

Powering Nusantara: Modeling the Electricity Future of Indonesia's New Capital City

Akhila Suri, Ardhi Wardhana, Raihan Amir Rashidi, Rio Kaswiyanto (Columbia SIPA); Advisor: Dr. James Glynn, Senior Research Scholar (CGEP)

Background

Objective:

- To model the electricity demand and supply for the Government of Indonesia's new capital city, Nusantara, in order to meet their goals of achieving 100% renewable energy by 2045.

Guiding questions:

- What is the projected electricity demand for Nusantara from 2024-2045?
- Which clean sources are most feasible to meet this demand?
- What policies can the new Capital City Authority (IKN) implement to help realize their net-zero & 100% renewable energy goals by 2045?

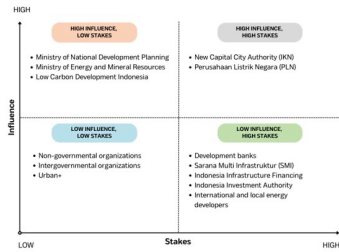


Location: from Jakarta to Nusantara

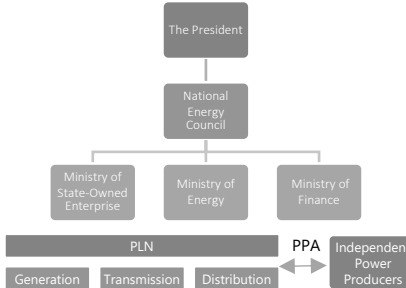


Visualization of the city (Source: IKN)

Landscape Assessment

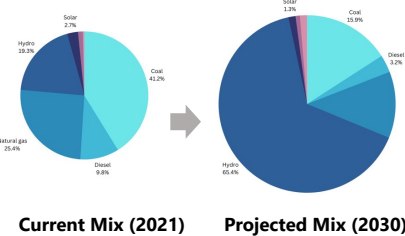


Stakeholder Analysis



Vertically Integrated Utility Structure

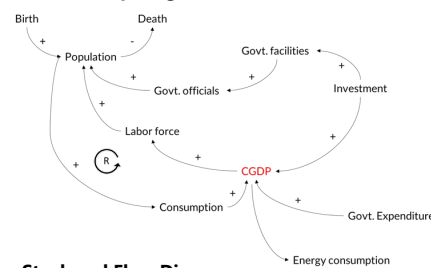
Current projection: to transition away from coal towards hydro and natural gas



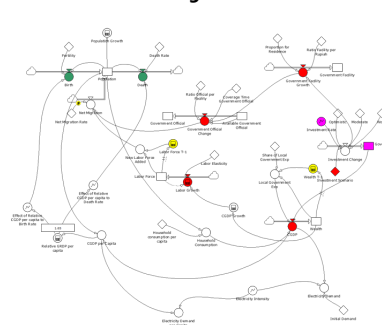
Transmission Planning & Development in Kalimantan (2021 –2030)

Demand Model

Causal Loop Diagram



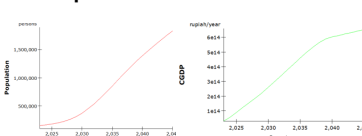
Stock and Flow Diagram:



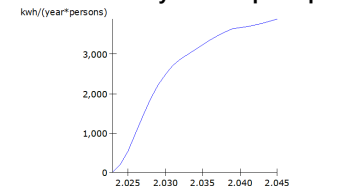
Assumptions

Variables	Parameter
Fertility	1.64%
Death rate	0.96%
Net migration rate	9.93%
GDP to mortality exponent	0.02
Household consumption per capita	Rp27
Share of household electricity intensity	0.024%
Share of local government expenditure	4.1%
Labor elasticity	0.51
Investment	Rp1,730 Tr
House per Rupiah ratio	1.83 x 10 ⁻⁹
Proportion to Residence	3%
Existing Electricity Demand	95 GWh/Year

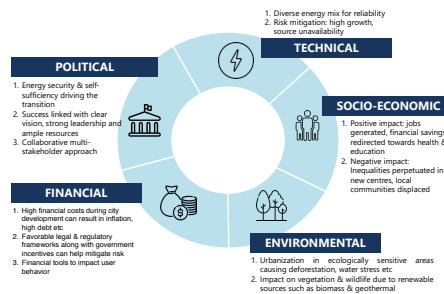
Population and Economic Growth



Electricity Demand per Capita



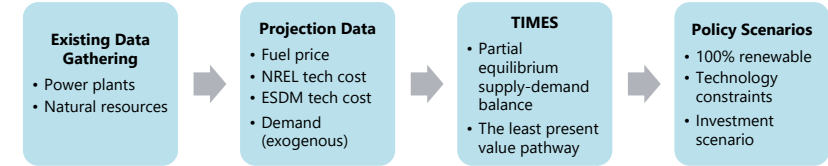
Case Studies



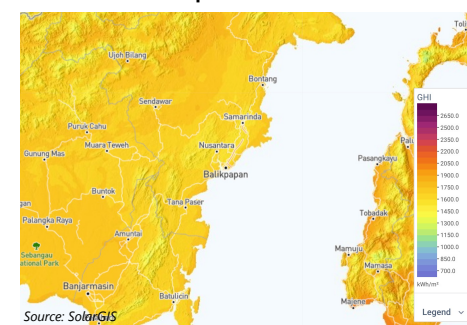
● Greenfield Capital Cities
● Cities powered by 100% RE

Supply Model

Methodology via TIMES:

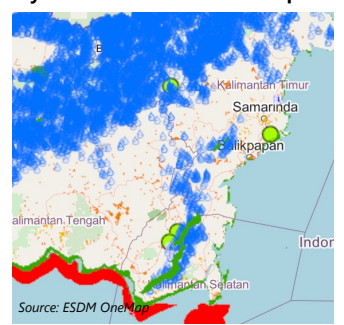


Solar Irradiance Map



Source: SolarGIS
High solar potential

Hydro and Wind Resources Map



Source: ESDM OneMap
Limited hydro and wind availability

Scenarios & Policies

Scenarios:

Baseline scenario: No investment constraint	Baseline Pathway: No technology constraint	Pathway 1: 100% new renewable energy with global market priced technology by 2045	Pathway 2: 100% new renewable energy with locally sourced technology by 2045	Pathway 3: A mix of new renewable energy from locally sourced and imports by 2045
Scenario 1: 100% investment achieved				
Scenario 2: 80% investment achieved				
Scenario 3: 57.6% investment achieved				

Policy Areas:

- Financing Mechanisms
- Carbon tax
- Dynamic Pricing
- Phased approach for local content regulation
- Direct Power Purchase Agreements
- Lower benchmark price for renewable energy
- Distributed energy resources