Deep decarbonization of Indonesia’s energy system: A pathway to zero emissions by 2050

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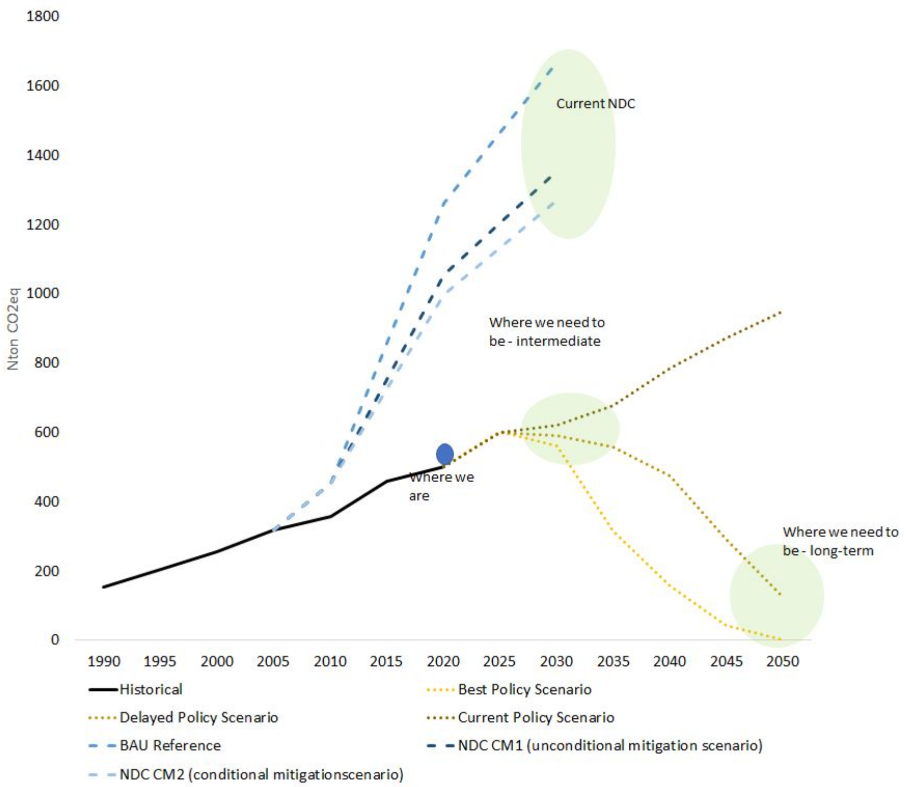
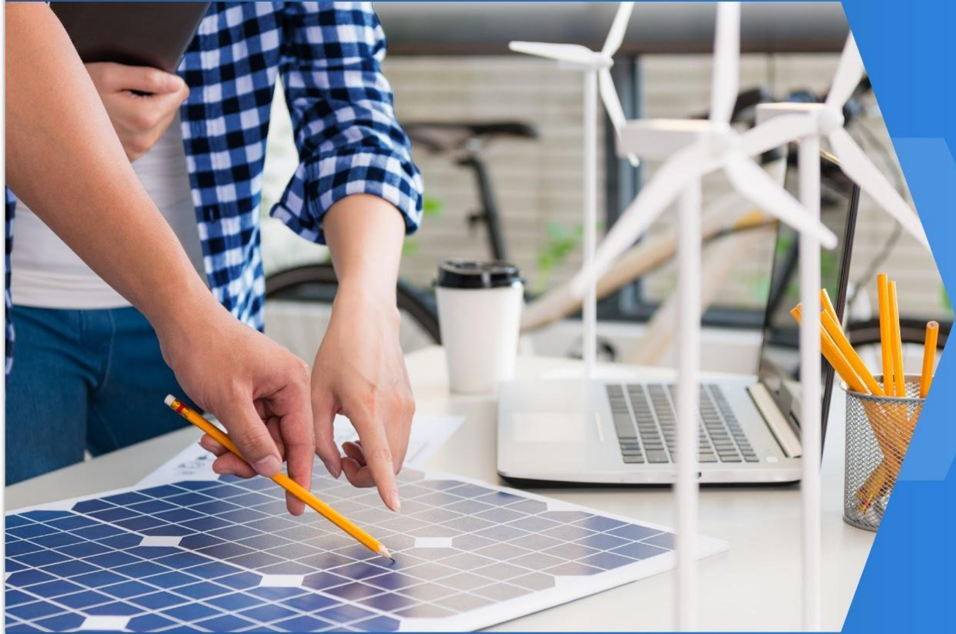
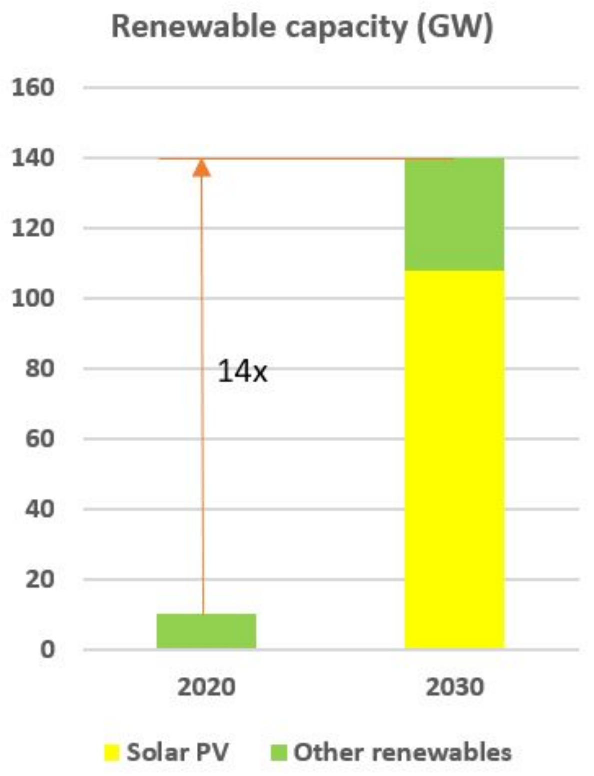
Current Indonesia's Nationally Determined Contribution (NDC) is not aligned with the Paris Agreement, a more ambitious target is required.

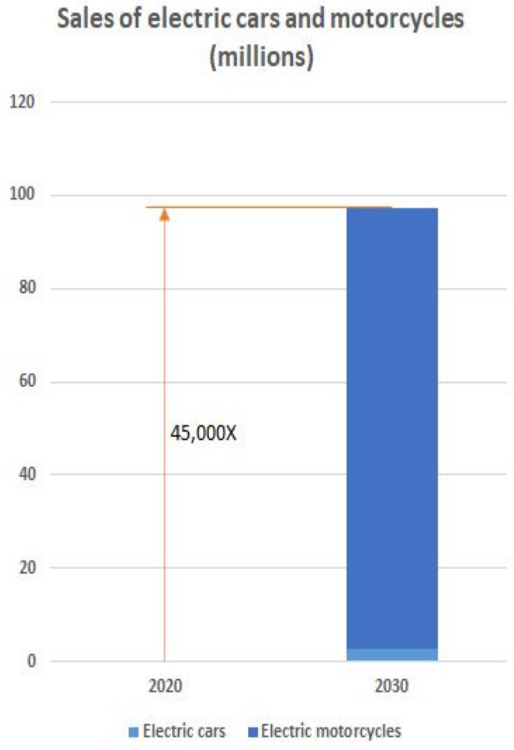


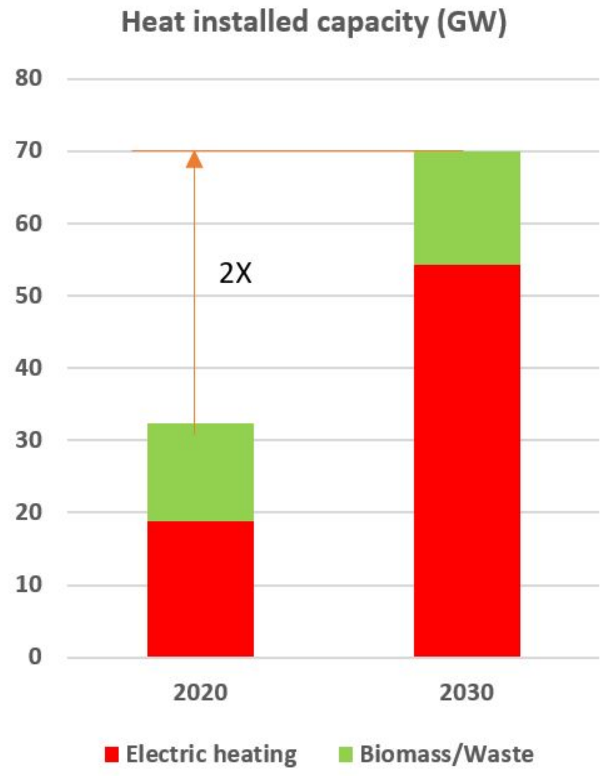


A pathway to zero emissions by 2050

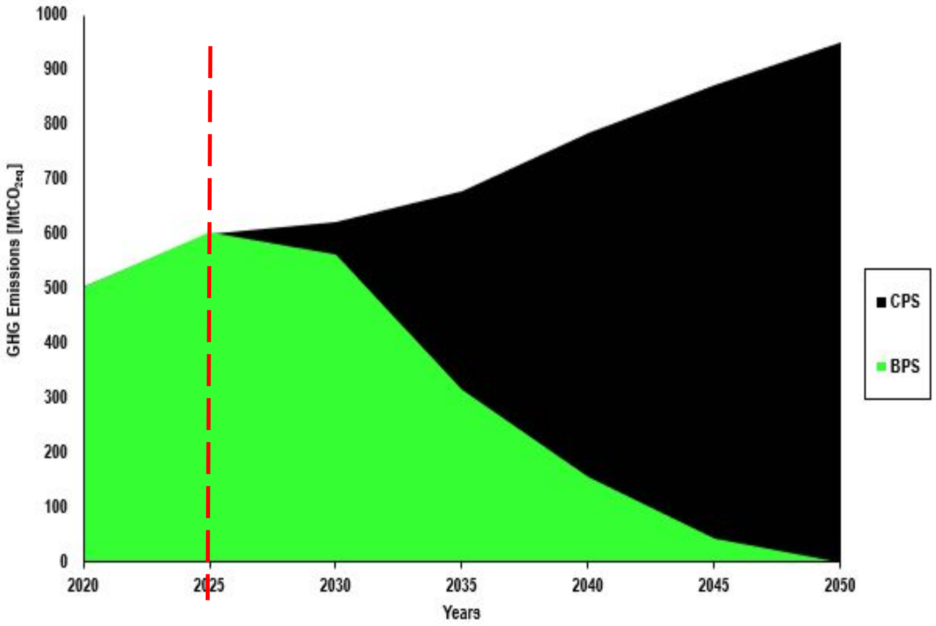
Bending the curve: this decade will determine the outcome of the 2050 emission target



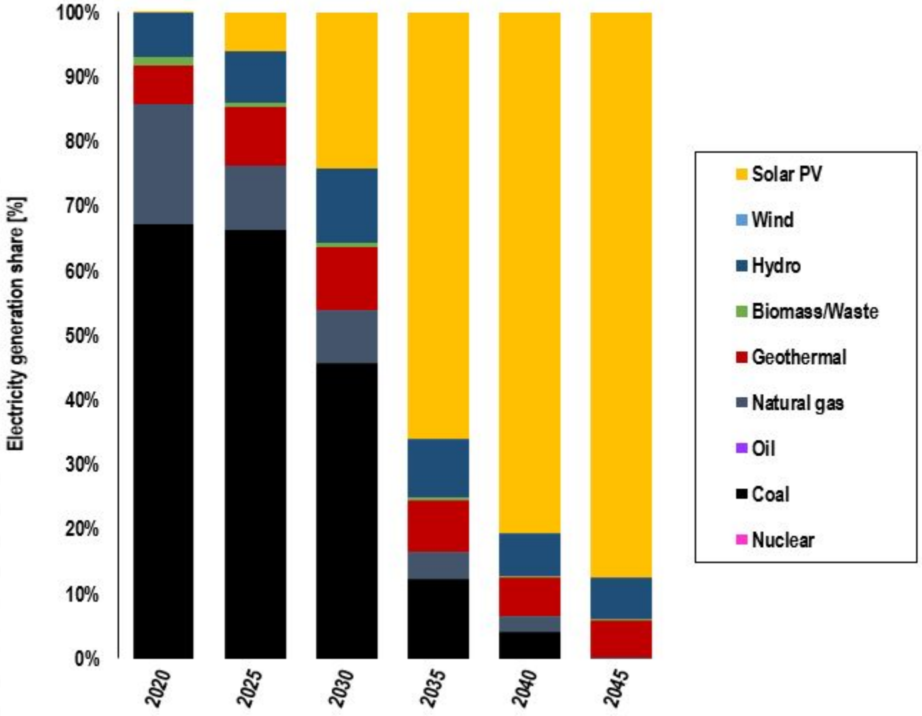


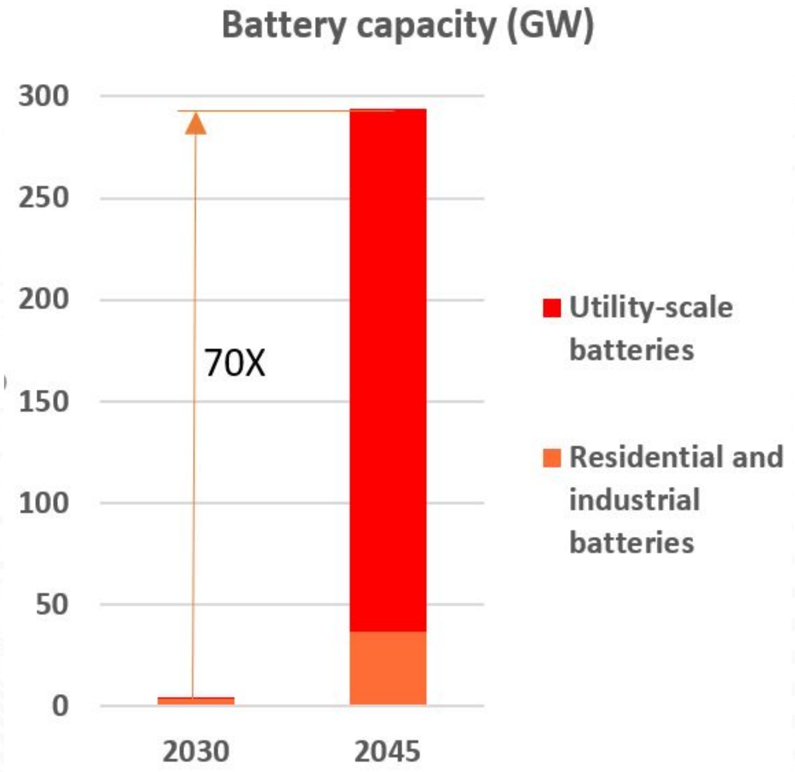


Bending the curve: a call for coal moratorium to peak carbon emissions by 2025

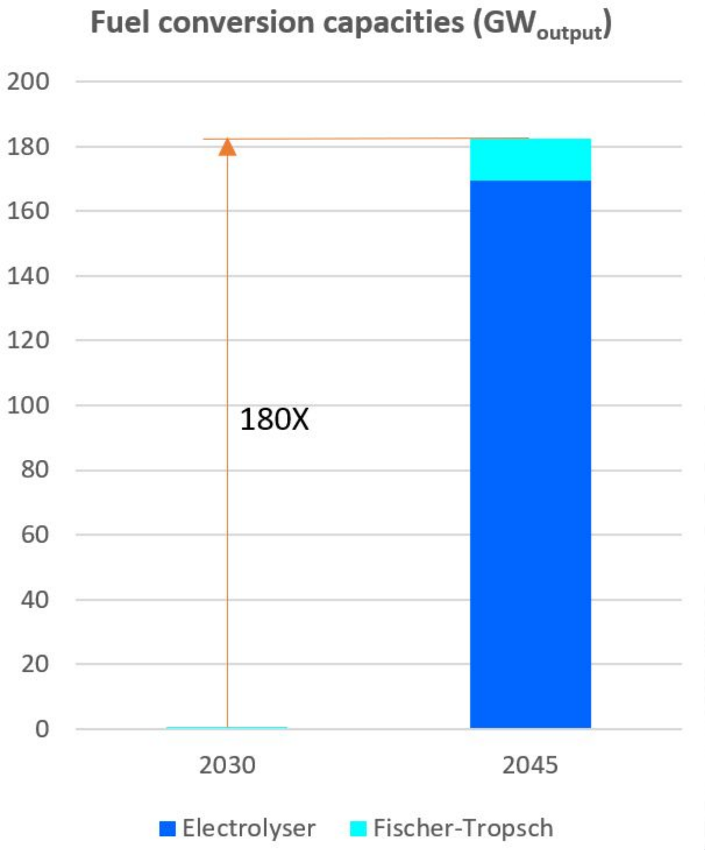


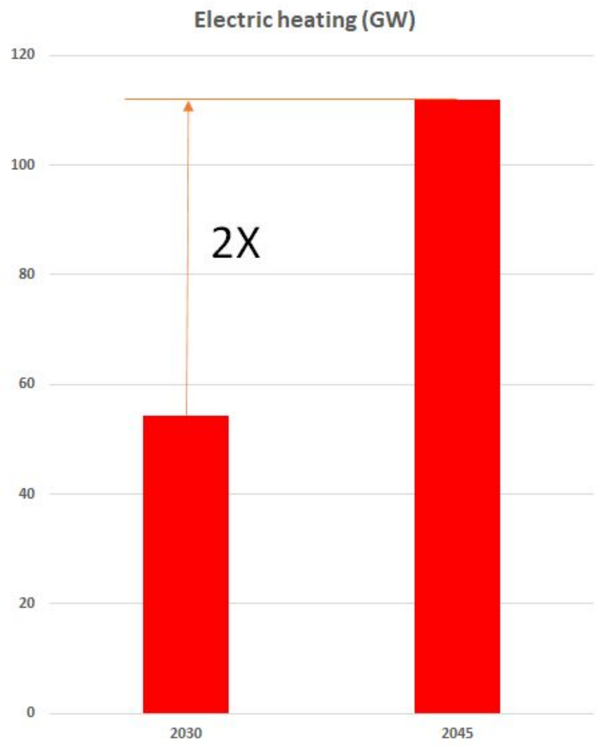
Power sector: The first sector to be carbon free by 2045 through the combination of 100% renewable energy and battery storage



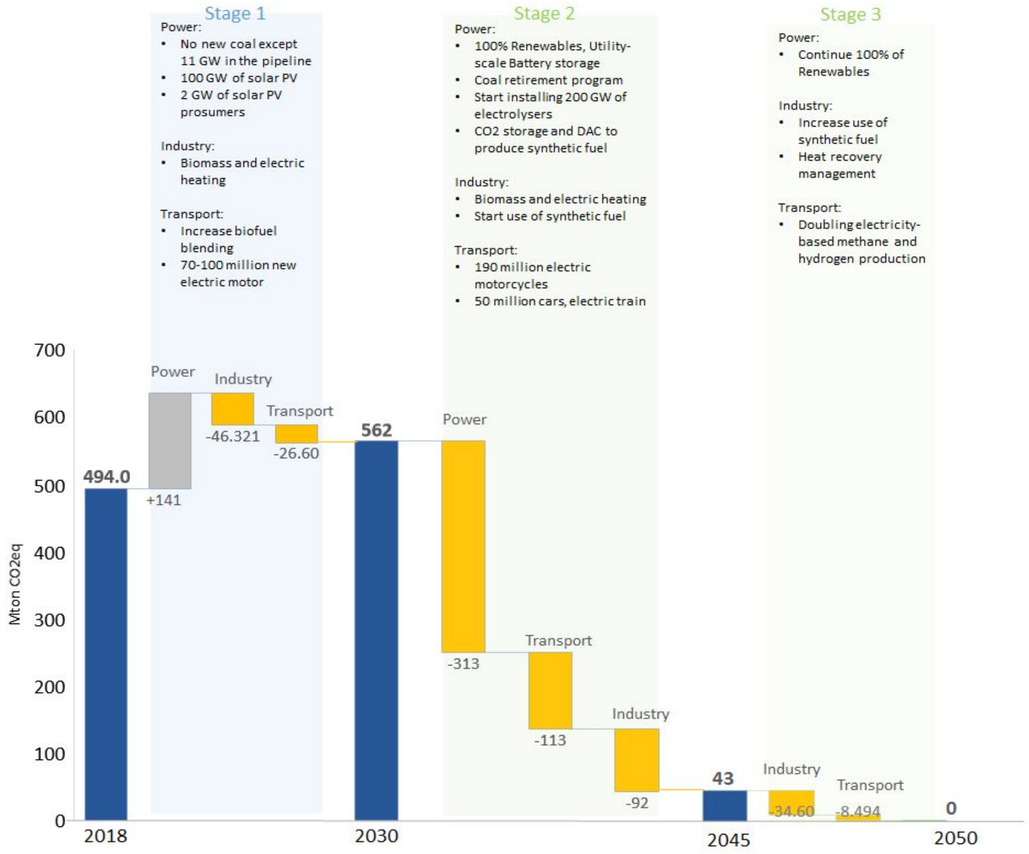


Transport and industry sectors: Synthetic fuels, hydrogen, and electric heating will play a greater role in decarbonization efforts by 2045



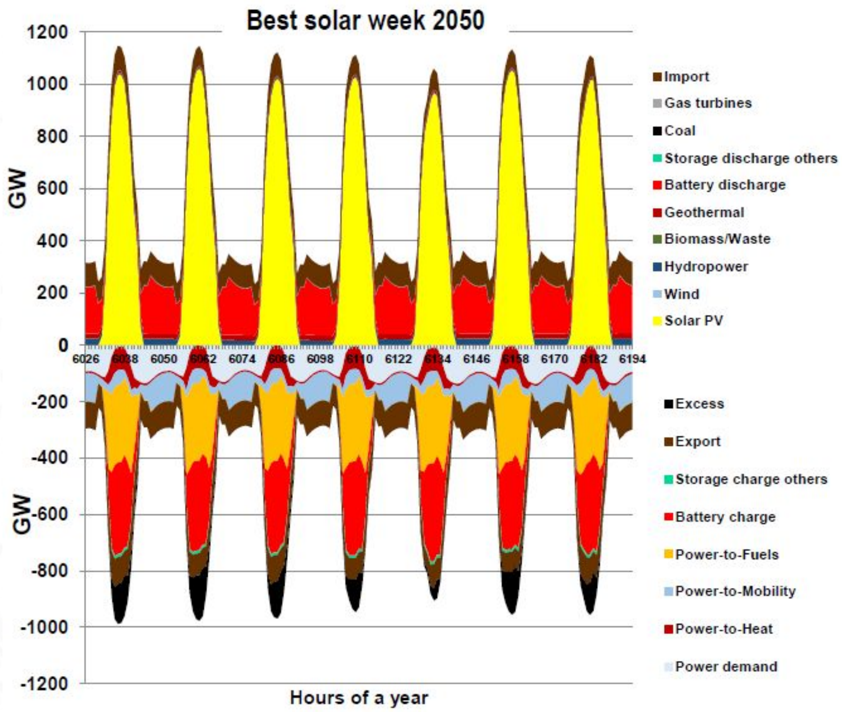


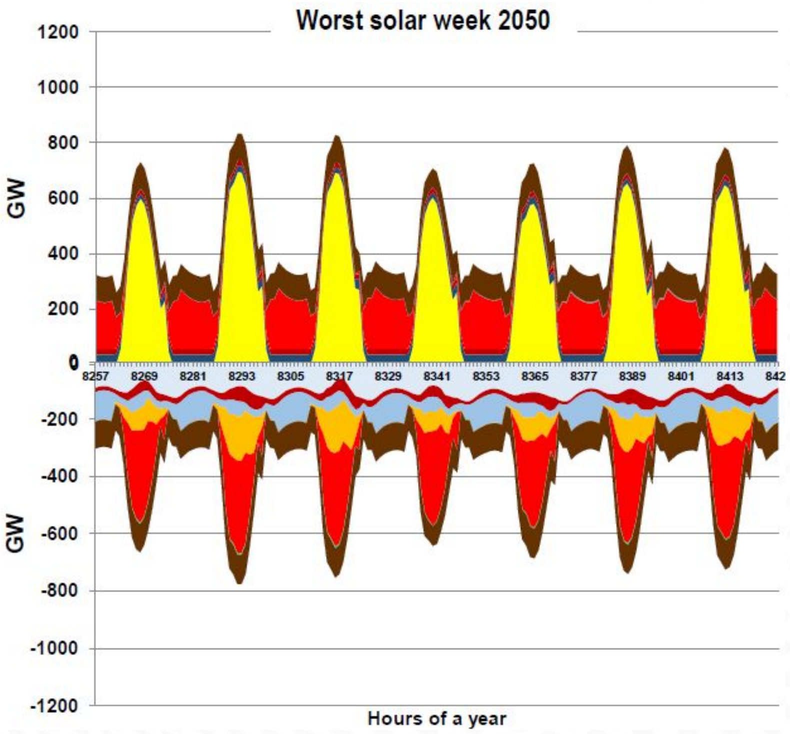
By 2050, all decarbonization efforts made in the previous stages will lead to a zero-emission energy system



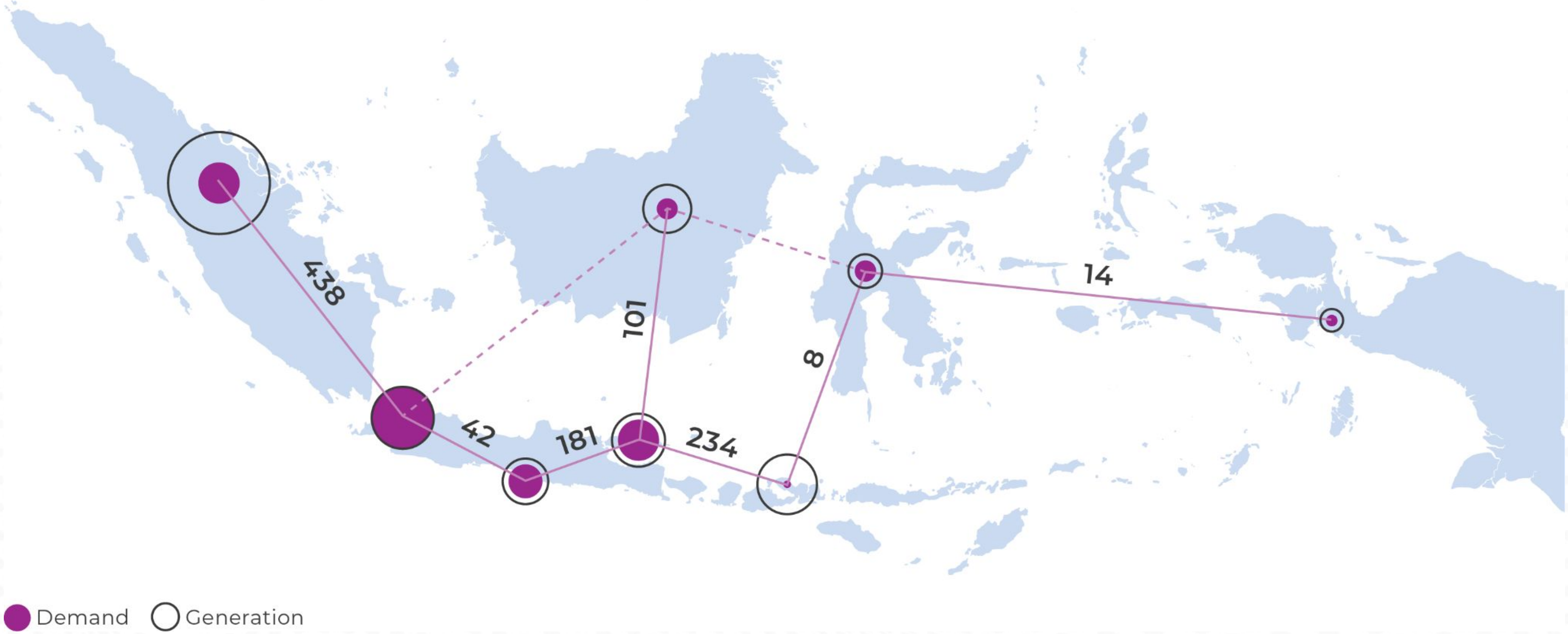
Four pillars of a zero-emission energy system

Pillar 1: Renewable energy
Solar energy is the backbone of the energy system



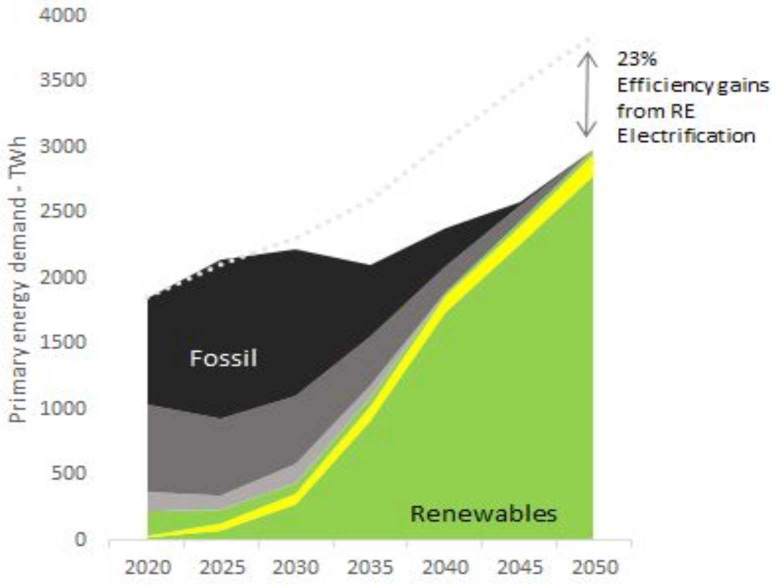


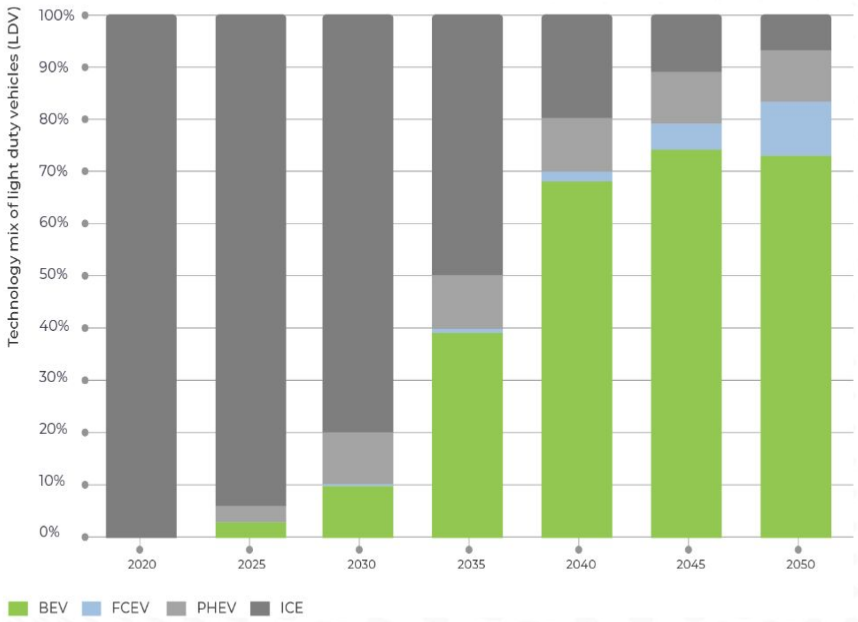
Grid integration is key in a 100% renewable energy system



Future grid planning needs to consider grid expansion and inter-island connection that will enable demand and supply balancing across the archipelago

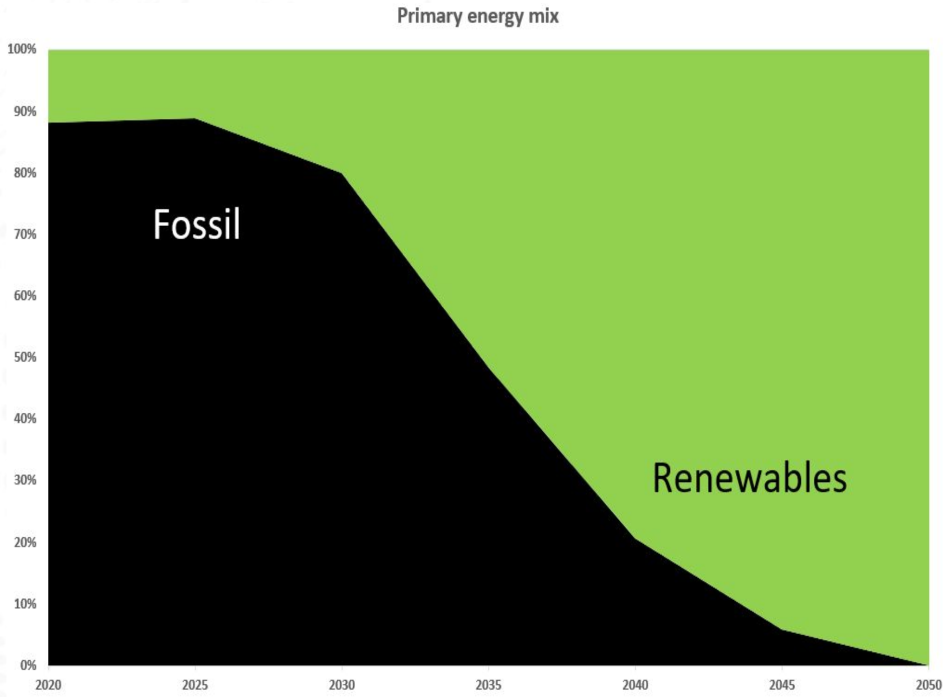
Pillar 2: Electrification
Direct electrification is carried out whenever possible





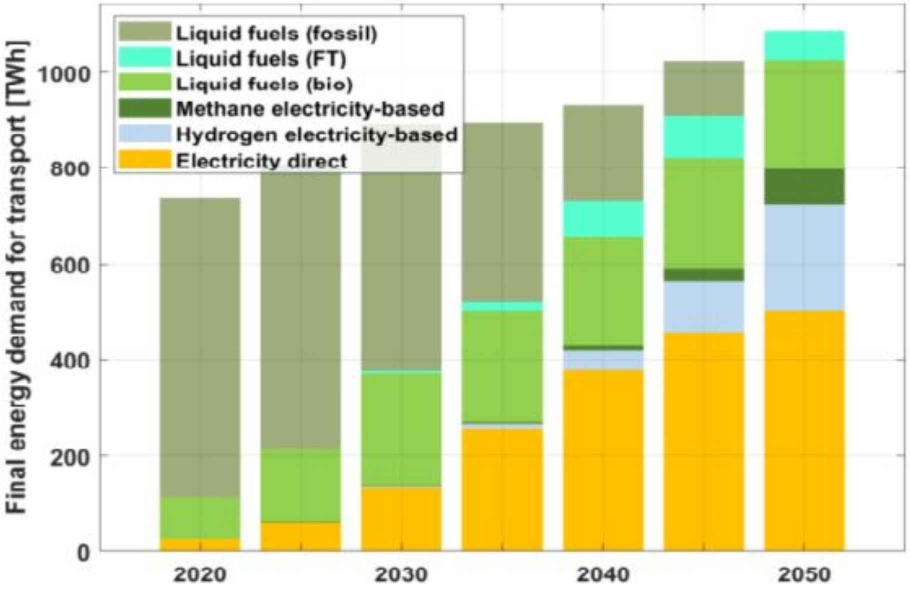
Pillar 3: Fossil fuel decline

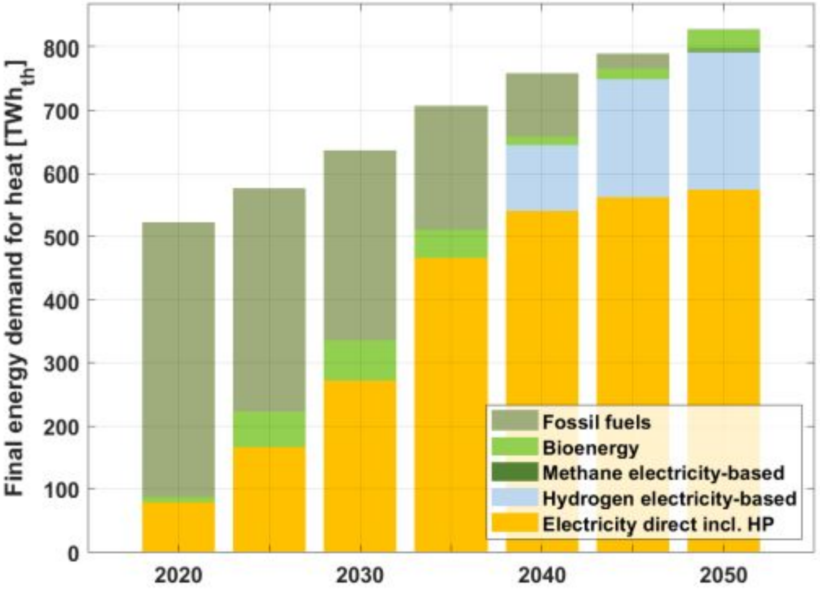
Any coal plants built after 2025 would not be utilized for more than 15-20 years



Pillar 4: Clean fuels

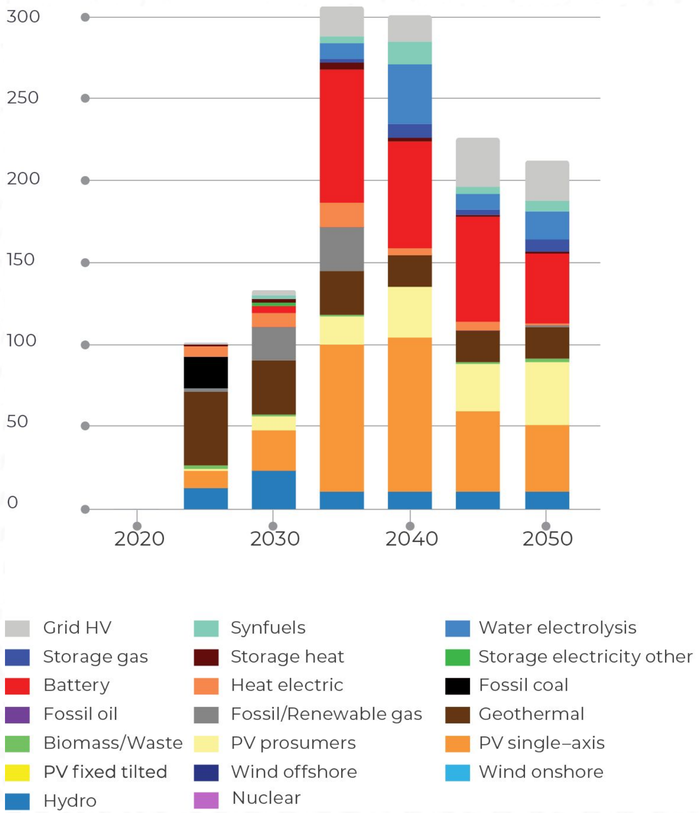
Hydrogen, synthetic fuels, and biofuels play important roles in transport and industry





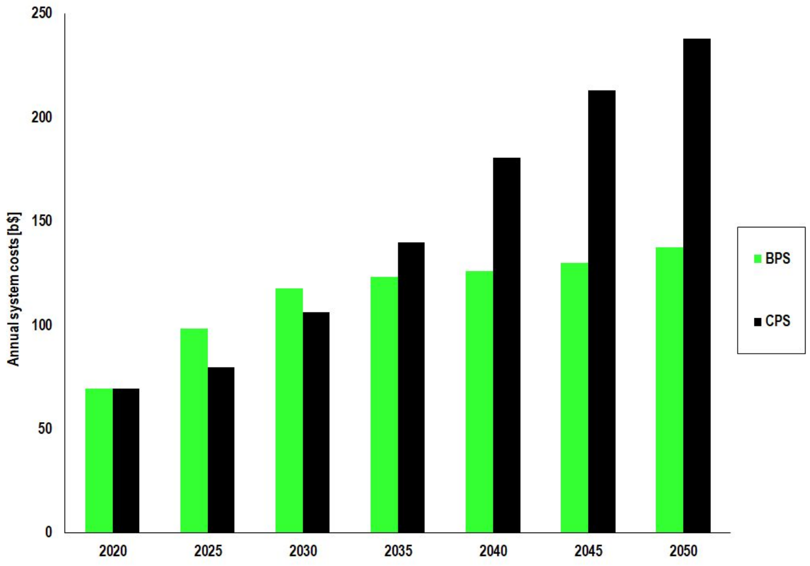
Investment needs and benefits

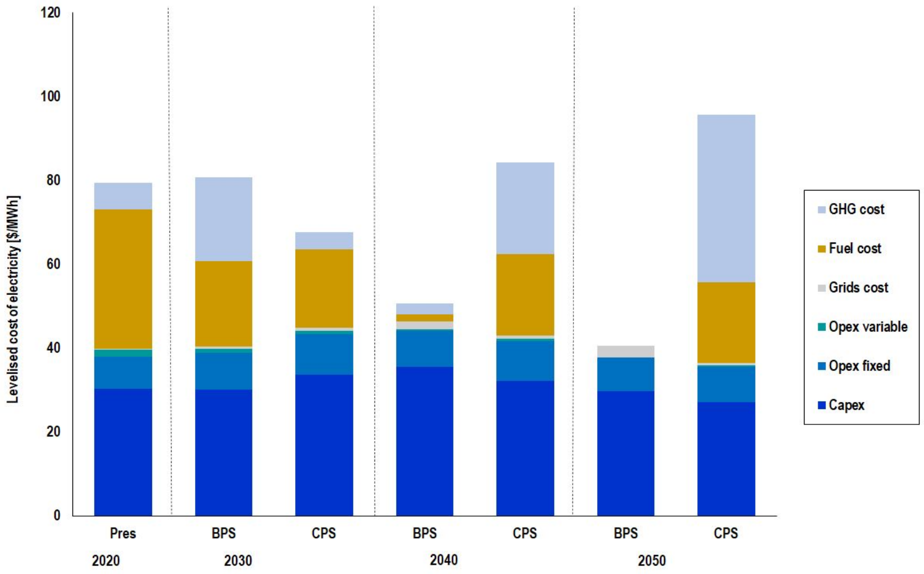
To achieve zero emissions by 2050, Indonesia needs a large amount of investment that is spread across a variety of technologies



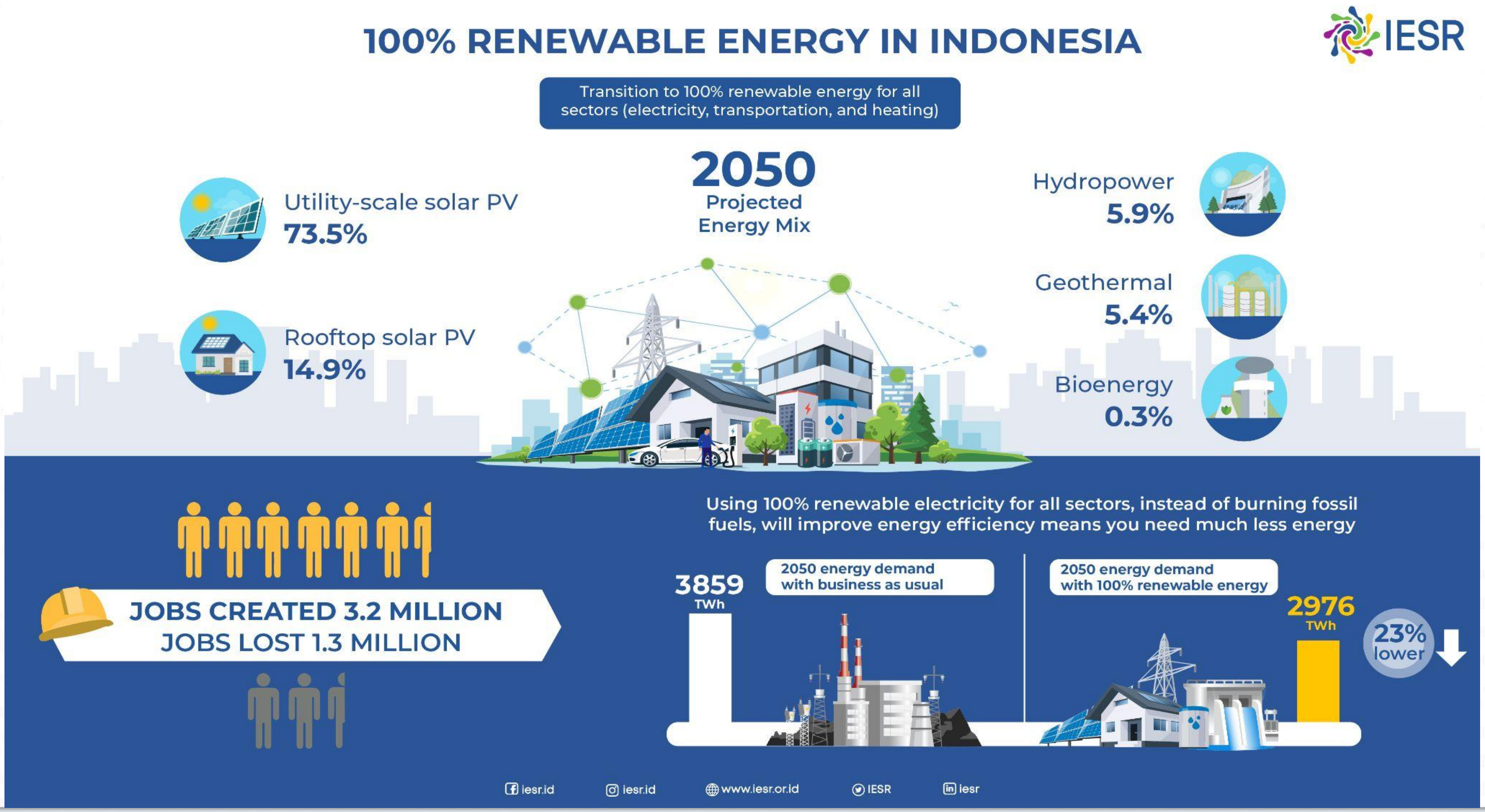
Capex in 10-year intervals [b$]	2030	2040	2050
PV utility-scale	35.7	183.2	89.8
PV prosumers	9.9	47.4	67.8
Battery	4.8	146.3	106.9
Geothermal	79.1	46.8	38.2
Hydro	36.2	22.2	21.8
Biomass/Waste	2.3	0.9	2.9
Water electrolysis	0	45.9	25.3
Synfuels	2.3	17.8	11.1
Heat electric	14.6	18.7	5.8
Storage gas	0.1	11.2	11.5
Storage heat	3.4	6.5	2
Storage electricity other	2.2	0	0
Grids HV	3.3	34.8	53.9
Fossil coal	19.3	0	0
Natural gas	21.7	26.6	0.6
Fossil oil	0.1	0	0.4
Total	235	608.3	438

Achieving zero emissions by 2050 is not only technically feasible but also economically attainable





Deep decarbonization could bring massive economic opportunities to Indonesia



Key takeaways

1. Deep decarbonization through the use of 100% renewable energy is possible, but it will require transformative changes in the energy sector
2. Solar PV will become the backbone of the energy system. Battery storage, electrification, and clean fuels will play a major role in decarbonization efforts
3. Investment needs are huge, multi-stakeholder participation should be encouraged
4. Deep decarbonization is essential to not only avoid climate risks but also ensure Indonesia’s economic competitiveness
5. Strong political leadership to make deep decarbonization a national priority is needed now

According to IEA WEO 2020, solar PV will provide the cheapest cost of electricity across all regions. An energy system with a high share of solar PV will be the most competitive one.

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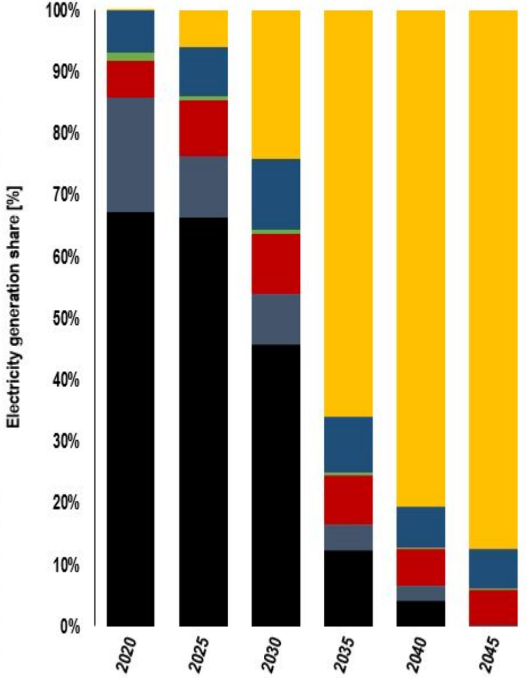
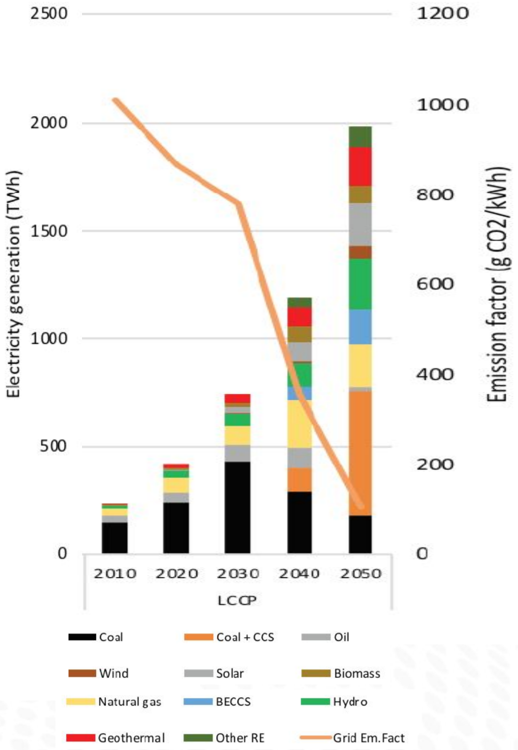


LTS-LCCP



		Capital costs ($/kW)		Capacity factor (%)		Fuel, CO_2 and O&M ($/MWh)		LCOE ($/MWh)	
		2019	2040	2019	2040	2019	2040	2019	2040
United States	Nuclear	5 000	4 500	90	90	30	30	105	100
	Coal	2 100	2 100	60	60	65	140	115	185
	Gas CCGT	1 000	1 000	50	50	40	70	65	95
	Solar PV	1 220	580	21	23	10	10	50	25
	Wind onshore	1 560	1 400	42	44	10	10	35	35
	Wind offshore	4 260	1 960	41	48	35	15	115	50
European Union	Nuclear	6 600	4 500	75	75	35	35	150	110
	Coal	2 000	2 000	40	40	95	165	150	225
	Gas CCGT	1 000	1 000	40	40	50	75	80	105
	Solar PV	840	440	13	14	10	10	55	30
	Wind onshore	1 560	1 380	28	31	15	15	55	45
	Wind offshore	3 800	1 820	49	59	15	10	75	35
China	Nuclear	2 600	2 500	80	80	25	25	65	60
	Coal	800	800	60	60	65	140	75	155
	Gas CCGT	560	560	50	50	75	110	90	125
	Solar PV	790	390	17	19	10	5	40	20
	Wind onshore	1 220	1 100	25	27	15	10	50	40
	Wind offshore	3 000	1 480	32	44	25	10	100	40
India	Nuclear	2 800	2 800	80	80	30	30	70	70
	Coal	1 200	1 200	60	60	30	30	55	55
	Gas CCGT	700	700	50	50	45	45	60	60
	Solar PV	610	310	20	21	5	5	35	15
	Wind onshore	1 060	980	26	29	10	10	50	45
	Wind offshore	3 140	1 540	29	38	25	15	130	55

Note: O&M = operation and maintenance; LCOE = levelised cost of electricity; kW = kilowatt; MWh = megawatt-hour; CCGT = combined-cycle gas turbine. LCOE figures are rounded.

Sources: IEA analysis; IRENA Renewable Costing Alliance; IRENA (2020).

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Thank You

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