

AIM Workshop

13 - 14 September 2022

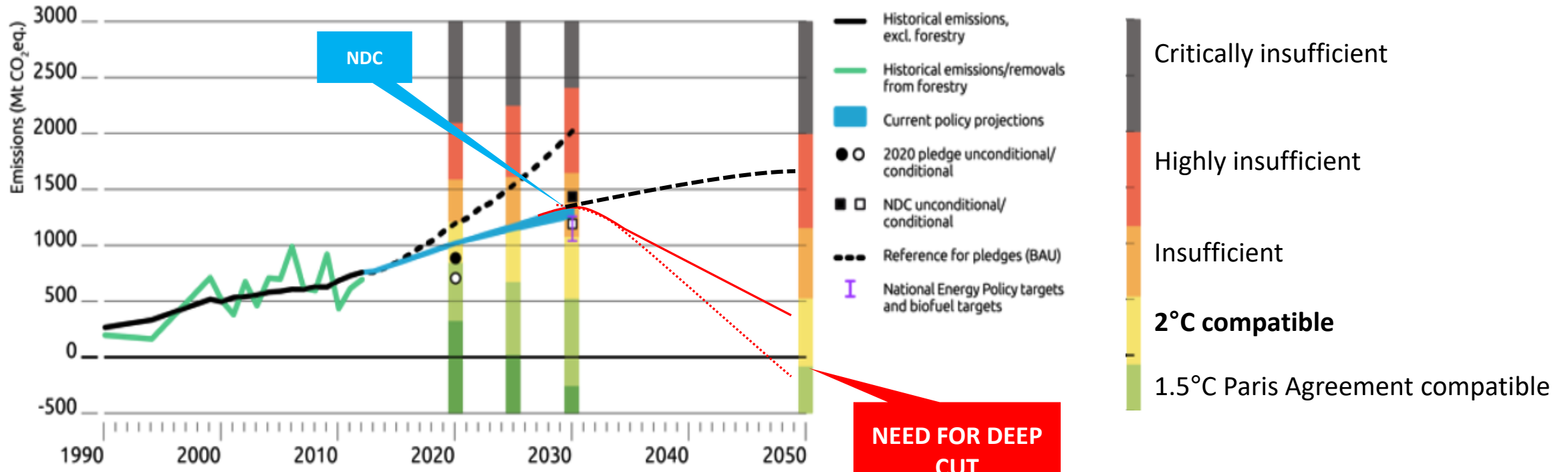
GHG Mitigation and AIM in Asia

Roadmap to Indonesia Energy Sector NZE



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Center for Research on Energy Policy - ITB

Indonesia Updated NDC 2030



Updated Indonesia NDC (Nationally Determine Contribution)

Sektor	Base Year 2010 (Mton CO ₂ -e)	GHG Emission Level 2030 (Mton CO ₂ -e)			% reduction of BaU	
		BaU	CM1	CM2	CM1	CM2
Energy*	453.2	1,669	1,355	1,223	11%	15.5%
Waste	88	296	285	256	0.38%	1.4%
IPPU	36	69.6	66.85	66	0.10%	0.11%
Agriculture	110.5	119.66	110.39	116	0.32%	0.13%
Forestry**	647	714	217	22	17.20%	24.1%
Total	1,334	2,869	2,034	1,683	29%	41%

*Including fugitive; **Including peat fire; CM1 = unconditional, CM2 = conditional

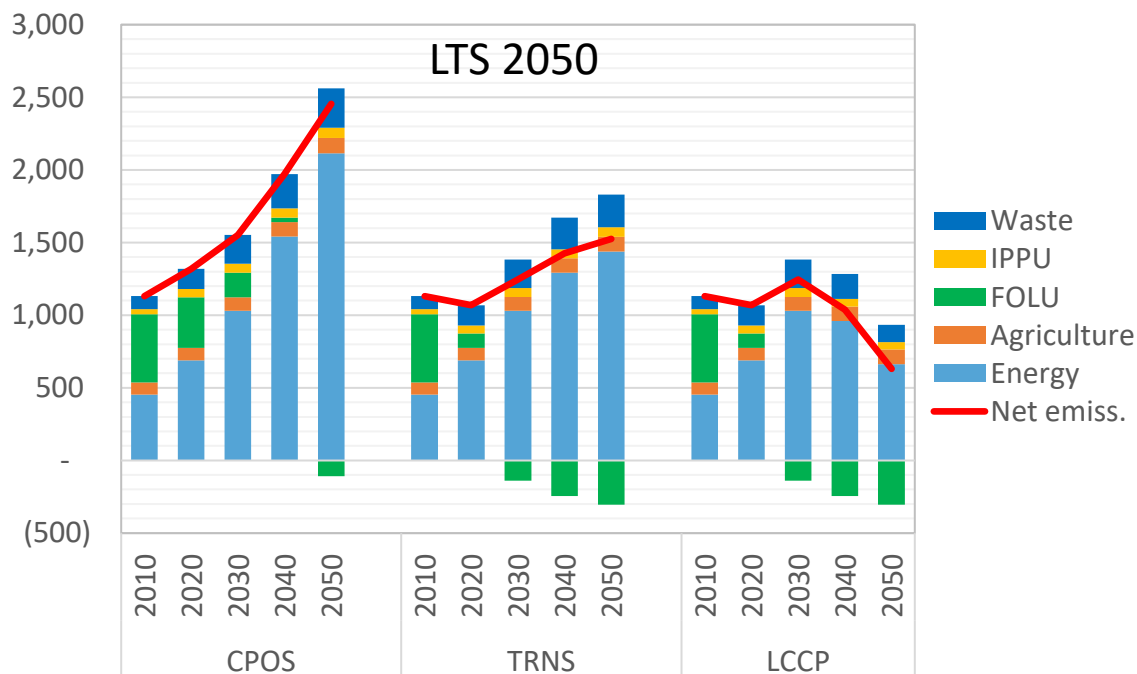
Remarks

BaU	Development Path <u>not</u> deliberated the mitigation policies
CM1	Mitigation scenario & considers sectoral development target (Unconditionally)
CM2	Ambitious mitigation scenario + International support available (conditionally)



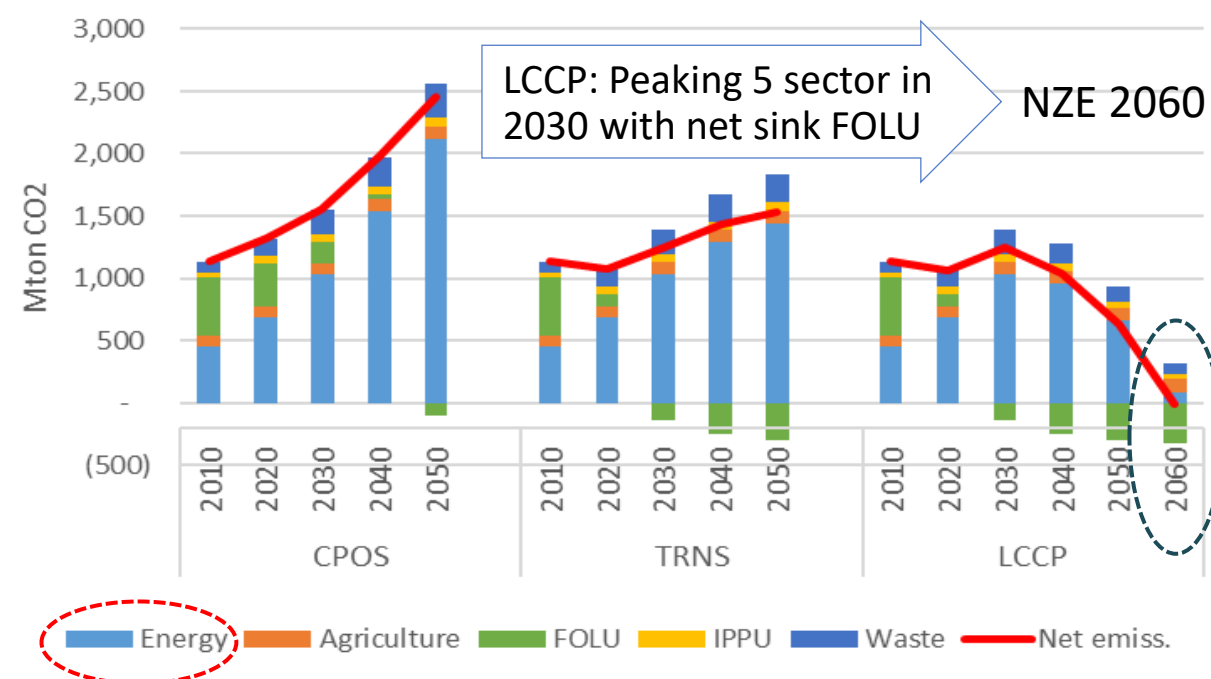
LTS LCCR 2050

(Long Term Strategy for Low Carbon and Climate Resilience)



NZE 2060

(Net Zero Emissions)



Sumber: LTS LCCR Indonesia, KLHK (2021)

- **CPOS** (Current Policy)
- **TRNS** (Transition)
- **LCCP** (Low Carbon Scenario Compatible with Paris Agreement Target)

Sector	2010	2020	2030	2040	2050	2060
Energy	453	638	1,030	960	572	129
IPPU	35	55	62	55	50	45
Agriculture	84	88	94	98	102	101
FOLU	470	98	-140	-246	-304	-362
Waste	89	139	198	170	120	87
Net Emissions	1,131	1,018	1,244	1,037	540	0

EndUse – ExSS Model

(GAMS, General Algebraic Modeling System) v 24.0



The **AIM-ExSS model** is used to estimate rational projections of energy demand (electricity) by the user side (industrial, commercial, residential, and transportation).

The **AIM-EndUse model** is a bottom up model developed by CREP ITB, NIES (Japan), and Mizuho (Japan) for solving linear optimization equations for technology selection (up to unit level) with a minimum cost approach and some restrictions (capability and availability of energy supplies, technology penetration, emissions targets, etc.).

Socio-economic indicators (input parameters to ExSS Modeling)

In the service demand projection, population growth, economic growth, economic structure (industry), enduse of technology (electric appliances) used by consumers, and consumer life style are energy drivers for the development of service demand.

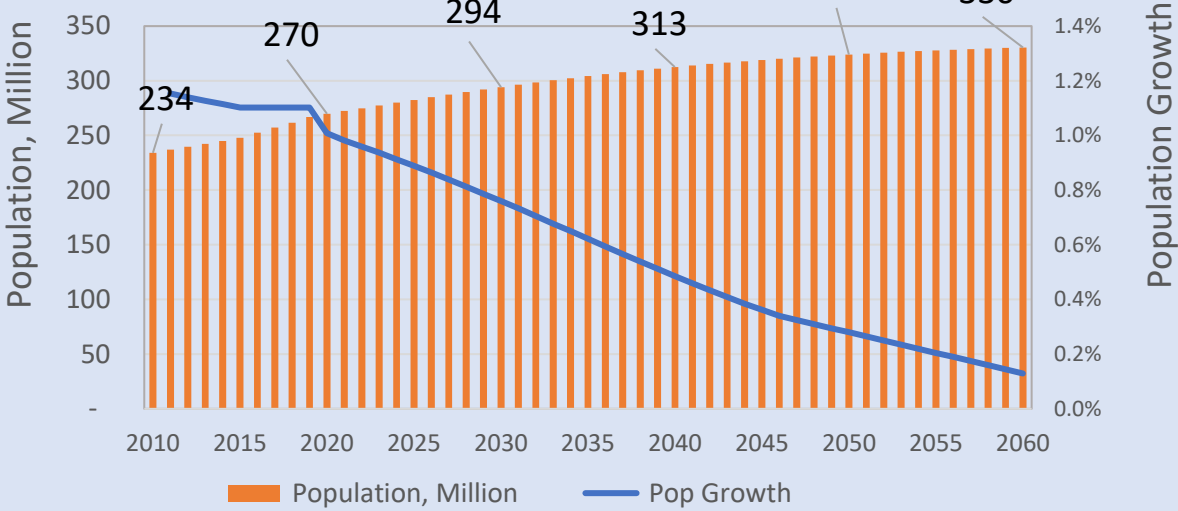
	Unit	2010	2030	2050	2060	2030/2010	2050/2010	2060/2010
Population	Million peoples	238.52	296.41	335.35	330,000	1.24	1.41	1.41
Passenger transport demand	bil. Pass –km	937,606	3,250,907	3,677,997	5,688,138	3.47	3.92	6.07
Freight transport	bil. Ton-km	435,156	2,535,818	7,259,895	1,700,341	5.83	16.68	3.91
Pass. Transport Specific Energy Consumption	TJ/mill-pass km	0.8	0.64	0.51	0.45	0.80	0.64	0.56
Freight Transport Specific Energy Consumption	TJ/mill-ton km	1.7	1.4	1.2	1.1	0.82	0.71	0.65

Assumptions for Socio-Economic and Energy Demand Target

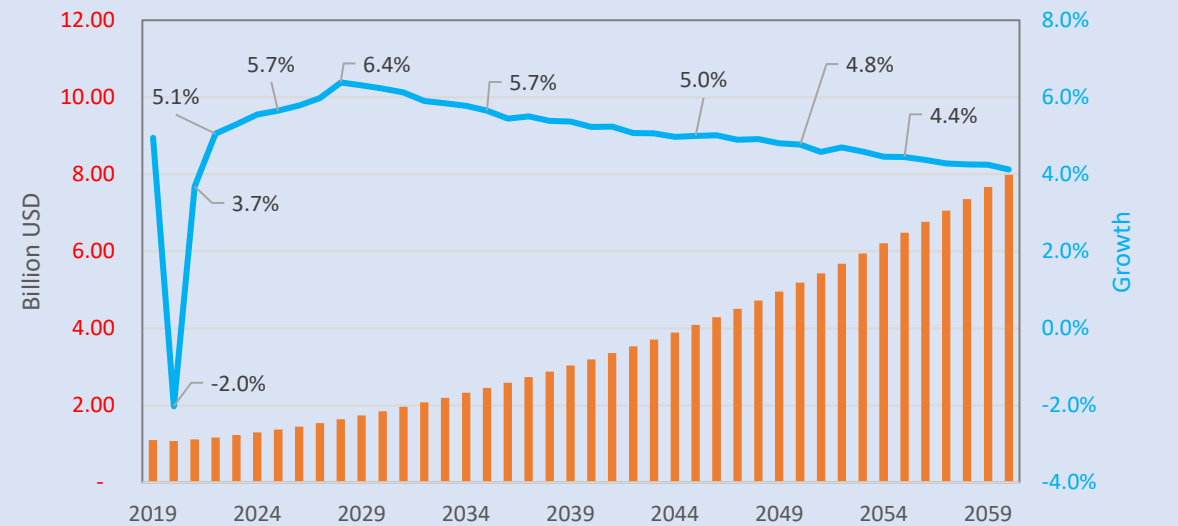


Future Economic and Population

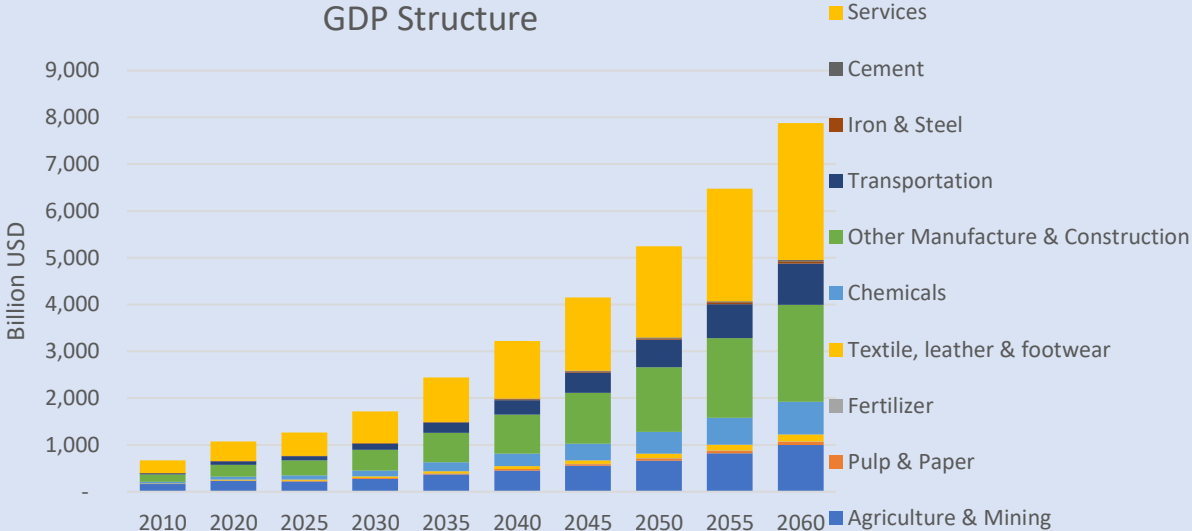
Population and Growth



GDP (constant rate 2010) & Growth

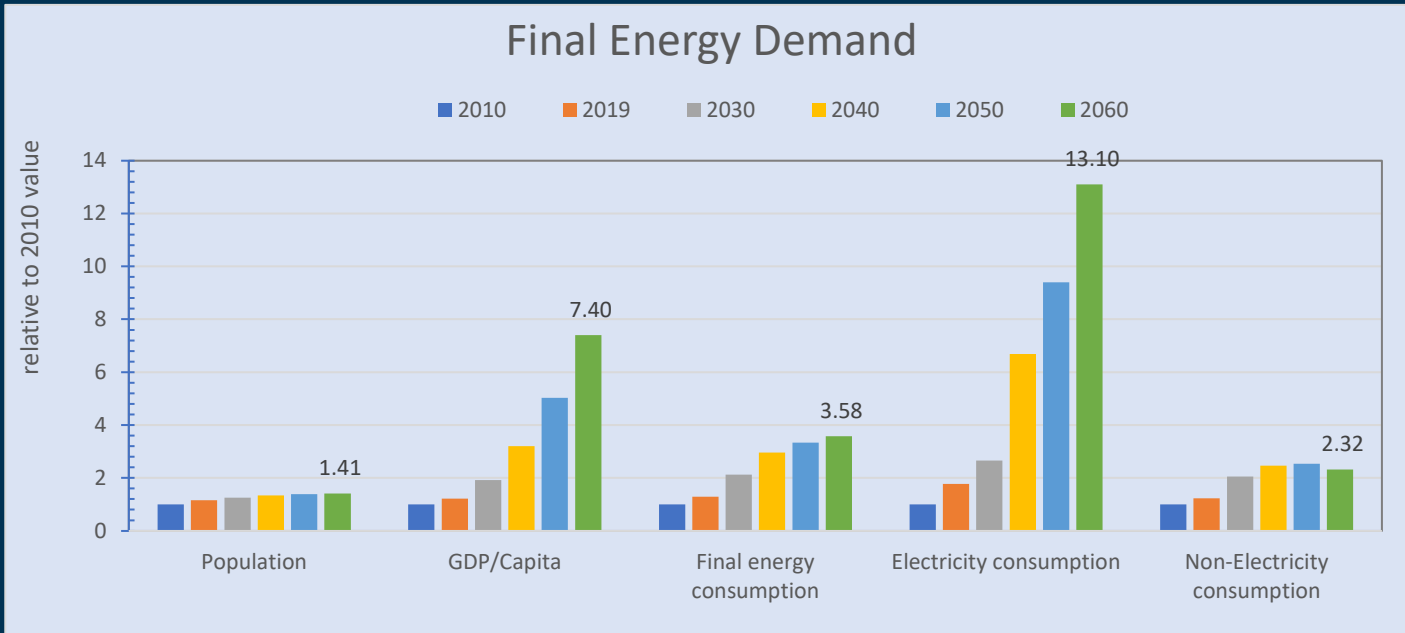


GDP Structure



- Economic development is expected to increase with average growth of 5.2%/year. *Pandemic recovery would require economic growth of 5%-6% (2022-2025) and 6.3%-7.1% (2026-2030) and then escape from 'middle income trap' become developed country in 2045, which will require high energy consumption*

Final Energy Demand Target



Resources Potential

Energy	Potential	Utilization	
	GW	GW	MW
Solar	3,295	0.22	217
Hydro	95	6.64	6,637
Bioenergy	57	2.28	2,284
Wind	155	0.15	154
Geothermal	24	2.29	2,293
Ocean	60	-	-
Total	3,686	12	11,585

- World average of final energy demand in 2020 (IEA 2022) was 1,32 toe/capita/year, in OECD countries it was 2,68 toe/capita/year, while world average primary energy supply was 3 toe/capita/year.
- In 2060, Indonesia energy consumption is targeted to exceed world average in 2020, i.e 1.45 toe/capita/year, which has considered more efficient energy technology trajectory.
- In 2060, electricity consumption level would reach 5000 kWh/capita/year, which is about the same level with developed country consumption level (7000-8000 kWh/cap/year in 2020).

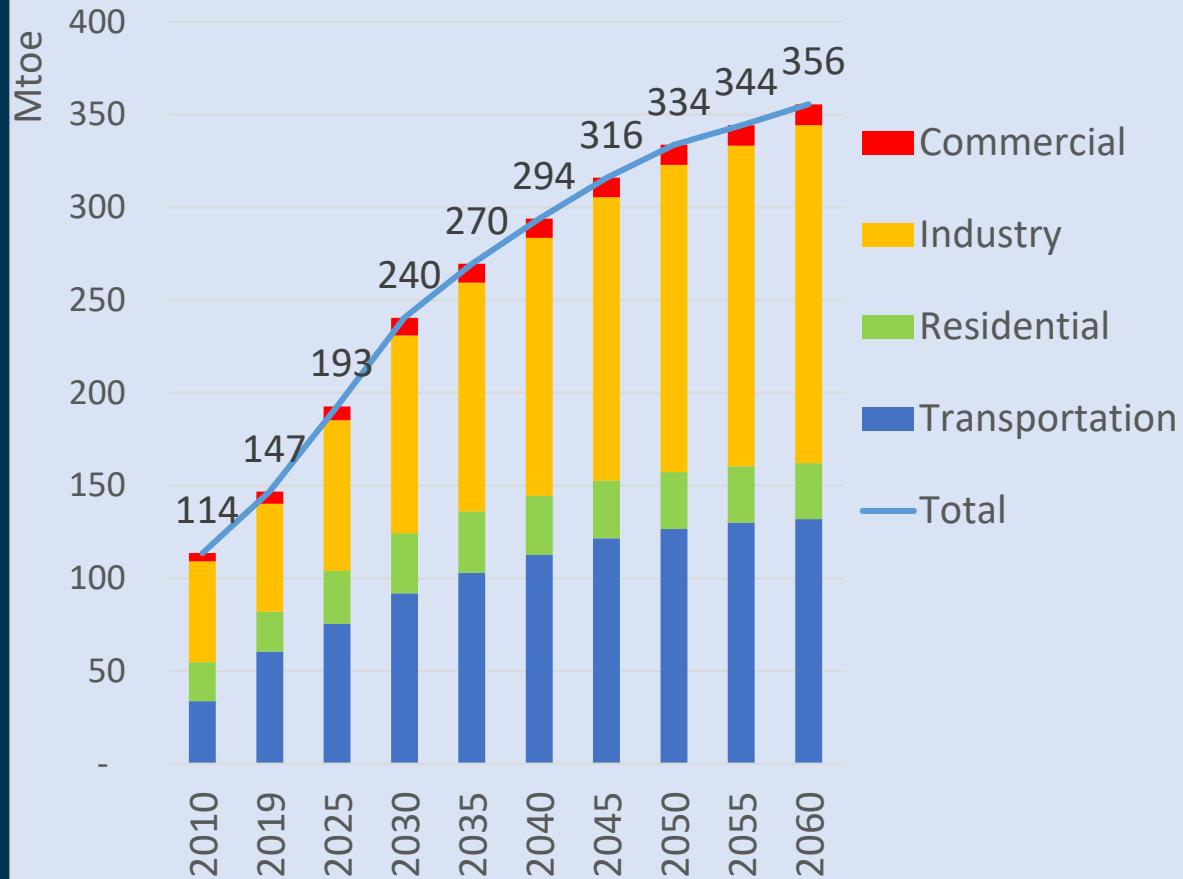


Projection of Energy Demand and Supply and The Associated GHG Emissions

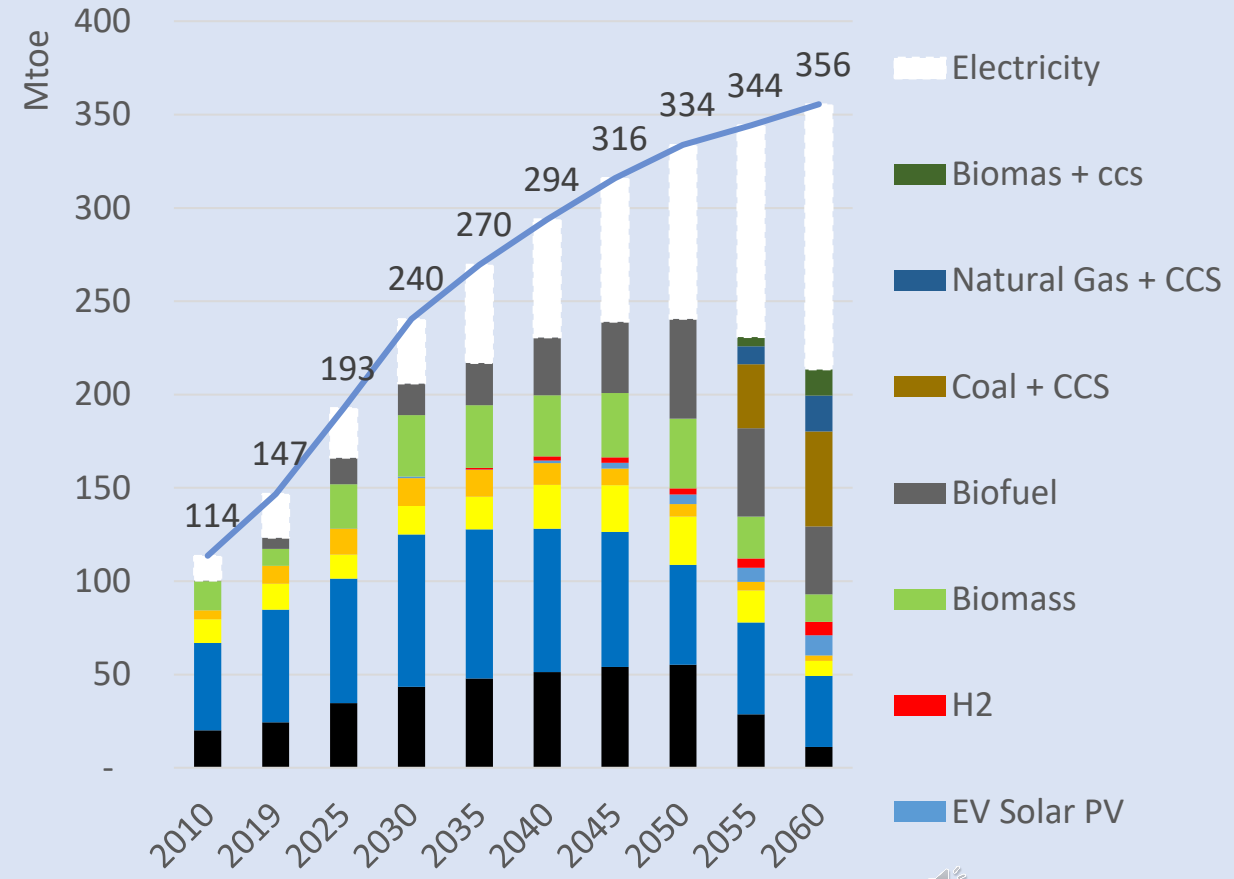


Final Energy Demand

Final Energy Demand by Sector



Final energy demand by fuel

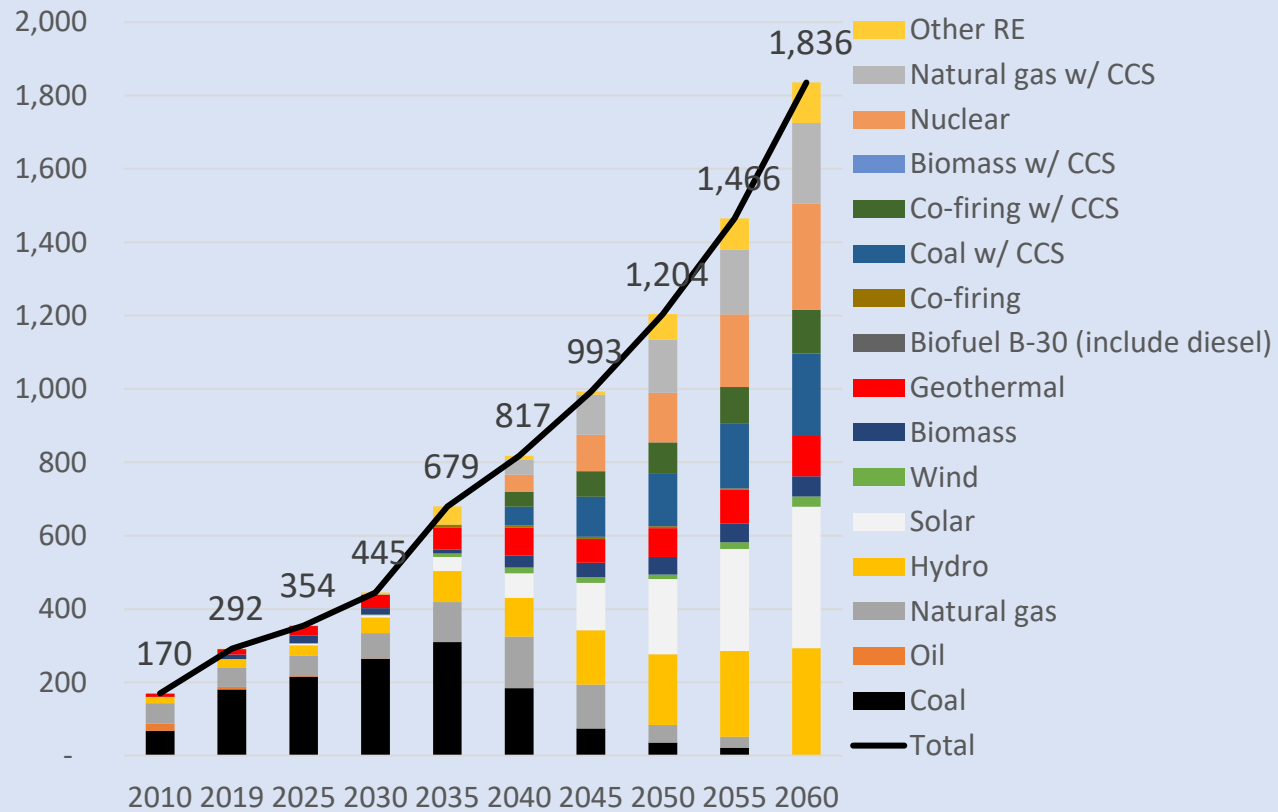


2020-2060 Average demand growth 2.2% per year

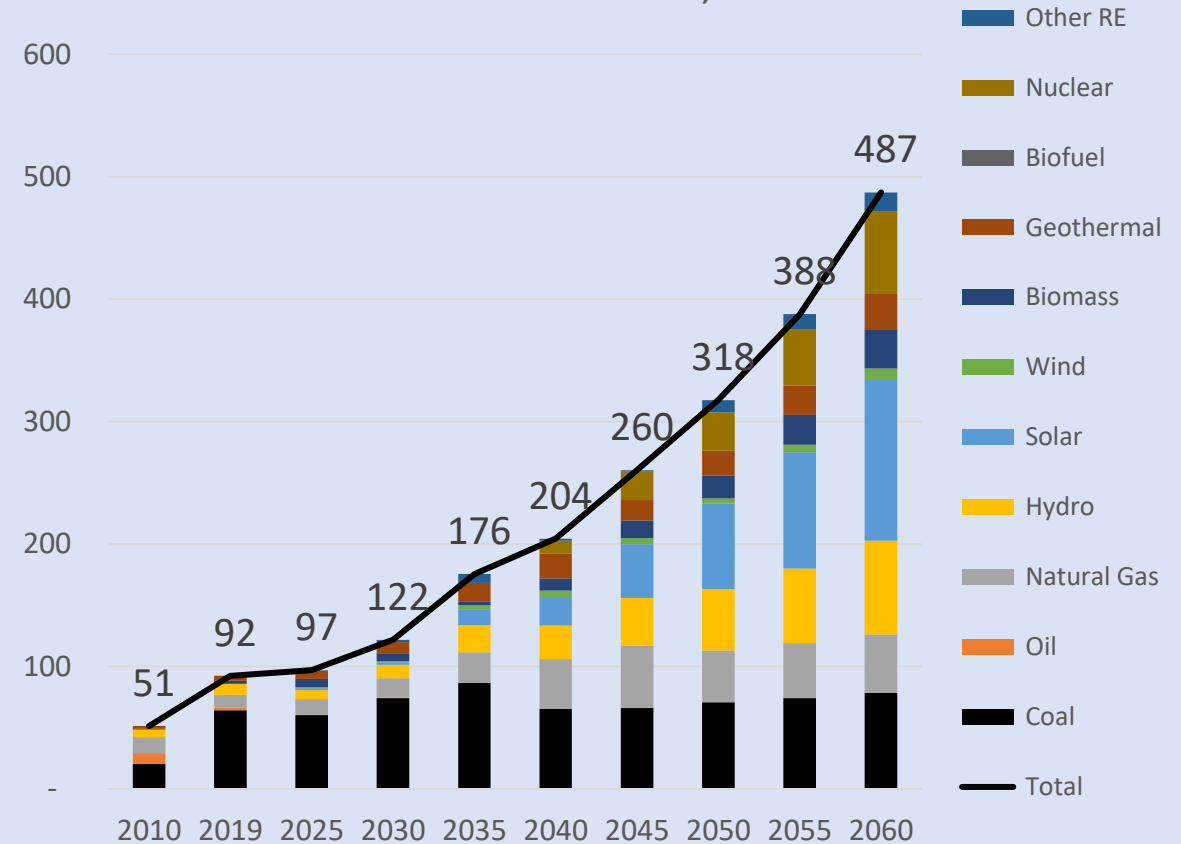
	2010	2019	2030	2040	2050	2060
Share of Elect.	12%	16%	14%	22%	28%	40%

Electric Power Generation Mix

Power Generation, TWh

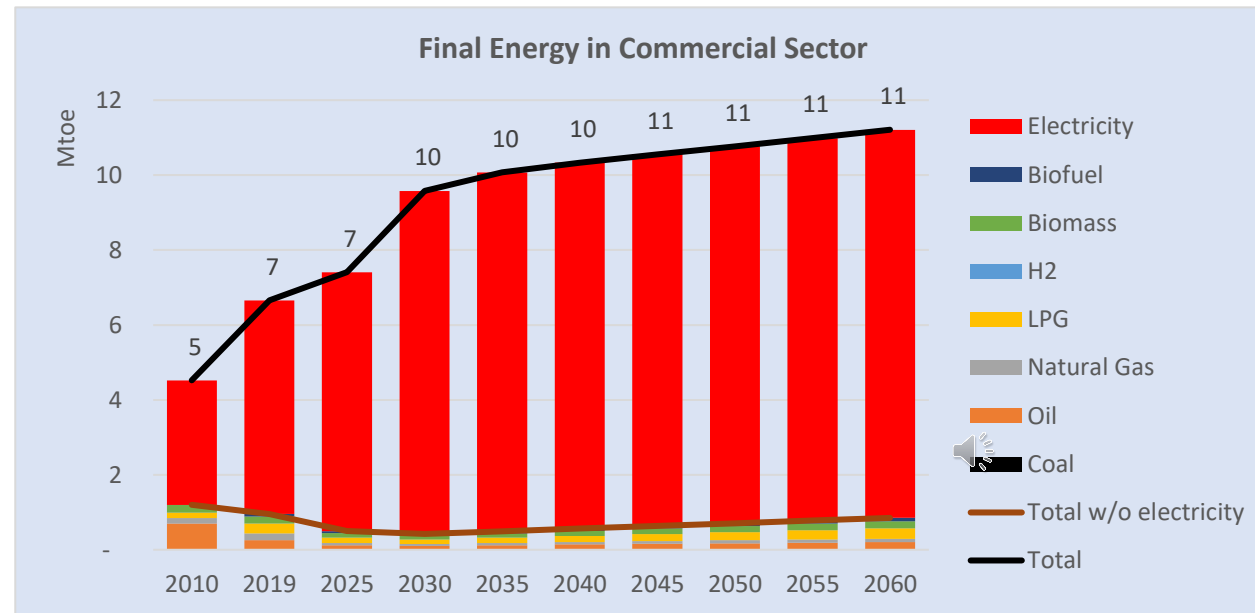
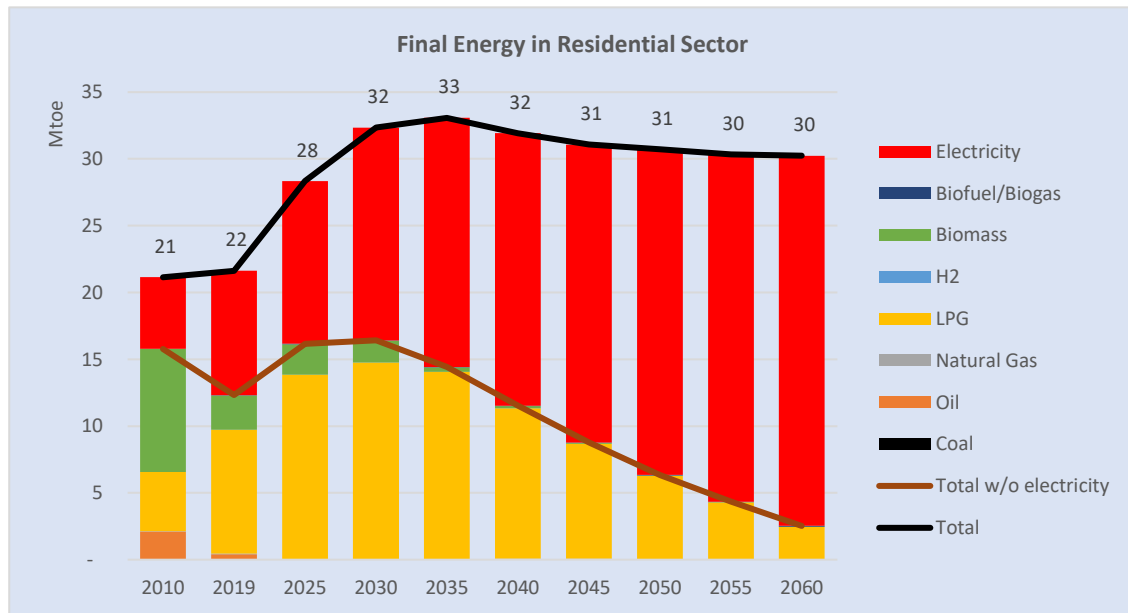
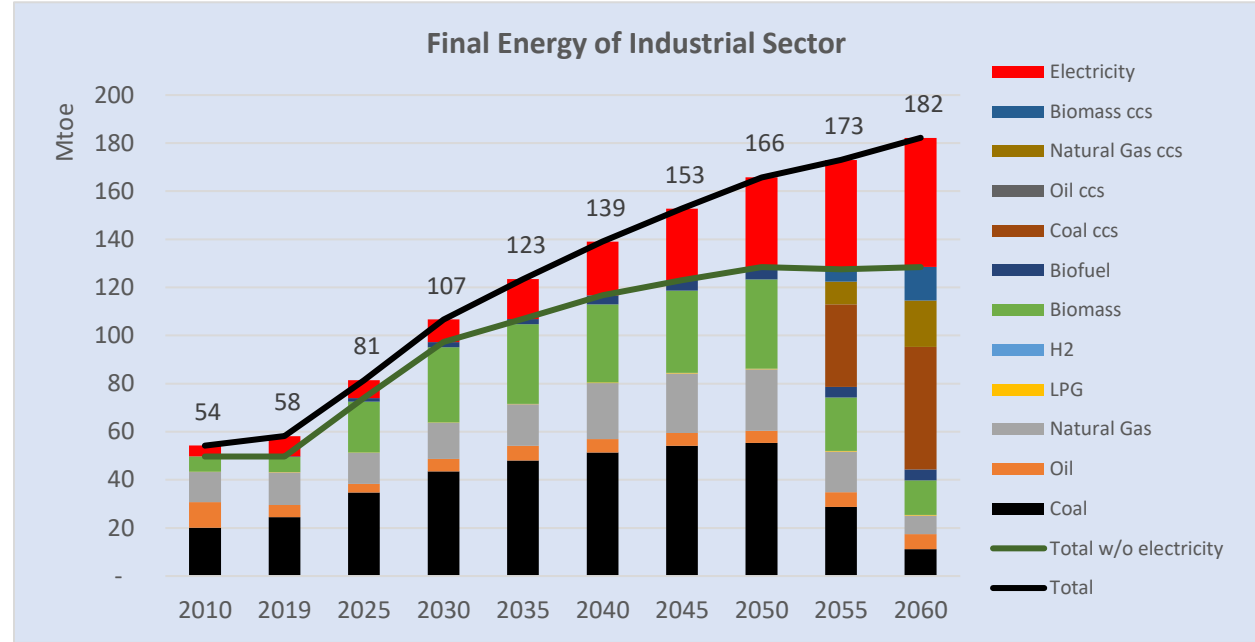
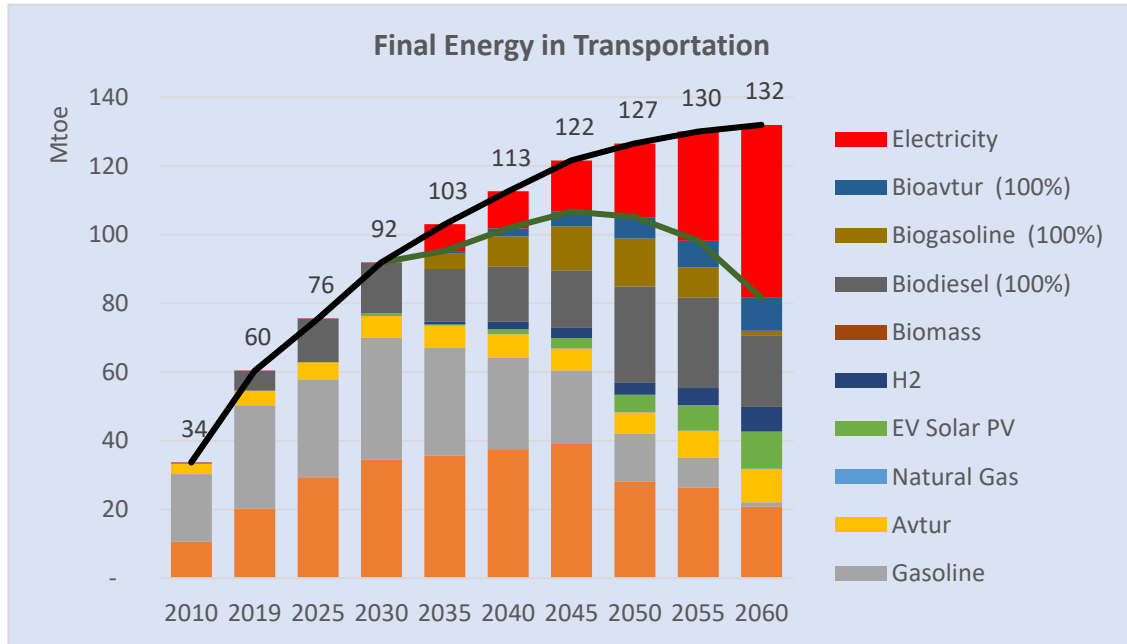


Fuel Use in Power, Mtoe



	2019	2025	2030	2035	2040	2045	2050	2055	2060
Share of RE	17%	24%	26%	36%	43%	46%	54%	57%	60%

Transport Sector Projection



Summary of development

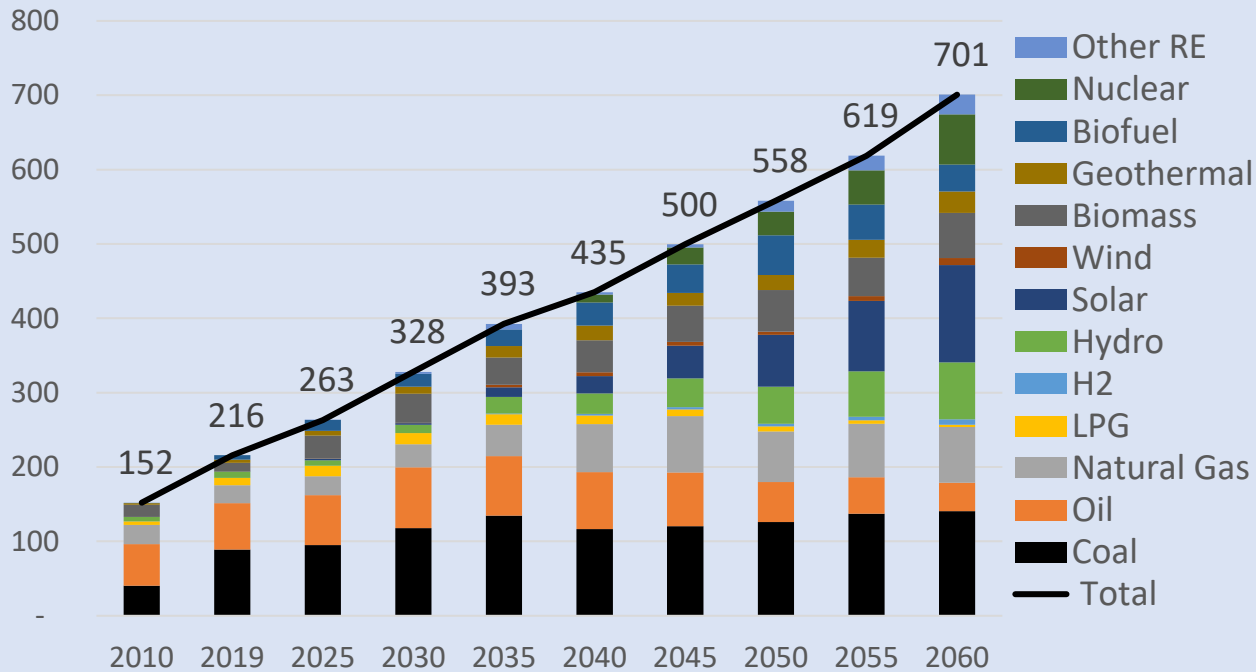
Parameter	Unit	2010	2019	2030	2040	2050	2060
Population	juta	234	270	294	313	324	330
GDP/Capita	USD /kap	3,224	3,924	6,204	10,309	16,200	23,852
Final energy consumption	ktoe	113,583	146,799	240,475	293,890	333,762	355,538
Electricity consumption	ktoe	13,254	23,469	34,444	63,249	93,176	142,045
Non-Electric. consumption	ktoe	100,330	123,330	206,031	230,642	240,587	213,493
Share of electricity	%	12%	16%	14%	22%	28%	40%
Electricity Consumption	TWh	148	273	401	736	1,084	1,652
Electricity Supply	TWh	170	284	445	817	1,204	1,836
Primary Energy Supply	ktoe	151,763	215,817	327,863	435,014	558,228	700,744
Primary Energy Supply	Toe/cap/year	0.65	0.80	1.11	1.39	1.72	2.12
Final Energy Demand	Toe/cap/year	0.48	0.54	0.82	0.94	1.03	1.08
Electricity Demand	kWh/cap/year	632	1,012	1,362	2,354	3,345	5,000
Electricity supply	kWh/cap/year	725	1,053	1,513	2,615	3,717	5,556

Ratio to base year 2010

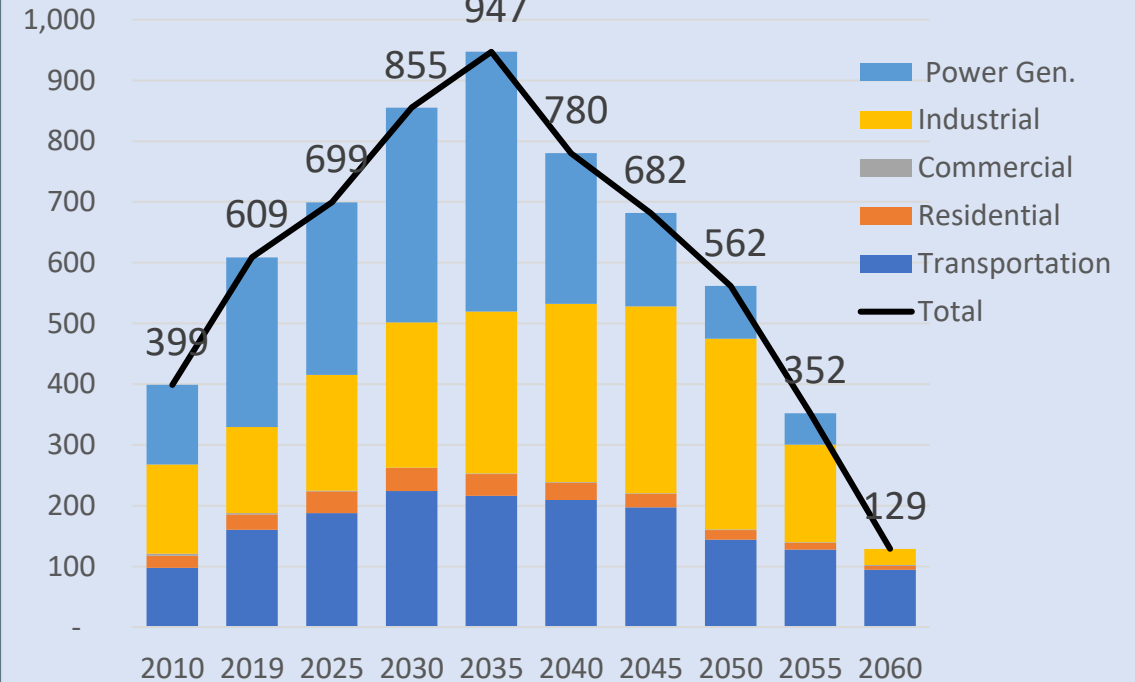
	2010	2019	2030	2040	2050	2060
Population	1.00	1.15	1.26	1.33	1.38	1.41
GDP/Capita	1.00	1.22	1.92	3.20	5.03	7.40
Final energy consumption	1.00	1.29	2.12	2.59	2.94	3.13
Electricity consumption	1.00	1.77	2.60	4.77	7.03	10.72
Non-Electricity consumption	1.00	1.23	2.05	2.30	2.40	2.13

Primary Energy Supply and GHG Emissions

Primary Energy Supply, Mtoe



GHG Emissions by Sector, Mton CO2e



Primary Energy	2010	2019	2030	2040	2050	2060
Toe/cap/year	0.65	0.80	1.11	1.39	1.72	2.12

Share of RE	2019	2025	2030	2035	2040	2045	2050	2055	2060
	14%	23%	25%	31%	38%	44%	54%	58%	63%

Sector	2010	2020	2030	2040	2050	2060
Energy	453	638	1030	960	572	129
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Main/Major Challenges:

- Energy security (accessible, available, affordable, acceptable, sustainable)
- Significant reduction of coal (coal phase down) – *stranded assets issues*
- Large deployment of coal + CCS – techn. readiness & locations
- De-dieselization, phase out diesel oil in power with an implication no biofuels in diesel engine anymore
- Deployment of large fraction of intermittent RE (solar PV) – grid stability and base load ‘issues’
- Nuclear ? – public acceptance issues
- Balance of trade (more RE technology imports)



To Do List

- Coal plant retirement in accordance with PLN's schedule PLN, remaining coal is equipped with CCS.
- Need to determine vision of NZE
- To transform from vision to road map (including regulatory road map and other supporting factors)
- road-map formulation must emphasize the concept to avoid “locked-in phenomena” of fossil energy (forced to continue to use fossil because investment is already done)
- Need road map of R&D and manufacturing of NZE technologies



Thankyou

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