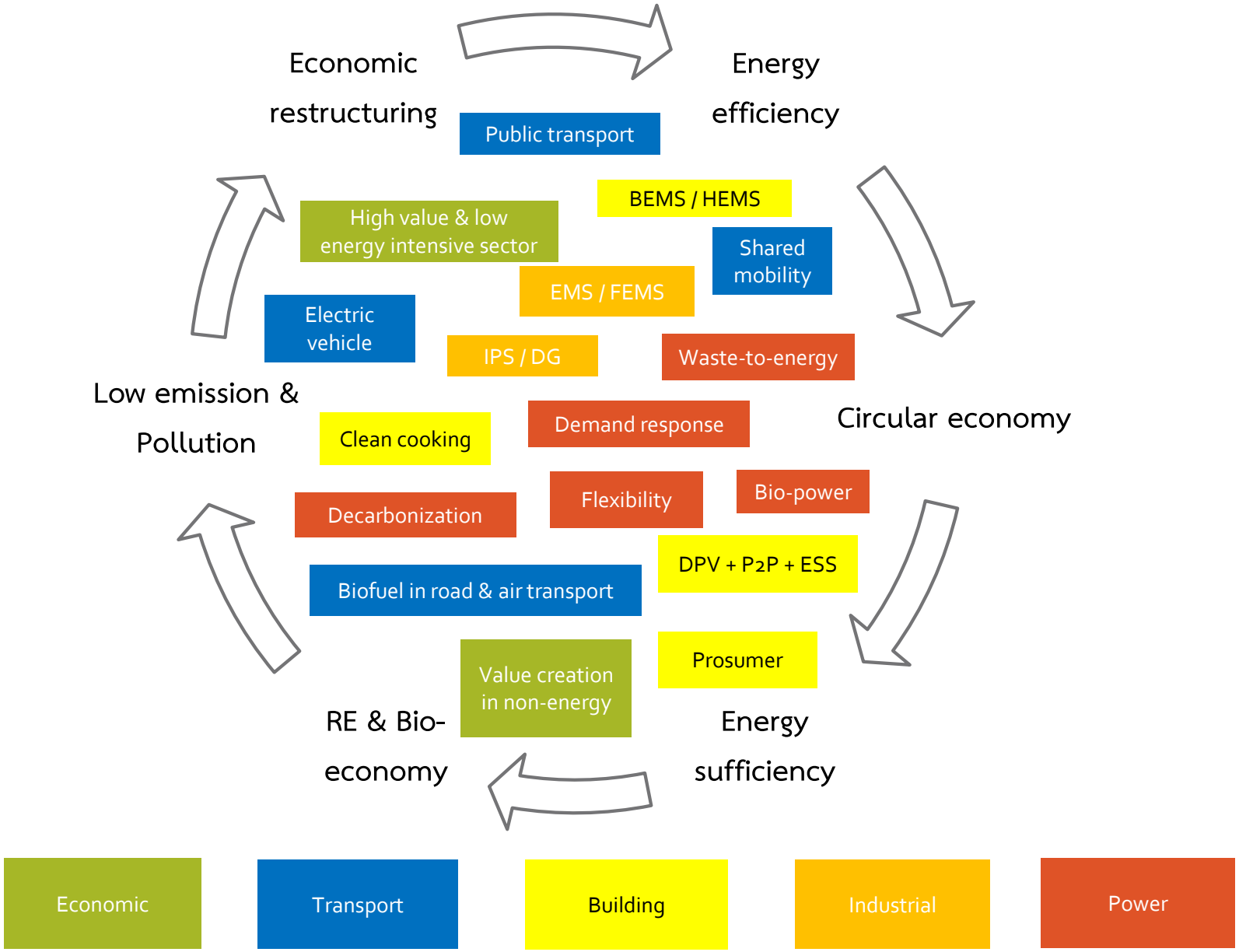
CLOUD scenario:



CLEAR scenario:



Key actions for CLEAR scenario



คุณวิภา สิรินุกุล

คุณอาวุธ นิติพน

คุณเบญจม์ภัทร เพาะพืช

คุณฐาปนา ถนัดสร้าง

คุณศุภกัญญา สุพรรณพงศ์

คุณพริม วินัยสุรเทิน

ดร.วีรินทร์ หวังจิรนิรันดร์

ดร.จักรพงศ์ พงศ์ธไนศวรรย์

ดร.นิธิดา นาคะปรีชา

ดร.อาทิตย์ ทิพย์พิชัย

ดร.กัญณภัทร ชื่นวงศ์