Indonesia Energy Transition Pathways 2050 and the Role of Hydrogen

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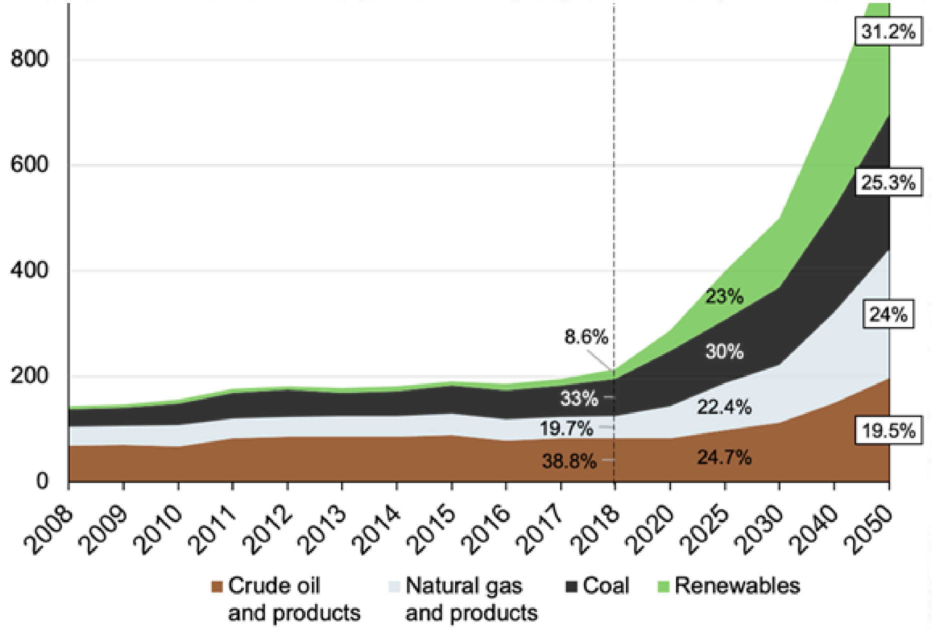
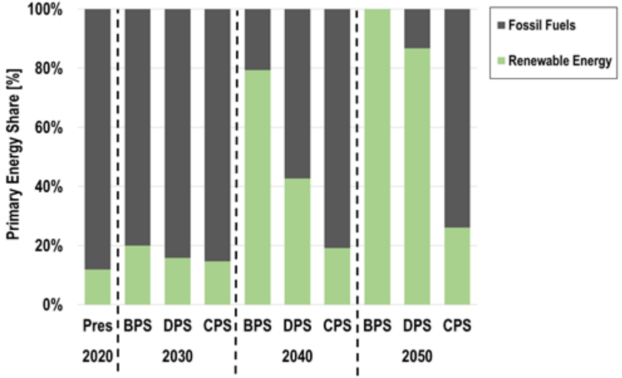
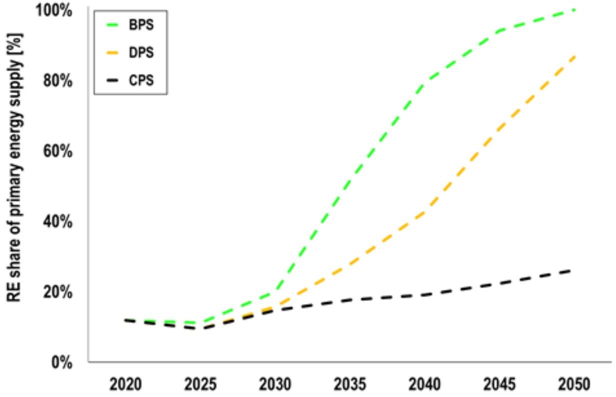
Indonesia 2014 National Energy Policy have not embraced energy transition vision yet. By 2050 fossil fuels are projected to supply 70% of national energy



- National Energy Policy enacted in 2014 and 2017 National Energy Plan set aspirational target to increase renewable energy mix by **23% in 2025** and **31% in 2050.**
- The national energy policy intends to address **energy diversification** by utilizing local energy resources to reduce energy import, mainly oil products and LPG.
- Coal is seen as solution to replace import LPG through coal to liquid and coal gasification technologies, and coal to dimethyl-ether (DME)
- Coal is abundant resources and **important source of revenue** for some local economies and **coal export** is source of **trade balance** for Indonesia.

Energy transition toward 100% renewable energy supply in 2050 is technically and financially viable

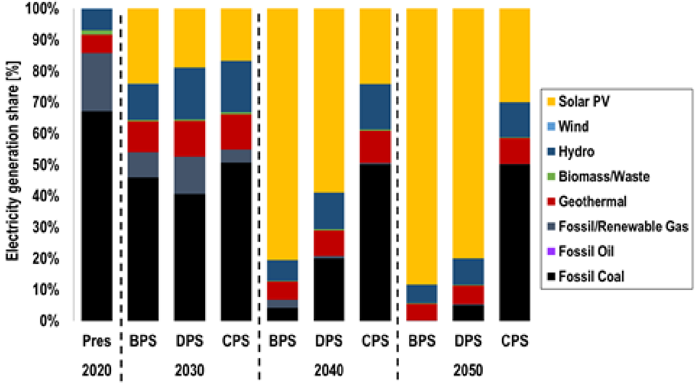




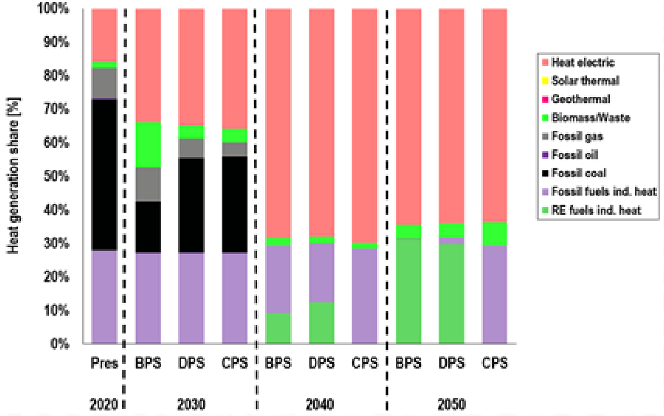
- The Primary Energy (PE) generation shares of **renewable energy across Indonesia is around 14% in 2020**, this share grows rapidly to more than 96% by 2040, more steady growth in the DPS scenario with 95% by 2050.
- **Fossil fuels have a significant share of around 86%** of the primary energy in 2020
- After 2030, a **rapid decrease** in coal generation is observed, as large-scale renewables and storage technologies is cost competitive

Source: IESR, Agora, LUT's study on Indonesia Energy Transition Pathways 2050 (upcoming)

Electricity generation

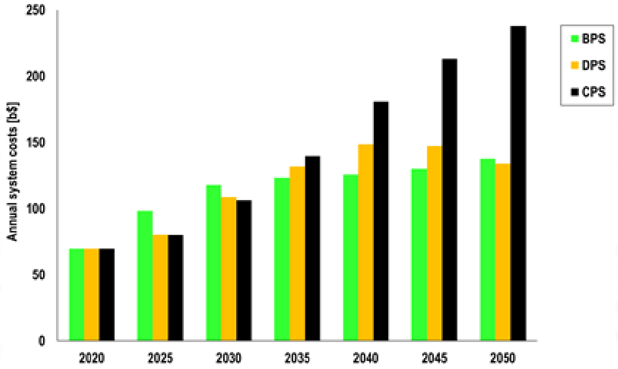


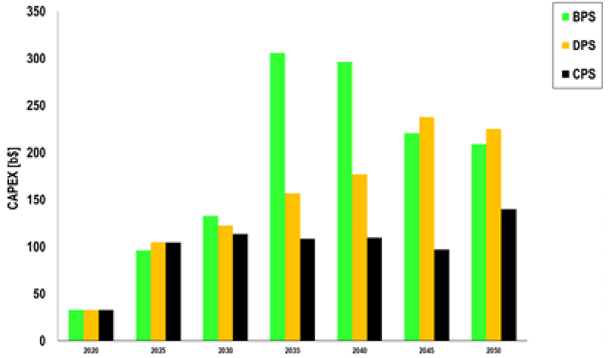
Heat generation



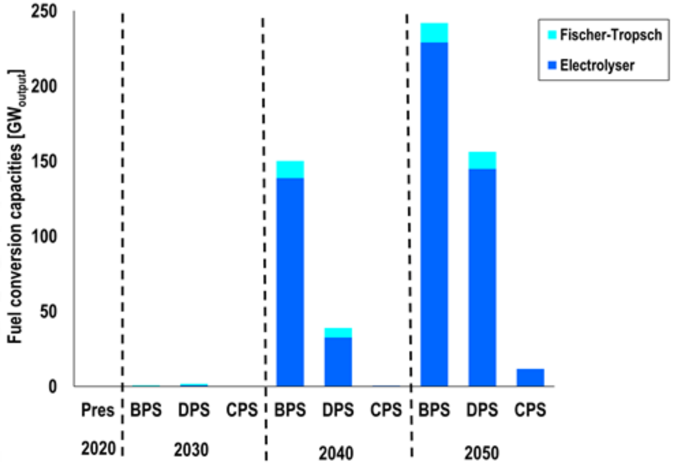
- Electricity generation is comprised of demand for all sectors (power, heat and transport) across Indonesia
- **Solar PV emerges as the primary source of electricity generation** across all the scenarios by 2050, with about 89% in the BPS scenario, about 80% in the DPS scenario and about 30% in the CPS scenario
- Coal-based generation declines through the transition
- Comparatively, **solar PV and batteries emerge as major technologies**, while hydropower and geothermal shares are almost similar in 2050 as in 2020
- The share of electricity based industrial heating increased significantly from 2030 onwards to about 50% by 2050
- Fossil fuel-based heating decreases significantly through the transition and is replaced by electricity-based heating solutions

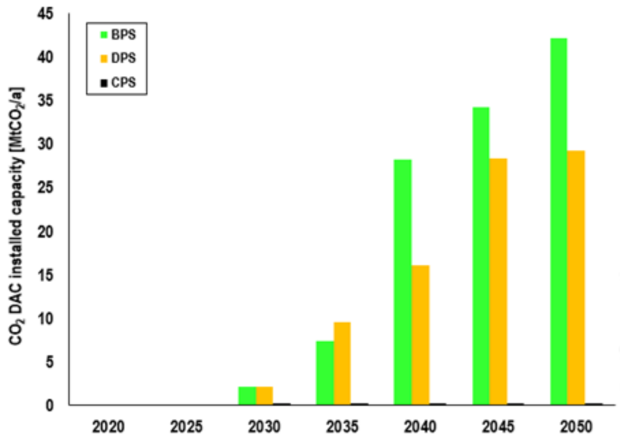
Source: IESR, Agora, LUT's study on Indonesia Energy Transition Pathways 2050 (upcoming)





- The total annual system costs are in the range of **134-238 b$** through the transition period across the 3 scenarios.
- Cumulative annual system costs indicate that pathways towards 100% renewables **will not require higher annual system costs**
- Cumulative capital expenditures are highest in the BPS scenario, with **massive investments in 2035 reaching around 306 b$**, and declining significantly to about 209 b$ in 2040
- The future investments are assumed to be based on the real current currency values
- The BPS requires the **highest capital expenditures**, in particular mid-2030s to mid-2040s, because of decommissioning of old fossil capacities, plus growing energy demand in all sectors, requires a huge shift towards installed capacities of renewable technologies.





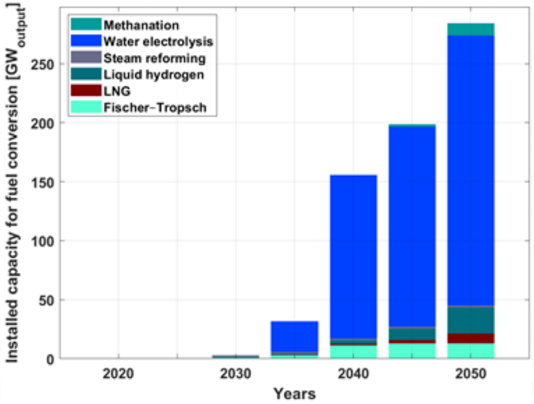
- Synthetic fuel conversion technologies including direct air capture of carbon dioxide (CO_2 DAC), play **a vital role in providing energy for applications** where direct electrification is not possible and the hard-to-abate sectors, such as marine, aviation and some industrial processes

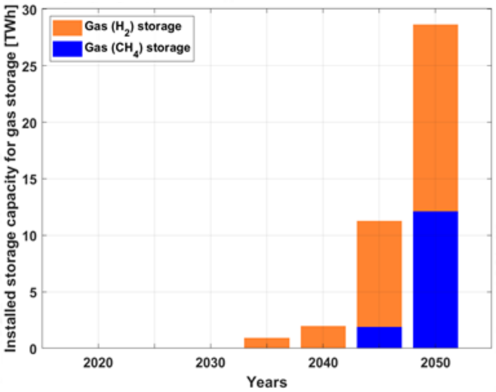
- Synthetic fuel conversion additionally provides vital flexibility to the energy system via the power-to-fuels integration, greater capacities provide higher flexibility enabled by electrolysers, but also add to the overall energy demand

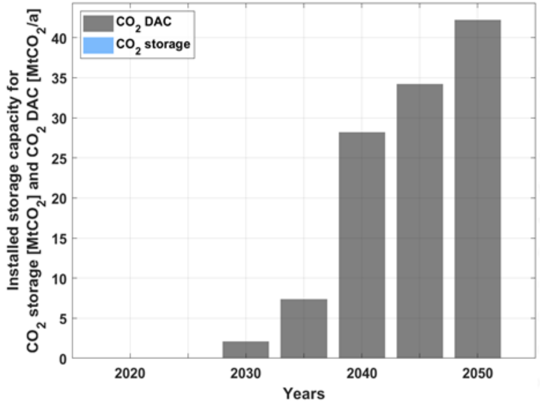
- Installations grow across all 3 scenarios, with most of the installed capacities increasing significantly beyond 2040, with a major share of water electrolysis along with CO_2 DAC as the basis for Fischer-Tropsch (FT) and hydrogen production up to 2050

- Electricity input for the FT fuels production is **159 TWh** in 2050 for the BPS scenario, while for the DPS it is **187 TWh**

In the best scenario hydrogen plays higher role therefore the need for storage infrastructure increased significantly by 2050







- Synthetic fuel conversion technologies play a significant role in the BPS scenario and installed capacities increase significantly from 2035 onwards, with a major **share of water electrolysis as the basis for Fischer-Tropsch and hydrogen production** up to 2050

- Installed capacity of gas storage comprising of hydrogen and methane reaches just over **25 TWh by 2050**, with major share of hydrogen storage

- Installed CO_2 DAC increases significantly from 2035 onwards, with **over 40 $MtCO_2$/a** installed in 2050

Integrated planning and policy approaches are need to overcome barriers of green H2 production and utilization is required

- **Policy makers must understand** the importance of green hydrogen for climate neutral/net-zero emission target.

- **Integrated planning and policy approaches** to overcome barriers and reach minimum threshold for market penetration.
    - Start with National (Green) Hydrogen Strategy
    - Identify policy support: R&D, commercialization
    - Increase renewable energy penetration
    - Make electrolyser system cost become more competitive
    - Develop potential market (demand)
    - Regulatory sandbox

Thank You

Accelerating Low Carbon Energy Transition

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