Net Zero emission plan for Indonesia

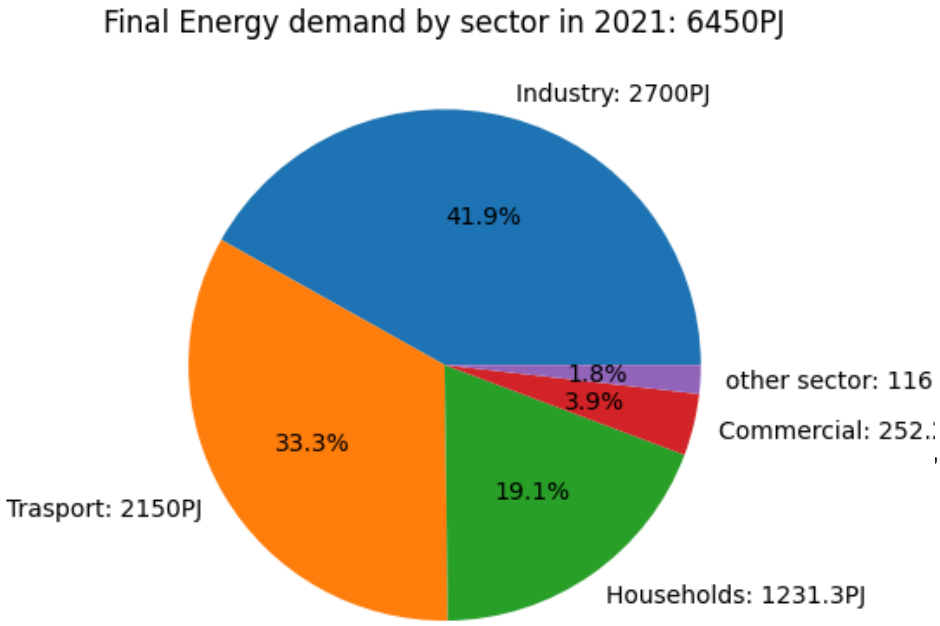
Overview:

Indonesia is a south asian country. It is the world's largest archipelago, the world's 4th most populous country, having a population of more than 275 million. It is the world's fourth fastest growing economy. It is the world's ninth largest emitter[2]. With increasing population and growing economy it is a challenge for Indonesia to decouple its economic growth with carbon emission. Indonesia submitted its revised ndc in COP26 to reduce its emission from 31.29 percent unconditional and 43.2 percent with conditions or with international in as business as usual (BAU) help by 2030. Indonesia aims to be carbon neutral by 2060 or sooner [1]. Here in this report mainly two scenarios are compared: the Announced pledged scenario (APS) and other is Net zero emission (NZE) scenario. Announced pledge scenario means the NDC and commitments country has internationally announced which have target of net zero by 2060. The NZE scenario is an accelerated pathway that aims to reach net zero much faster by 2050.

Demand Management:

Energy demand for major sector:

Fig 1: Total final energy demand by sectors in 2021 (Petajoules)



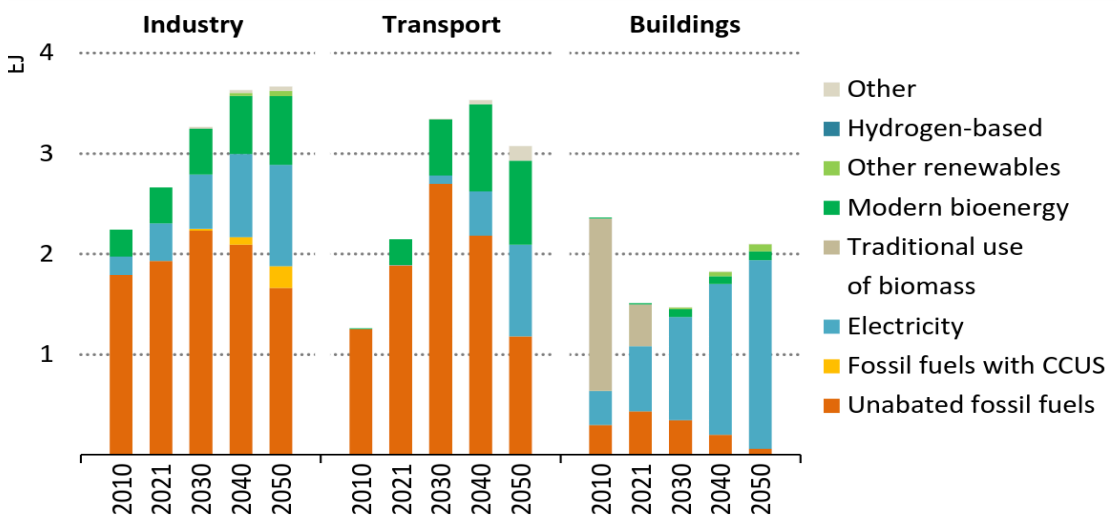
source: IEA report, An energy sector road map to net zero emission in Indonesia[2]

Industrial sector accounts for more than 40 percent of the total Final energy demand. More than 85 percent of the final energy demand is met by fossil fuel. In which coal dominates, 33 percent of energy demand is met by coal and 25 percent by natural gas, the share of electricity is 14 percent.

Transport sector accounts for one third of the total final energy consumption and 40 percent of CO2 emissions from final energy consumption. Major source of energy in the transport sector is oil products which account for about 90 percent of total energy and the remaining 10 percent energy demand is met by biofuels. 90 percent of the CO2 emission in the transport sector is from road transport (120 Mt CO2) in which about 35 Mt CO2 emitted by passenger cars and trucks accounts for over 50 Mt CO2. shipping and aviation each accounts for 5 percent of energy demand in the transport sector.

Building sector is the third largest energy consumer, its share is about one fourth of final energy consumption. 83 percent of energy in the building sector is consumed by residential buildings. Two third of the total electricity is consumed by the building sector which is generated by fossil fuel. This electricity demand in the building sector is going to increase in the coming decades.

Fig 2: final energy demand by sector and fuel in the Announced Pledges Scenario, 2010 – 2050



source: IEA report, An energy sector road map to net zero emission in Indonesia[2]

In 2021, about 30 percent of energy demand is met by traditional use of biomass. Which is used for cooking ,it will phase out by 2030. Majority of the population is transitioning to clean cooking fuel (LPG) due to availability and subsidization.

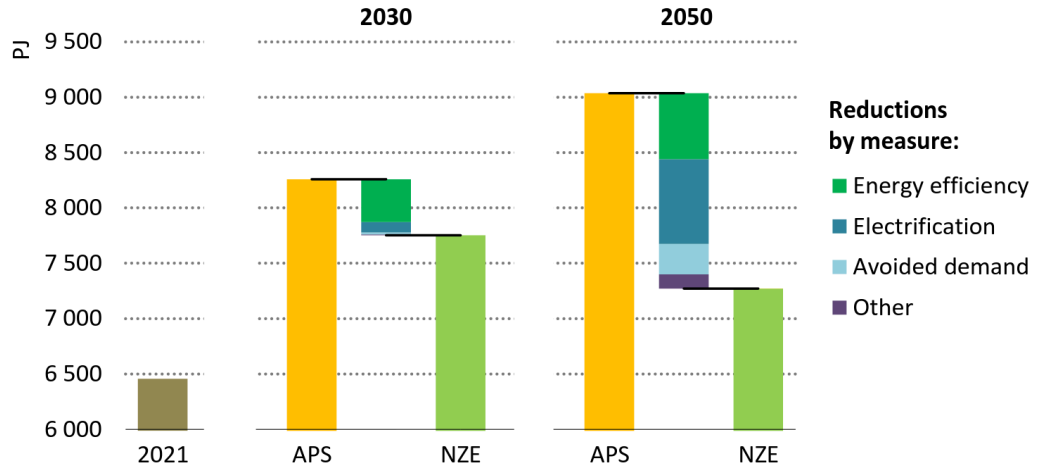
Plan for demand reduction:

Net zero emission by 2050 requires accelerated effort to shift to clean and energy efficient technologies in all end user sectors. Demand is going to rise in all sectors due to population growth, urbanization and economic growth. To reduce the energy demand measures that are

taken energy efficiency, electrification, avoid demand and fuel shift. If we lower energy demand it takes less effort for decarbonization.
In industry energy efficiency enables lower material and energy requirements for the same output.Particularly material efficiency is very important in the industrial sector as the energy industries are highly incentivised to be energy efficient because of the significance of energy in the production cost and low emission technologies are less matured in these industries. So energy reductions are achieved through design regulation, incentive to promote longer life,circularity measures to increase re-use and recycling of steel, aluminum and plastic reduces the need for more energy intensive primary production. In the transport sector energy demand is reduced mainly by replacing Ic engine vehicles by electrical vehicles. In the building sector demand is mitigated by phasing out inefficient use of traditional use of biomass and setting the net zero emission standard for buildings.

Impact of demand mitigation measure:

Fig 3: demand reduction in the net zero scenario compared to APS in 2030 and 2050



source: IEA report, An energy sector road map to net zero emission in Indonesia[2]

Demand in the aps scenario in 2030 is projected to be around 8250 PJ which reduces to about 7750 PJ in the net zero scenario. Of the total demand reduction in the net zero emission scenario most about 90 percent is achieved by energy efficiency because of lack of availability of technology(e.g heavy truck) and supportive infrastructure(charging station) for the end user electrification. After 2030 electrification is pushed when the technology is available.in the NZE scenario the demand is 20 percent less compared to APS scenario. In 2050 Most of the demand reductions with respect to APS in the NZE scenario are achieved by end user electrification (43%) energy efficiency(34%) and avoided demand also plays a significant role (15%).

Policy level Intervention:

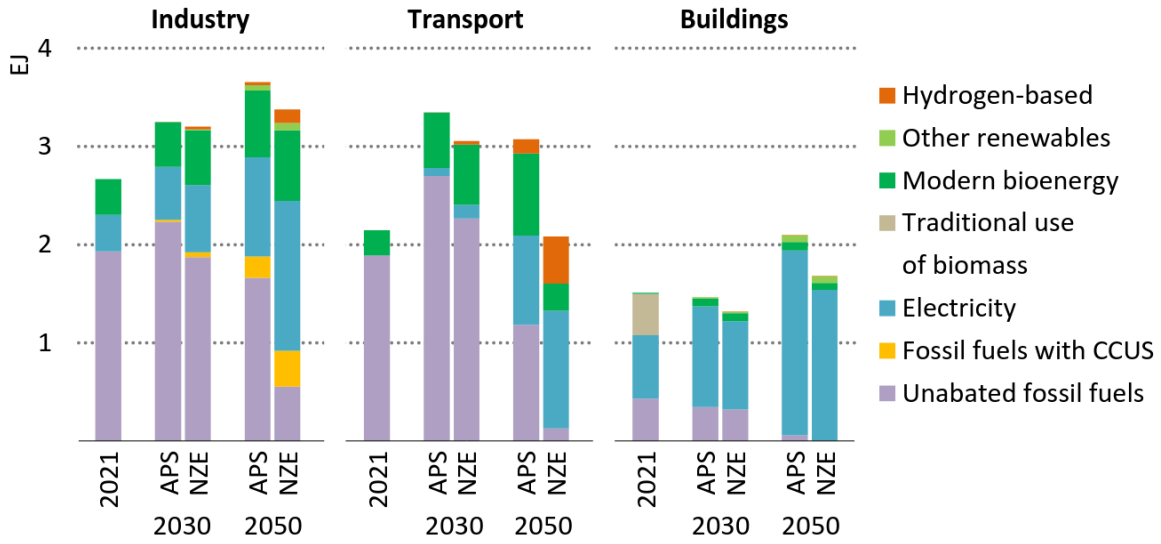
Policies can be implemented for encouraging energy intensive industries to reduce its demand some of them are suggested below:

Energy saving certificates(ESC): according to the previous energy consumption in industry some standards are set. If a company saves more than the standard limit. it gets an energy saving certificate which it can trade in the market. And the companies which consumed more energy than their standard limit are penalized by making them buy those certificates.

Renewable Purchase obligation(RPO): heavy industries are obliged to buy some percentage of the total final energy consumption by renewables. Which promotes energy generation by renewable sources.

Demand trajectory from 2021 to 2050:

Fig 4: project energy demand in both scenario by sector in 2030 and 2050



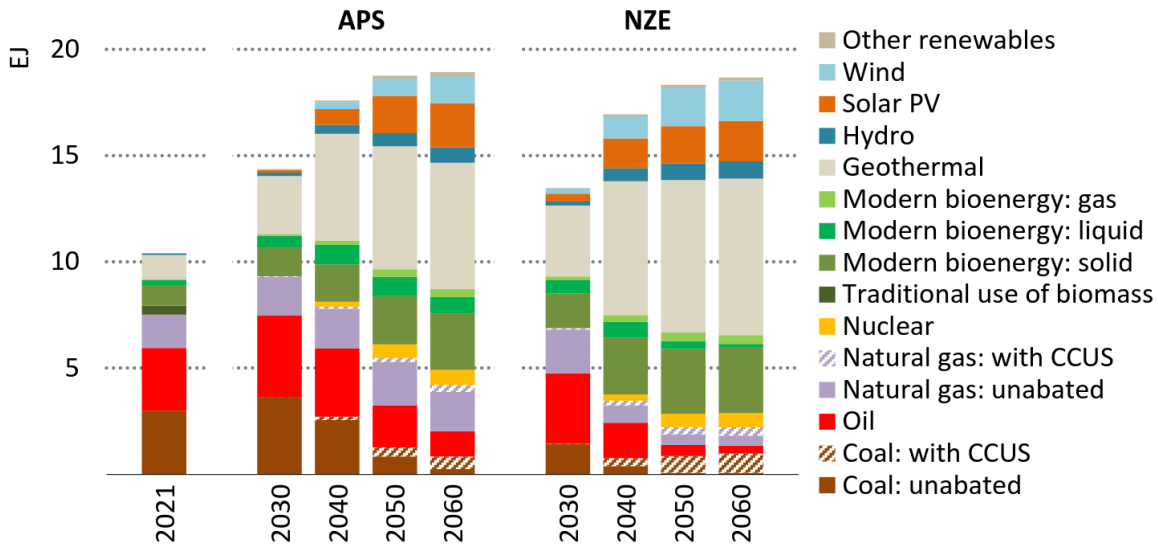
source: IEA report, An energy sector road map to net zero emission in Indonesia[2]

Energy Demand in both the scenario APS and NZE is going to increase in all sectors. In the net zero emission scenario 60 percent of the final demand is met by electricity. By 2050, in the NZE scenario there will be a complete phase out of fossils in the building sector. In the transport sector the share of oil for energy demand in passenger cars will be reduced to 5 percent by 2050. The oil demand for energy in heavy trucks is reduced by scaling up biofuels which increases to 40 percent by 2040 and then slowly shifting to electrical models available due to technological advancement. In industry, reducing fossil fuel is not an easy task where very high temperatures are needed. Increasing share of electric arc furnaces in the steel sector results in half of the energy demand from heavy industries met by electricity and hydrogen and bioenergy plays an important role which meets about 20 percent of energy demand in industry by 2050.

Generation management:

Energy generation by sources in 2021 to 2023:

Fig 5: energy generation by sources in APS and NZE scenario in 2021 to 2060



source: IEA report,An energy sector road map to net zero emission in Indonesia[2]

Indonesia is heavily dependent on fossil for its primary energy supply and its share in the primary energy supply was above 80 percent in 2021. Total primary energy supply in 2021 was around 10,400 EJ. Primary energy demanded is driven by electricity. 52 percent of the total installed capacity of 70GW in 2020 is from coal. Of the newly added capacity of 20GW in the period 2011-2020, 16GW is from coal[3] .

The energy generation mix in both scenarios looks similar in broader perspective but stronger push for energy efficiency and electrification in NZE scenario. total energy supply in the NZE scenario is 2 percent lower than the APS scenario in 2060. Electricity sector transition is much faster in the NZE scenario. NZE scenario faster phase out of unabated fossil fuel, which remains only 6 percent of the energy mix in NZE scenario by 2050. Oil demand is curbed more faster in NZE scenario compared to APS due accelerated roll out of EVs. In 2050, in NZE scenario, the majority of the oil used in chemical processes and other non emitting uses.The solid bioenergy is used in power generation and in industry more extensively and demand for liquid biofuels is less in NZE scenario in 2050 compared to APS due to electrification in transport.

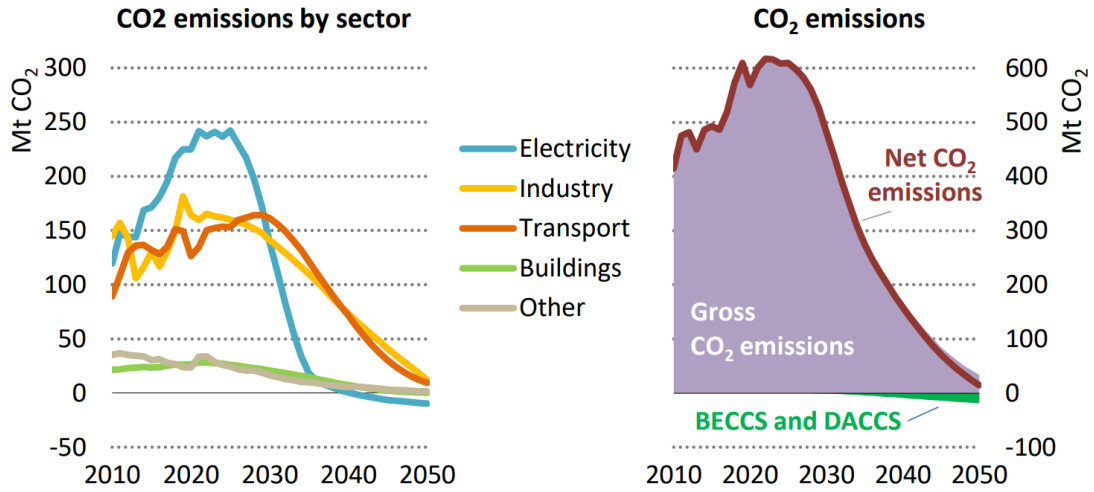
NZE by 2050 requires deployment of renewable at a much faster rate than APS. in the NZE emission scenario renewables i.e. solar, wind, geothermal and bioenergy are deployed due to which the electricity sector reaches net zero by 2040.

Net zero emission by 2050 needs power plants to be compatible with the net zero pathway. Least efficient power plants are closed by 2040 and youngest and efficient power plants are made compatible with ccus. Power plants with ccus in the NZE scenario reach 13 GW by 2060[2].

Policy intervention needed for grid integration with renewables and decreasing the country's dependents on coal both for both energy and economy.

Projected Carbon emission in Net zero emission by 2050 and role of CCUS:

Fig: 6 projected CO2 emission by sector and total energy related emission in NZE scenario 2010- 2050



source: IEA report, An energy sector road map to net zero emission in Indonesia[2]

Net GHG emission in 2019 was about 1.8 Gt CO2e, in which more than 50 percent of the emission came from FOLU. The energy sector accounted for one-third of the net GHG emission which is about 600 Gt CO2e.[4]

Electricity sector is reaching net zero by 2040 and after 2040 negative emission due to the use of bioenergy carbon capture storage(BECCS). In which biomass is converted into fuel. This huge quantity of biomass requires a large plantation which works as a carbon sink resulting in negative emission. That is why electricity is shown negatively. In 2050, remaining Unabated fossils in the Industry and transport sector results in 30 Mt CO2e of which 20 Mt CO2 is absorbed by BECCS and direct air carbon capture storage(DACCS), resulting in net emission of 10 MtCO2[2].

References:

1. Enhanced Nationally determined contribution, Republic of Indonesia,2022, https://unfccc.int/sites/default/files/NDC/2022-09/23.09.2022_Enhanced%20NDC%20Indonesia.pdf

2. An energy sector road map to Net Zero Emission in Indonesia, 2022, https://www.iea.org/reports/an-energy-sector-roadmap-to-net-zero-emissions-in-indonesia

3. Indonesia Country Climate and Development Report, world bank, 2023, https://www.worldbank.org/en/country/indonesia/publication/indonesia-country-climate-and-development-report#:~:text=The%20Indonesia%20CCDR%20analyzes%20how,carbon%20and%20climate%20resilient%20economy.

4. Indonesia Third Biennial Update Report, Republic of Indonesia, 2021, https://unfccc.int/sites/default/files/resource/IndonesiaBUR%203_FINAL%20REPORT_2.pdf