



WEST NUSA TENGGARA

MULTI-LEVEL AND MULTI-SECTORAL ENGAGEMENT TOWARD 100% RENEWABLE ENERGY TRANSITION



Figure 1: Map of Province of West Nusa Tenggara, Indonesia
Source: Google Map Data, 2024

West Nusa Tenggara Province, Indonesia: Facts and figures

Population

5,473.700 (2020)

Total area

20,124.48 km²

Regional Budget

IDR 6,12 trillion (2023,
ESDM)

The West Nusa Tenggara (NTB/WNT) province, with main islands Lombok and Sumbawa, pledged an ambitious target of 60% renewable energy in Lombok's electricity system by 2030, 100% renewable energy in the whole province's grid in 2040, and net zero emissions for all energy sectors by 2050. This commitment represents a pioneering initiative in Indonesia's energy landscape.

Introduction

The 1.5°C goal of the Paris Agreement has compelled nations and cities worldwide to pursue low greenhouse gas emissions development pathways, including shifting towards renewable energy, to reach climate neutrality by 2050. Despite the COVID-19 pandemic's economic impact, coal still accounted for over 40% of the growth in global CO₂ emissions in 2021 (IEA, 2021)[1]. Transitioning to renewable energy (RE) offers a safer, more sustainable energy system, reducing exposure to fuel price volatility, lowering energy bills, mitigating carbon emissions, generating green jobs, and making energy access more equitable (IEA, 2022)[2].

As part of its commitment to reach net zero by 2060 or sooner, Indonesia signed the Global Coal to Clean Power Transition declaration at COP26 and aims to phase out coal by 2040 (Climate Action Tracker, 2022)[3]. The Enhanced Nationally Determined Contribution (E-NDC) of Indonesia targets a mitigation of 358 million tons of CO₂, representing 12.5% of total conditional emission reduction (E-NDC, 2022). These commitments highlight Indonesia's proactive stance in developing a low-carbon future.

Indonesia, the largest economy in Southeast Asia, has significant untapped potential for cleaner energy sources, crucial for its sustainability and economic development goals (IEA, 2022) [4]. However, renewable energy investments face financing issues, as Indonesian banks have yet to fully implement project finance for renewable energy (IRENA, 2022)[5].

To accelerate the transition, the Presidential Regulation No. 11/2023 empowers regional governments to manage renewable resources, aiming to foster local strategy and sustainable energy use. Furthermore, in line with the National General Energy Plan (RUEN) mandate to achieve a renewable energy share of 23% by 2030 and 31% by 2050, provincial governments are mandated to incorporate these goals into their Local General Energy Plans (RUED-P) (MEMR, 2017)[6].

In recent years, the West Nusa Tenggara (WNT) provincial government has shown a strong commitment to the energy transition. Energy security is the main energy-related challenge



Bukit Selong Sembalan, WNT, Indonesia. Source: Canva

in WNT, as most of the electricity is sourced from imported coal and diesel. According to WNT's Head of Regional Development Planning Agency, Dr. Ir. H. Iswandi, M.Si, balancing energy security and regional development is key to achieving energy independence in the region.

This ambition is further affirmed by its political commitment to achieve net zero emissions (NZE) by 2050, a decade ahead of the national agenda as declared at COP26 in Glasgow. The region's NZE strategy is built on Green Tourism, Green Energy, and Green Industry (DESDM, 2023)[7]. Since 2019, ICLEI - Local Government for Sustainability Indonesia has closely collaborated with the WNT government to implement the 100% Renewable Energy Roadmap for 2050 (100 RE), aiming to reduce carbon emissions in the energy sector.

Achieving this target requires concrete actions beyond political statements. Essential steps include multi-level governance, multi-sector engagement, research-based strategies, and national-local policy initiatives—all imperative to creating an enabling environment for a renewables transition in WNT.

This case study provides an overview of WNT's challenges and opportunities in its shift to 100% renewables as identified through the 100% Renewables Cities and Regions Roadmap project, offering insights for a clean energy transition in archipelagic contexts.

"The energy sector, encompassing electricity generation and transportation, is the second highest emitter of greenhouse gasses in West Nusa Tenggara. In alignment with our vision of developing eco-based tourism, West Nusa Tenggara aims to achieve net zero emissions by 2050. This commitment is outlined in our roadmap for 100% renewable energy, which is supported by ICLEI."

- WNT Deputy Governor Dr. Ir. Hj. Sitti Rohmi Djalilah, M.Pd., (High-level message during Multilevel Action Pavilion at COP26 in 2021)

West Nusa Tenggara's present context and birth of its 100% renewables goal

West Nusa Tenggara (WNT) is an archipelagic province in northern Indonesia, comprising 2 cities and 8 regencies spread across the main islands of Sumbawa and Lombok, along with 380 smaller islands (BPS, 2023)[8]. Geographically, the northern area of the island is mountainous while the southern and western sides are dry and arid lands[12].

With a population of over 5 million people, the region's economy relies mainly on agriculture, forestry, fishing, and mining (BPS, 2023)[8]. The population is densely concentrated on

Lombok Island, which occupies only 24% of the province's area but houses over 80% of its residents or approximately 4.5 million people (ICLEI, 2024)[9].

WNT's proactive approach towards renewable energy is coupled with its focus on socio-economic improvement. WNT's gubernatorial mission includes poverty alleviation, as outlined in its fifth mission, "WNT Prosperous and Independent" as stated in the region's Long Term Development Plan (RPJMD) 2019-2023. This includes increasing electrification ratios, particularly for impoverished households (DESDM NTB, 2023)[7].

In providing electricity for its community, Perusahaan Listrik Negara (PLN), the Indonesian state-owned electric utility, has exclusive rights over the transmission, distribution and sale of electricity in the region. In 2020, electricity sales grew by 10.2%, accompanied by a 5.7% increase in the number of customers in WNT (PLN, 2021)[12]. However, several locations are not covered by PLN. These areas rely on private, non-PLN electricity, and such is usually the case due to the geographic challenges of connecting the entire archipelagic province into one grid.

No	District/City	Non-PLN Electrification Ratio (%)	PLN Electrification Ratio (%)	Total Electrification Ratio (%)
1	Mataram City	0.00	99.99	99.99
2	West Lombok district	0.15	99.84	99.99
3	Central Lombok district	0.01	99.98	99.99
4	East Lombok district	0.11	99.88	99.99
5	North Lombok district	0.66	99.33	99.99
6	Sumbawa district	0.72	99.27	99.99
7	West Sumbawa district	2.65	97.34	99.99
8	Bima City	0.00	99.99	99.99
9	Bima district	0.24	99.64	99.85
10	Dompu district	0.33	99.66	99.99
AVERAGE				99.98%

Figure 2: Electrification ratio data per district and city in WNT Province. Source: NTB Satu Data, 2022

In 2022, WNT achieved 100% electrification of villages and 99.98% electrification of households. However, five villages still rely partially on independent electricity sources in Sumbawa Regency, namely Tepal, Baodesa, Tangkampilit, Baturotok and Mungkin (DESDM NTB, 2023). The five villages receive electricity from micro-hydro power plants due to being located in remote and mountainous areas where the PLN electricity network has not yet reached. Ensuring reliable and affordable electricity is crucial to support economic growth, fundamentally assuring a just and inclusive energy transition in the province.

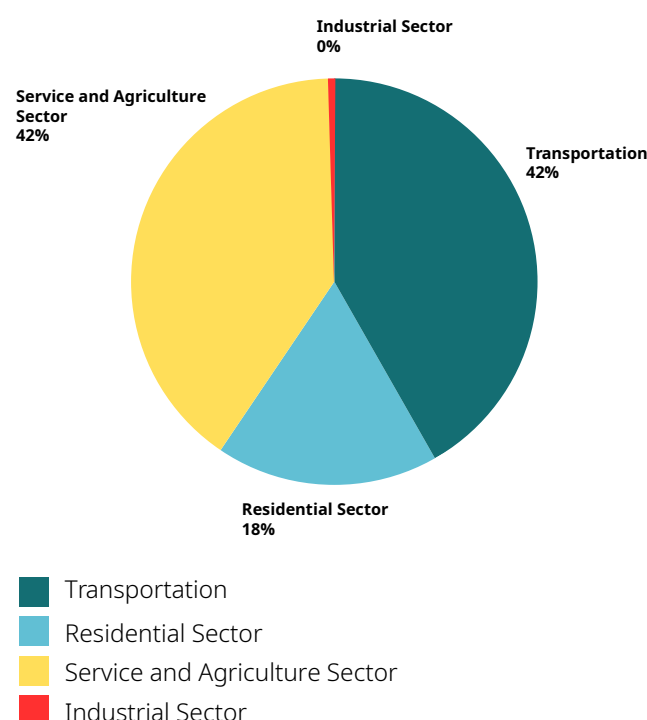


Figure 3: Energy Consumption by Sector in NTB for 2019. Source: DESDM NTB

In January 27, 2021, supported by ICLEI Indonesia, stakeholders at the regional level convened for a workshop on envisioning a 100% renewables scenario in West Nusa Tenggara. Following deliberations, the region reached a consensus on the vision: "To achieve 100% Renewable Energy in all sectors in WNT by 2050." This vision was further reaffirmed by the province's Deputy Governor, Dr. Ir. Hj. Sitti Rohmi Djalilah, who expressed optimism for collaborative stakeholder engagement in developing the roadmap to realize this vision.

Employing multi-level governance and engagement at both regional and national levels to align regional targets for emissions reduction and renewable energy within the local strategy development plan is crucial. Adequate monitoring and evaluation also ensure the effectiveness and responsiveness of renewables initiatives in relation to achieving net-zero emission goals.

West Nusa Tenggara's progress toward 100% Renewable Energy by 2050

WNT has outlined its RUED-P with targets aligned with the RUEN, namely 23% by 2025 and 31% by 2050. In 2023, WNT Province achieved a renewable energy mix of 22.43%, exceeding the set target of 19%. However, these numbers will be a challenge to maintain in the following years, considering that there is still a planned coal power plant that is under construction and set to be operated with an installed capacity of 2x50 MW. (DESDM NTB, 2023)[7].

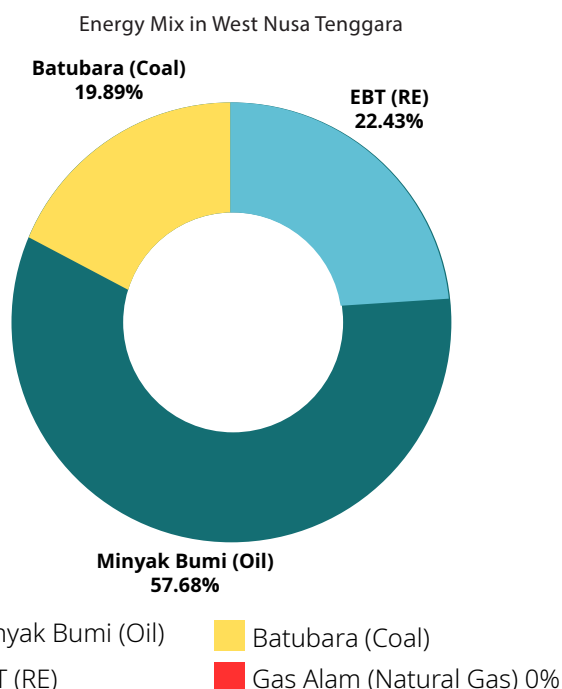


Figure 4. Co-firing sites at Jeranjang Power Plant (3 x 25 MW) and Kertasari Power Plant (2 x 7 MW). Source: DESDM NTB

To develop a sustainable electricity sector despite the aforementioned, the WNT province established ambitious targets for the Lombok system, aiming for a 60% share of RE in power sectors by 2030. Additionally, the region targets 100% RE in the entire WNT grid by 2040, and net zero emissions across all energy sectors by 2050 (DEA, 2022)[11]. Furthermore, this objective is further refined in the WNT 100% RE Roadmap, aiming for a 50% renewable energy share in the WNT Province's power system by 2035, and escalating to 100%

renewable electricity by 2050. A potential strategy to achieve this goal includes phasing out steam/coal power plants, and transitioning to use 100% biomass sources by 2040 (ICLEI, 2024)[9].

According to IRENA's GIS analysis, West Nusa Tenggara has high potential for solar and wind energy, along with significant hydro and ocean energy potential (IEA, 2022)[4]. By the end of 2022, WNT had installed 40.19 MW of renewable energy capacity, with hydropower contributing 18.59 MW and solar energy contributing 21.6 MW (PLN UIW NTB, 2023).

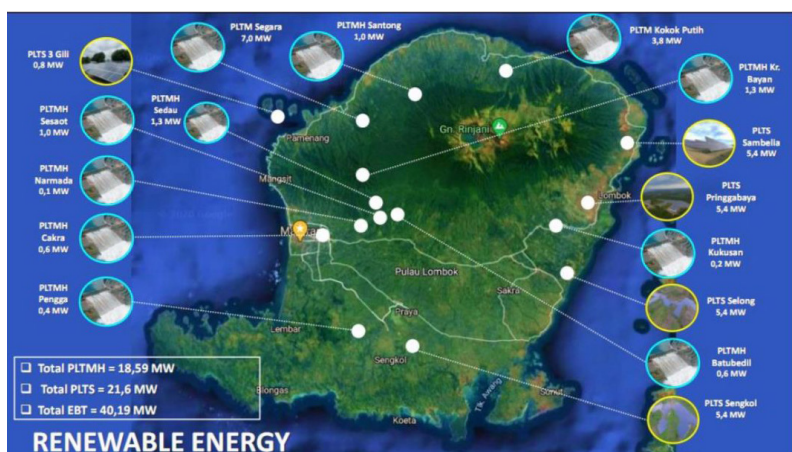


Figure 5. PLN's New and Renewable Energy Power Plants on Lombok Island (DESDM NTB, 2023)[7]

In the household sector, clean energy technologies have been adopted to boost the adoption of renewables. A total of 2,342 biogas digester units are currently being installed with the support of a local non-government organization (NGO) in 2021-2022 (DESDM NTB, 2023) [7]. Recognizing the high potential of agricultural waste utilization, a liquefied natural gas (LNG) plant utilizing biogas is in development. This involves converting corn cobs into LNG, and is intended for use in households and industries as a substitute for natural gas for applications such as cooking and firing..

Co-firing initiative to reduce emissions in WNT's power sector

To reduce emissions from coal-fired power plants, PLN has implemented biomass co-firing technology at two sites: PLTU Jeranjang in Lombok and PLTU Taliwang in Sumbawa. Biomass used includes rice husks, wood chips, corn cobs, and other organic waste, which share around 5% biomass in the coal power plant's fuel mix, with plans for future expansion. This marks the first stage in transitioning coal power plants to use 100% biomass.

The main challenge lies in securing a sustainable biomass supply. Long-term studies are needed to ensure raw material availability and competitive pricing. There is also potential for community involvement in the supply chain, offering local residents a new source of income.

To achieve the target of 100% RE, the implementation strategy of renewable energy technologies must encompass all sectors, not only in electricity and households but also in transportation, industry, and commercial.

The challenges specific to each sector are identified in the development of the renewables roadmap through a multi-stakeholder approach and comprehensive literature studies. This approach enables the accurate depiction of the current WNT energy landscape and the crafting of tailored action strategies towards the target.



Figure 5. Co-firing sites at Jeranjang Power Plant (3 x 25 MW) and Kertasari Power Plant (2 x 7 MW). Source: DESDM NTB

Adopting a multi-stakeholder approach to achieve the renewables target

The graphic below illustrates the energy organizational structure diagram in West Nusa Tenggara regarding electricity. The Energy and Mineral Resources Agency (DESDM) is responsible for developing and implementing West Nusa Tenggara's energy policy including the Regional Energy Plan (RUED). The National Energy Council (DEN) has a key role in facilitating local governments in developing RUED. The local development agency (BAPPEDA) has responsibility for planning the regional development under prevailing laws and regulations. BAPPEDA is also the General Chairman of the RUED Implementation Working Group in addition to the Energy Agency as the Daily Chairman (ICLEI,2024)[9].

Meanwhile, the involvement of the PLN Regional Main Unit of WNT (UIW NTB)—the primary electricity provider—ensures alignment with regional energy goals and facilitates the integration of renewable energy sources into the grid.

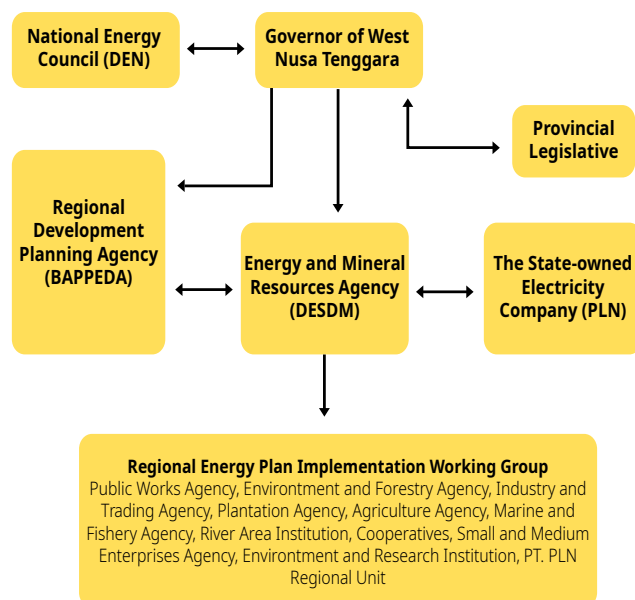


Figure 6. Energy Organizational in West Nusa Tenggara province



Figure 7. ICLEI Indonesia in collaboration with WNT Energy Agency hosted the 2nd National Advisory Group (NAG) Meeting discussing the development of WNT 100% renewables roadmap on February 27, 2024, in Jakarta. Source: ICLEI Indonesia

Local strategy to reduce emissions in WNT

Furthermore, WNT is actively enhancing its energy mix in the electricity sector by implementing a local strategy involving expanded collaboration with various stakeholders, including state-owned enterprises (BUMN), the private sector, international partners, communities, and NGOs. These actions include:

- Constructing a communal solar power plant with a capacity of 26.8 MWp by PT AMMAN Mineral Nusa Tenggara, primarily for captive power needs at its mining operations.
- Utilizing biomass at the Jeranjang PLTU through a co-firing program, aiming to supply 5% of its fuel requirements using biomass derived from waste with PLN.
- Installing four rooftop solar PV systems with a combined capacity of 100 kWp in government offices and educational institutions, a project initiated in 2020. Additionally, two units of rooftop solar PV systems, each with 50 kWp, were installed in Gerung and Narmada Hospitals.
- Advancing the adoption of other renewable energy sources through the construction of 2,342 biogas digesters by the Rumah Energi Foundation from 2021 to 2022. (DESDM Annual Report, 2022)

By engaging multiple sectors and stakeholders, including government agencies, utilities, and regional authorities, WNT shows that a collaborative and coordinated approach can be adopted to address the complexities of transitioning to 100% renewables in WNT.



Figure 8. Regional Public Hospital RSUD Awet Muda Narmada 50 kWp, WNT. Source: DESDM NTB



Figure 9. Regional Public Hospital RSUD Awet Muda Narmada 50 kWp, WNT. Source: DESDM NTB



Figure 10. Constructed in 2021, the Amman Mineral Solar Power Plant (26 MWp) supplies about 20% of the electricity required for the AMNT smelter and processing unit in WNT. Source: DESDM NTB

Building towards a 100% RE roadmap for West Nusa Tenggara

When charting a course toward a 100% renewable energy transition, it is imperative that all sectors are aligned; otherwise, the goal will be harder, if not impossible, to reach. WNT's commitment to achieving net-zero emissions by 2050 is inspired by its selection as a deep-dive region of the 100% RE project and drives the implementation strategies through the development of the WNT 100% RE Roadmap under the same project.

The development of WNT's 100% renewable energy roadmap follows the 100% Renewables Roadmap Framework, which is grounded in the GreenClimateCities methodology developed by ICLEI – Local Governments for Sustainability. The methodology aims to guide local governments

towards climate neutrality. The methodology unfolds in three stages: analyze, act, and accelerate (ICLEI, 2023)[13].

In the “Analyze” phase, local governments are urged to politically commit to a long-term vision for realizing a sustainable energy system. This phase is followed by the “Act” phase, beginning with the development of a pathway with feasibility studies and energy modeling. The “Accelerate” phase focuses on enablers to support the action, including effective communication, encouraging public participation, practicing effective multilevel governance, and developing robust monitoring frameworks to track progress.



Figure 11. 100% Renewable Roadmap Framework. Source: ICLEI, 2021 [14]

Identifying renewables potential as an entry point

Scaling up the ambitious renewable energy target requires the evaluation of its feasibility. The 100% RE Project facilitated a series of preliminary assessments through an initial status report and energy system modeling during 2021-2022. External experts from Fraunhofer ISE, supported by local experts, developed energy scenarios in WNT using energy and macroeconomic data collected between August and November 2020. Given WNT's archipelagic nature, various scenarios were simulated, considering multiple energy demand projections, the potential connection of Lombok and Sumbawa islands' energy systems, and different fuel price conditions. These research-based analyses guided stakeholders in shaping the region's strategy towards 100% renewable energy by 2050 which is further elaborated in the WNT 100% RE Roadmap.

Defining political commitment through a shared co-created vision and public engagement

Securing government ownership and public participation in implementing the renewables target is crucial to ensure its long-term sustainability. WNT's strategic development in mitigating emissions includes building alliances with international organizations. The signing of the Memorandum of Understanding (MoU) between ICLEI Indonesia and WNT's Energy Agency in July 2020 served as a basis of collaboration to develop the 100% RE roadmap to accelerate the region's net zero vision. In January 27, 2021, supported by ICLEI Indonesia, stakeholders at the regional level convened for a workshop on envisioning 100% renewables in the province. Following deliberations, the region reached a consensus on the vision: "Achieving 100% Renewable Energy in all sectors in WNT by 2050." This vision was further reaffirmed by the province's Deputy Governor, Dr. Ir. Hj. Sitti Rohmi Djalilah.

Mobilizing local resources with multi-sectoral engagement

The project has facilitated the establishment of a Project Implementation Team (PIT) since 2021 to assist the province in renewable energy planning. Led by WNT's Energy Agency, this approach cultivates an enabling environment to identify stakeholder interests, roles, and engagement levels, while facilitating planning processes and fostering collaboration within the task forces. Essentially, the involvement of PIT members has initiated enabling frameworks and the preparation of feasible RE projects.

The PIT members consist of representatives from various agencies, including the energy agency, industry agency, transportation agency, agriculture

Figure 12: PIT members and key stakeholders participate in the Serious Game (SETS) activity on 25 July 2023 in WNT province



agency, Bappeda of WNT Province and Bappeda in networking cities both in Mataram and Sumbawa, along with other institutions.

A series of follow-up public consultations with PIT members were conducted through a number of regular meetings, capacity-building sessions, kick-off meetings, visioning workshops, and multi-level governance dialogues with National Advisory Group (NAG) members between 2020-2024. These efforts have proven instrumental in developing a cohesive and actionable energy strategy.

Notably, the Sustainable Energy Transition Strategy (SETS), a participatory tool developed by ICLEI and Generation.Energy, has productively empowered a diverse array of stakeholders. In 2023, this activity engaged over 30 key local stakeholders from diverse backgrounds and roles, encouraging them to empathize with one another's viewpoints and experiences. This approach has successfully brought out a wide range of concerns and perspectives, fostering a more inclusive and effective policy-making process, leading to imperative local energy solutions.

Assess local capacity building needs to develop and implement 100% RE strategies

Local capacity is crucial for supporting 100% RE strategies in the region. The assessment was conducted twice: first was a lighter assessment using surveys, followed by a comprehensive assessment using questionnaires. Respondents included various relevant stakeholders, such as local governments and academics. One of the objectives of the assessments was for the results to serve as the basis for a capacity-building development plan, addressing specific project interests and priorities.

The assessment results indicate that the limited number of personnel is the main obstacle in WNT. While some departments have budget allocations for renewable energy (RE) or energy efficiency (EE), these funds are limited. Only the Energy Agency has a sufficient number of skilled personnel, though their expertise varies. Other departments and teams have limited or no capacity in renewable energy. To address this, three main themes have been identified

to enhance local capacity: technology, planning and regulation, and financing. Based on these themes, 10 capacity-building topics have been identified, covering various aspects of the identified areas.

From the identified topics, in-person and virtual capacity-building sessions have been conducted by experts in these areas. To cover all these topics, collaboration with various experts and organizations was required. Resource persons for capacity building came from academia, NGOs, and the ICLEI World Secretariat for technical themes. For planning and monitoring, collaboration occurred with think tanks for finance, which includes five topics, experts in climate financing from the OECD, academia, development partners, and the national infrastructure finance institutions under the Ministry of Finance (PT SMI) were tapped.

Streamlining energy planning process through multi-level governance

The project has organized several National Advisory Group (NAG) meetings in 2019 and 2024. The first NAG meeting was held to introduce the project at the national level and invite experts to join the National Advisory Group, which includes professionals and key stakeholders from the government, business, finance agencies, and utilities sectors. Their role was to provide strategic guidance to the project, develop recommendations to improve national, regional, and local framework conditions to unlock RE and EE potential, and advise on how to enhance the financeability of local projects.

The second NAG meeting was conducted by inviting NAG members to attend and provide input on the draft 100% WNT RE Roadmap at the national level, with the expectation that the existing roadmap should align with national strategies and encourage national regulatory support.

Developing ready-to-finance RE or EE projects that will attract potential funders locally or internationally

The selection of the pilot project aims to demonstrate the financial viability of renewable energy, contributing to the broader goal of

establishing a replicable and sustainable energy system in WNT. Before selecting a location for the pilot project, a workshop was held with stakeholders from the WNT provincial government to brainstorm on existing RE/EE projects in the region. The information gathered included existing technology, the completeness of technical documents, current conditions, and existing funding mechanisms.

The selection was based on discussions with PIT members. After the pilot project was chosen, various activities were undertaken, including

technical system design, studies on procedures, permits, and the environmental and social impact of the project. Additionally, analysis was conducted to identify and evaluate suitable business models and financial modeling. Finally, a business matchmaking event was held to connect the WNT government with potential donors interested in the project or other projects in RE/EE.



Figure 13: Various key stakeholders gathered at the first business matchmaking event for a financeable solar PV project for Mataram City's Public Health Center on 5 June 2024 in Jakarta.

Lesson learned and recommendations

Political commitment drives progress

Clear political commitment serves as a foundation for undertaking large-scale initiatives. This lesson highlights the critical importance of political will, as demonstrated by the local leadership of WNT, serving as the foundation for pursuing an ambitious development plan. Additionally, it raises public awareness and reinforces ownership of the RE implementation process across the local, regional and national levels.

Community involvement is key

Engaging local communities and stakeholders in the planning and implementation processes ensures that the energy transition is inclusive and addresses local needs and contexts. WNT's steady effort to improve local capacity for decision-making by engaging multiple sectors and stakeholders has significantly transformed energy planning activities in the region which consist of cities and regencies across the island province.

Enhancing local modalities through research and data exploration

Data collection activities are critical for the energy modeling process because the quality of modeling results depends on the input data. To improve data collection activities in the future, several factors must be considered:

- Standardized data templates are important for consistent data collection.
- Stakeholders must have clear goals for determining the type of data needed.
- Conduct data source mapping for each required data to identify reliable sources.
- Exploring alternative data sources from key relevant sources is necessary considering publicly available data may not always meet requirements
- When encountering data gaps, a meticulously designed methodology is essential to fill these gaps efficiently and effectively.

Enhance multi-level governance

In transitioning to renewable energy, the region faces numerous political, institutional, and legal challenges. These include minimal involvement of local governments in national energy planning, a lack of inter-institutional coordination, and inconsistency and uncertainty in regulations governing renewable energy deployment.

These challenges can be attributed to the government's limited fiscal allocation and the need for alternative funding mechanisms for renewable energy implementation. The perceived high risk of renewable energy investments also poses a constraint. Additionally, social and environmental factors must be taken into account alongside economic and fiscal implications.

It is important to ensure policy sustainability through clear and consistent legislation and granting greater authority and support to local governments like WNT Province for energy sector

planning and management. Adequate policies in terms of authority and technical aspects are also necessary at both national and provincial levels. Additionally, special attention should be given to financing and capacity building. This underscores that strong policy support, sufficient financing, and capacity building are key elements to support a successful and just energy transition.

Promote local policy and regulatory reforms

Provincial islands are often isolated from each other, making it costly and logistically complex to establish reliable energy connections. Lombok and Sumbawa islands have vastly different contexts requiring unique approaches to renewable energy. This underscores the fact that even within the provincial level of local governments, there won't be a one-size-fits-all approach. Each area will have unique circumstances that must be addressed, highlighting the importance of decentralization. It is therefore essential to advocate for supportive policies and regulatory frameworks that incentivize local and even community-based renewable energy investments and facilitate the integration of renewables into the energy grid. This includes simplifying permitting processes and offering financial incentives, all the while ensuring a just and inclusive RE transition for all involved.

By reflecting these lessons in other regions, governments and stakeholders can lay the groundwork for successful renewable energy transitions, fostering sustainability and resilience in energy systems nationwide.

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The 100% Renewables Cities and Regions Roadmap project facilitates the energy transition by raising local awareness on renewable energy sources, showcasing how local and national governments can create coordinated enabling frameworks and policies, exploring access to public and private sector finance, and building local renewable energy projects to address electricity, heating and cooling.

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