NEDO成果報告書

Study on Business Model Development for the Technologies on Green and Carbon Neutrality in ASEAN

NRI Consulting & Solutions (Thailand) Co., Ltd.
Consulting Division

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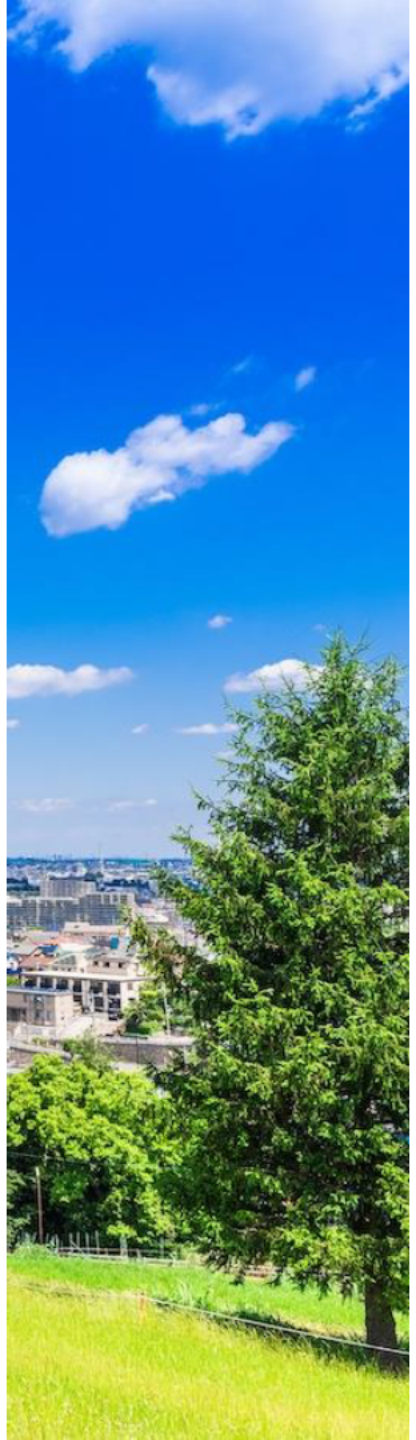
NRI
Nomura Research Institute
Thailand

Share the Next Values!



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調査概要・実施タスク

Task 1で重要分野の独自仮説の深掘りを行い、Task 2-3で独自仮説における事業オプションのモデルを策定・検証する。

		タスクの目的	アプローチ
Task 1 (2か月~)	重要分野の独自仮説の深掘り・検証	• グリーン分野の重要分野に関する独自仮説について、事業オプションのモデル策定をしていく重要分野の深掘りや検証を行い、日系企業の事業オプションのモデル策定の基礎資料を作成する。	• ASEAN主要6か国の現地企業の"生声"をもとに、フォーカスをする重要分野 における課題・ニーズについてインタビューで深掘りをする。 • 課題・ニーズを踏まえて、外部とどのようなパートナーシップを必要としているか、把握する。 • 日系企業が提供できるソリューションについて、把握する。
Task 2 (1.5か月~)	事業オプションのモデルの策定	• ASEAN主要6か国において、重要分野における事業オプションのモデルを策定して、その中でNEDOが提供できる価値を明らかにすることにより、国際実証事業のモデルケースを策定する。	• 既存事例によるベンチマークを行い、事業を最大化するために、どのような体制が最適か、整理する。 • 既存事例のベンチマークをもとに、事業オプションの顧客セグメント、提供価値、商流、マネタイズ方法を決定して、その中でNEDO等の公的機関との連携するメリットについても明らかにする。
Task 3 (1.5か月~)	事業オプションのモデルの検証	• 策定した重要分野における事業オプションのモデルに対する、ASEAN現地・日系企業のフィードバックを踏まえ、検証およびブラッシュアップをする。	• 日系企業との議論を通じて、事業オプションのモデルを検証・ブラッシュアップする。

タスクの全体像と流れ

重要分野の深掘りは、ASEAN現地企業および日系企業のそれぞれの観点から行い、事業オプションのモデル策定は、既存事例のベンチマークを踏まえて実施することを想定している。

✓ 本プロジェクトのゴール：
グリーン分野の重要分野における、日系企業にとっての有望な領域が具体化（＝深掘り）しており、そこにおける事業オプションのモデルが構築されている状態。

Task 1：重要分野の独自仮説の深掘り・検証

Task. 1 -1

ASEAN現地企業の課題・ニーズの深掘り

- ✓ 国際実証事業の組成に向け、どの重要分野に優先的に取り組むべきか
- ✓ フォーカスする重要分野において、どのような課題・ニーズがあるか

Task.1-2

ASEAN現地企業の連携状況の把握

- ✓ 現在は、どのような連携を行っているか。
- ✓ 将来的に、どのような連携をしていくことを検討しているか。

Task.1-3

日系企業のソリューション・競争力の把握

- ✓ どのような技術やソリューションを有しているか。

Task 2：事業オプションのモデルの策定

Task.2-1

既存事例のベンチマーク

- ✓ 他の企業について、どのような体制で、どのようなリソースを活用しているか。

Task.2-2

事業オプションのモデルの構築

- ✓ どのような顧客に、どのような価値を提供できるか。
- ✓ 事業の商流やマネタイズ方法は何か？

Task 3：事業オプションのモデルの検証

Task.3-1

業界プレーヤーの視点での検証

- ✓ 主要な日系企業から見て、事業モデルが有効であるか否か。

Task.3-2

事業オプションのブラッシュアップを実施

- ✓ 主要な日系企業の観点から、どのように事業オプションをブラッシュアップしていくべきか。

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調査からの示唆・要点

■ カーボンニュートラルの重要分野において、CCS/CCUSやアンモニア・水素など、本格的な社会実装がまだ先の分野においても、ASEAN現地企業は日系企業以外にも欧米、アジア（中国、韓国等）などの主要な海外企業と既に幅広く連携をしており、どの国の企業とパートナーシップを構築すべきか、見極めを行っている段階にある。

■ 日系企業は、ターゲット国の重要分野における現地企業の技術ニーズを、社会実装が開始される前の段階から見極め、事業主体となる、主要な現地企業（国営・財閥系のエネルギー会社等）を含めた事業体制を構築することによって、ASEANカーボンニュートラルでのビジネス機会を獲得できると考える。

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List of Local Companies which Interviews were Conducted

NRI conducted interviews to understand the issues and needs, as well as the partnership of local companies for each of the selected priority area.

List of ASEAN Companies which Interview were Conducted

Category	Priority Area	Company	
		Name	Description
Malaysia	CCS / CCUS	Petronas	Energy company
	Ammonia / Hydrogen	Petronas	Energy company
	Ammonia / Hydrogen	TNB	Electricity company
Thailand	CCS / CCUS	PTTEP	Energy company
	Green Manufacturing	CP Foods	Food manufacturing (Large size)
	Green Manufacturing	Thai Beverage	Food manufacturing (Large size)
	Green Manufacturing	Sunshine International	Food manufacturing (Mid size)
	Green Building	Sansiri / SC Asset	Real estate developer
Indonesia	Renewable Energy	Medco Power	Electricity company
	Ammonia / Hydrogen	Pertamina	Energy company
	Ammonia / Hydrogen	PLN	Electricity company
Vietnam	Renewable Energy	Trung Nam	Electricity company
	Green Manufacturing	Vinfast	Automotive manufacturer
	Green Manufacturing	Tan A Dai Thanh Group	Water solution manufacturer
Philippines	Renewable Energy	Aboitiz	Electricity company
	Renewable Energy	Meralco	Electricity company
	Smart City	Ayala Land	Real estate developer
Laos	Renewable Energy	EDL Gen	Electricity company

CCS / CCUS (Malaysia): Potential Value Proposition by Japanese Companies

Japanese technology can help address the issues regarding the cost and energy efficiency for CCS / CCUS, which are major issues for local companies.

High added value | Cost Reduction

Category	Issues / Needs of Local Companies	Example of Value Proposition by Japanese Companies	
		Benefit	Technology
Capture	Large amount of energy is required during the CO2 capture	Reduce energy during CO2 capture in emission source	Energy saving CO2 capture system
	CO2 capture cost is high	Reduce cost during capture in CO2 emission source	Low-cost CO2 capture system
Transportation	Economic efficiency of the vessels low	Increase efficiency in cross-border / domestic transportation	Multi-purpose vessels (e.g. Carry ammonia and LCO2)
	GHG emission during transportation	Reduce GHG emission in cross-border / domestic transportation	Clean energy fueled vessels (e.g. ammonia-fueled)
Storage	Safety and security of storage sites	Reduce the risk of leakage of CO2 when storing CO2 for long period	Storage and monitoring system for safe storage
Utilization	Cost reduction for carbon recycle		
	Adding value to the product manufactured	Has value added other than low GHG emission during production	Value-added carbon recycle products

Source: Created by NRI based on interviews and publicly available sources

Ammonia / Hydrogen (Malaysia): Potential Value Proposition by Japanese Companies

When developing green and blue ammonia / hydrogen, technological issues remain, in which Japanese technological solutions can support local companies.

High added value | Cost Reduction

Category	Issues / Needs of Local Companies	Example of Value Proposition by Japanese Companies: Benefit	Example of Value Proposition by Japanese Companies: Technology
Production	Enhancing efficiency and durability of electrolyzer (green ammonia / hydrogen)	Increase efficiency while maintaining reliability	Advanced electrolyzer technology
	High cost due to fluctuation of renewable energy (green ammonia / hydrogen)	Lower cost of production by efficiently utilizing RE	Hydrogen energy management system
	Gaining technology to control the CO2 emission (blue ammonia / hydrogen)	⇒**Refer to the business models in CCS / CCUS**	
Transportation/ Storage	Lack of specialized transportation vessels (ammonia / hydrogen)	Provide safe and efficient transportation	Specialized transportation vessels
	Development of transportation terminal (ammonia / hydrogen)	Increase the capacity for export / import of hydrogen / ammonia	Port terminal for ammonia / hydrogen
	Development of technology for safe large scale storage (ammonia / hydrogen)	Increase the safety of ammonia / hydrogen storage	High safety large scale storage tanks
Utilization	Increasing the amount which can be used for co-firing (ammonia / hydrogen)	Enable co-firing with higher % of ammonia / hydrogen	Ammonia / hydrogen co-firing
	Reducing the Nox from emission (ammonia)	Reduce the amount of Nox generated from ammonia	Ammonia(NH3) Removal Catalyst
	Reducing the cost for power generation utilization (ammonia/ hydrogen)		

Source: Created by NRI based on interviews and publicly available sources

CCS / CCUS (Thailand): Potential Value Proposition by Japanese Companies

Japanese technology can help address the issues regarding the cost and energy efficiency for CCS / CCUS, which are major issues for local companies.

High added value | Cost Reduction

Category	Issues / Needs of Local Companies	Example of Value Proposition by Japanese Companies	
		Benefit	Technology
Capture	Large amount of energy required	Reduce energy during capture in CO2 emission source	Energy saving CO2 capture system
	High CO2 capture cost	Reduce cost during capture in CO2 emission source	Low-cost CO2 capture system
	CO2 source has impurities apart from CO2	Remove impurities efficiently	High impurities removal technology
Transportation	Economic efficiency of the vessels low	Increase efficiency in transportation	Multi-purpose vessels (e.g. ammonia+LCO2)
	Safety of the pipeline transportation	Increase the safety level for pipeline	Durable materials to prevent leakage
Storage	Safety of the storage system	Reduce the risk of leakage of CO2 when storing CO2 for long period	Storage and monitoring system for safe storage
	Ensuring a stable monitoring system		
Utilization	Cost reduction for carbon recycle		
	Energy required during the production process	Reduce the amount of CO2 required during carbon recycle	Low CO2 carbon recycle

Source: Created by NRI based on interviews and publicly available sources

Green manufacturing (Thailand): Potential Value Proposition by Japanese Companies

Implementation of energy management and energy saving solutions still remain a key issue, in which Japanese technologies can support with the issues.

High added value | Cost Reduction

Category	Issues / Needs of Local Companies	Example of Value Proposition by Japanese Companies	
		Benefit	Technology
Energy Management	Making equipment IoT ready	Make the equipment IoT ready	IoT ready machine / equipment
	Utilizing cloud system which can collect data in a structured manner	Visualize the energy utilized, to optimize the energy usage	Energy management system
	Implementation of AI technology to analyse the data collected		
	Integrating data in different divisions		
Energy saving	Robotics with more durability	Enable robotics with higher durability	High durability robotics
	Usage of equipment with lower energy consumption	Reduces the energy consumed	Energy saving compressors
Green energy	High initial investment cost for renewable energy (e.g. solar)	Reduces the cost of initial investment	Low cost solar power
	Instability of battery technology	Stabilizes the storage battery	Storage battery
	High cost of storage battery	Reduces the cost required for storage battery	
	Lack of technology for usage of hydrogen in factory	Enables the usage of hydrogen in factory	Hydrogen power generation

Source: Created by NRI based on interviews and publicly available sources

Green Building (Thailand): Potential Value Proposition by Japanese Companies

Implementation of energy management and energy saving solutions still remain a key issue, in which Japanese technologies can support with the issues.

High added value | Cost Reduction

Category	Issues / Needs of Local Companies	Example of Value Proposition by Japanese Companies	
		Benefit	Technology
Energy Saving / Energy Management	Lack of IoT equipped equipment	Connect the devices and equipment to utilize the data efficiently	IoT Systems
	Limited choice of energy management systems (e.g. usage of AI for analysis)	Optimize the energy usage, by understanding how the energy is used	Energy management system
	Energy control and management is not centralized		
Green Energy	Battery storage too expensive to install for solar power generation	Reduce the cost to install battery storage	Low cost battery storage system
	Wind turbine too expensive to install		
Green Materials	Limited amount of certified green materials	Reduce the GHG emission reduction within scope 3	Certified materials for GHG reduction

Source: Created by NRI based on interviews and publicly available sources

Renewable Energy (Indonesia): Potential Value Proposition by Japanese Companies

Issues for renewable energy differ across the power generation type, in which Japanese solutions can support with addressing the issues.

High added value | Cost Reduction

Category	Issues / Needs of Local Companies	Example of Value Proposition by Japanese Companies: Benefit	Example of Value Proposition by Japanese Companies: Technology
Power Generation	Geothermal: High investment cost for exploration drilling	Lower the investment cost required for exploratory drilling	Low cost drilling technology
	Solar: High cost of energy storage	Lower investment cost for energy storage	Low cost storage battery
	Lack of know-how for waste management regarding the renewable energy equipment	Circular model for waste coming from the equipment	Recycling system for equipment
	Solar module technology of local company is low (Needs to have 40% local products)	Provide advanced technology for solar power generation	Solar power module technology
Distribution / Transmission	Electricity loss during distribution/transmission	Stabilizes the grid for distribution / transmission	Grid stabilization system
	Instability for grid, especially for low voltage		
Retail	Development of new technology to utilize excess energy	Utilize excess electricity for green solutions	Electricity to hydrogen / ammonia

Source: Created by NRI based on interviews and publicly available sources

Ammonia / Hydrogen (Indonesia): Potential Value Proposition by Japanese Companies

When developing green and blue ammonia / hydrogen, technological issues remain, in which Japanese technological solutions can support local companies.

High added value | Cost Reduction

Category	Issues / Needs of Local Companies	Example of Value Proposition by Japanese Companies	
		Benefit	Technology
Production	Low stability due to fluctuation of renewable energy (Green ammonia / hydrogen)	Stabilize the production when using renewable energy	Advanced PEM electrolyzer technology
	High cost due to fluctuation of renewable energy (green ammonia / hydrogen)		
	Requires large amount of energy for Harber-Bosh process (ammonia)	Reduce the amount of energy required to manufacture ammonia	New ammonia manufacturing process
Transportation/ Storage	Lack of specialized transportation vessels (ammonia / hydrogen)	Provide safe and efficient transportation	Specialized transportation vessels
	Requires large amount of energy for conversion from ammonia to hydrogen	Reduce the amount of energy required for conversion	Photocatalytic reactors
	Development of technology for safe storage (ammonia / hydrogen)	Increase the safety of ammonia / hydrogen storage	High safety storage tanks
Utilization	Increasing the amount which can be used for co-firing (ammonia / hydrogen)	Enable co-firing with higher % of ammonia / hydrogen	Ammonia / hydrogen co-firing
	Improving the performance when using hydrogen for gas-turbines	Maintain performance when utilizing hydrogen	Combustion technology with high adaption
	Reducing the Nox from emission (ammonia)	Reduce the amount of Nox generated from ammonia	Ammonia(NH3) Removal Catalyst
	Need to develop infrastructure for industrial (e.g. steel) and FCV usage	Enable usage in steel manufacturing process	Steel production facility with ammonia usage

Source: Created by NRI based on interviews and publicly available sources

Renewable Energy (Vietnam): Potential Value Proposition by Japanese Companies

Issues for renewable energy differ across the power generation type, in which Japanese solutions can support with addressing the issues.

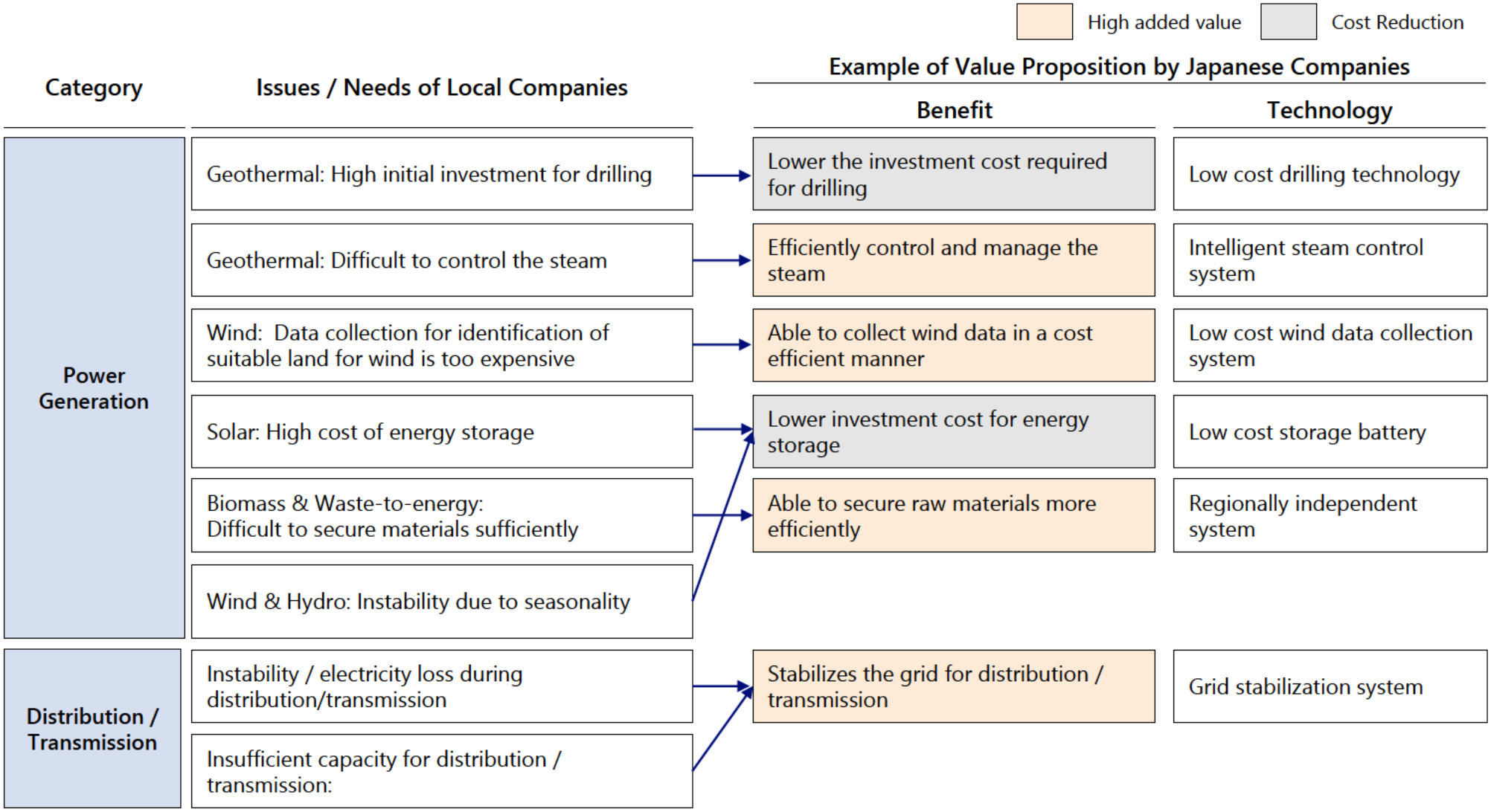
High added value | Cost Reduction

Category	Issues / Needs of Local Companies	Example of Value Proposition by Japanese Companies	
		Benefit	Technology
Power Generation	(Waste-to-energy) Difficult to secure materials sufficiently	Able to secure raw materials more efficiently	Regionally independent system
	High investment cost for storage battery	Lower investment cost for energy storage	Low cost storage battery
	(Solar) Instability of power generation		
	(Wind) Instability of power generation, without hybrid with other types (e.g. hydro)		
	Lack of know-how for pumped storage hydro power	Able to adjust the supply for hydro	Pumped hydro power generation
Distribution	Increasing the capacity of transmission line:	Increase the volume for transmission	Grid stabilizing system
Retail	Development of new technology to utilize excess energy	Utilize excess electricity for green solutions	Electricity to hydrogen/ ammonia

Source: Created by NRI based on interviews and publicly available sources

Renewable Energy (Philippines): Potential Value Proposition by Japanese Companies

Regarding the issues and needs of local companies, the potential value proposition by Japanese companies are the following.



Source: Created by NRI based on interviews and publicly available sources

Smart City (Philippines): Potential Value Proposition by Japanese Companies

Key issues for smart city development are regarding energy, security, and mobility in which Japanese solutions are available to help address the issues.

High added value | Cost Reduction

Category	Issues / Needs of Local Companies	Example of Value Proposition by Japanese Companies	
		Benefit	Technology
Energy	Lack of connectivity for smart grid technology	Able to monitor and utilize the data efficiently	Smart meter / smart grid
	Limited area and lack of safety monitoring system for large size battery for city supply	Smaller sized storage batteries for the smart city	Small-sized storage battery
	Difficult for individuals to install solar panel at the households	Lower the price for solar panel installation	Low price solar panel technology
	High initial investment for energy management in and IoT conversion	Lower the price for the installation of energy management	Low price energy management system
	Human errors from manual reporting system		
Security	Lack of natural disaster management system	Enhance the resilience towards natural disasters	Natural disaster prevention system
	Lack of responsive and automated security system	Automate the security system for real-time data usage	Real time security system
Mobility	Lack of connected transportation system and parking identify system for private driver	Automatic connected system for parking	Parking lot monitoring system

Source: Created by NRI based on interviews and publicly available sources

Renewable Energy (Laos): Potential Value Proposition by Japanese Companies

Wide range of issues and needs across power generation types, in which the Japanese companies' solutions can help address the issues.

High added value | Cost Reduction

Category	Issues / Needs of Local Companies	Example of Value Proposition by Japanese Companies	
		Benefit	Technology
Power Generation	Hydro: Instability based on seasonality		
	Solar: Instability based on lack of storage systems, given the high price of battery storage	Able to store the excess power during sunny period, in a cost efficient manner	Low price battery storage system
	Biomass: Instability based on fluctuation of raw material (sugarcane) availability	Increase the variety of biomass power generation materials	Alternative biomass power generation
	Hybrid (Hydro & Solar): Difficult to regulate, as hydro is mostly run-of river	Able to adjust the supply for hydro, by using reservoir	Hybrid using reservoir or pumped hydro
	Geothermal: Lack of understanding on feasibility and supply capacity	Able to evaluate the potential of geothermal power generation	Exploration of geothermal potential
Distribution / Transmission	Energy loss during transmission	Reduce loss during distribution transmission	Grid stabilizing system
	Limited volume for transmission	Increase the volume for transmission	
Retail	Can't fully utilize excess electricity as difficult to anticipate surplus energy		
	Development of new technology to utilize excess energy	Utilize excess electricity for green solutions	Electricity to hydrogen / ammonia

Source: Created by NRI based on interviews and publicly available sources

目次

Hydrogen / Ammonia (Malaysia) - Example of Business Model (Green Hydrogen Export)

Providing technology to support production and transportation will provide business opportunities for Japanese companies.

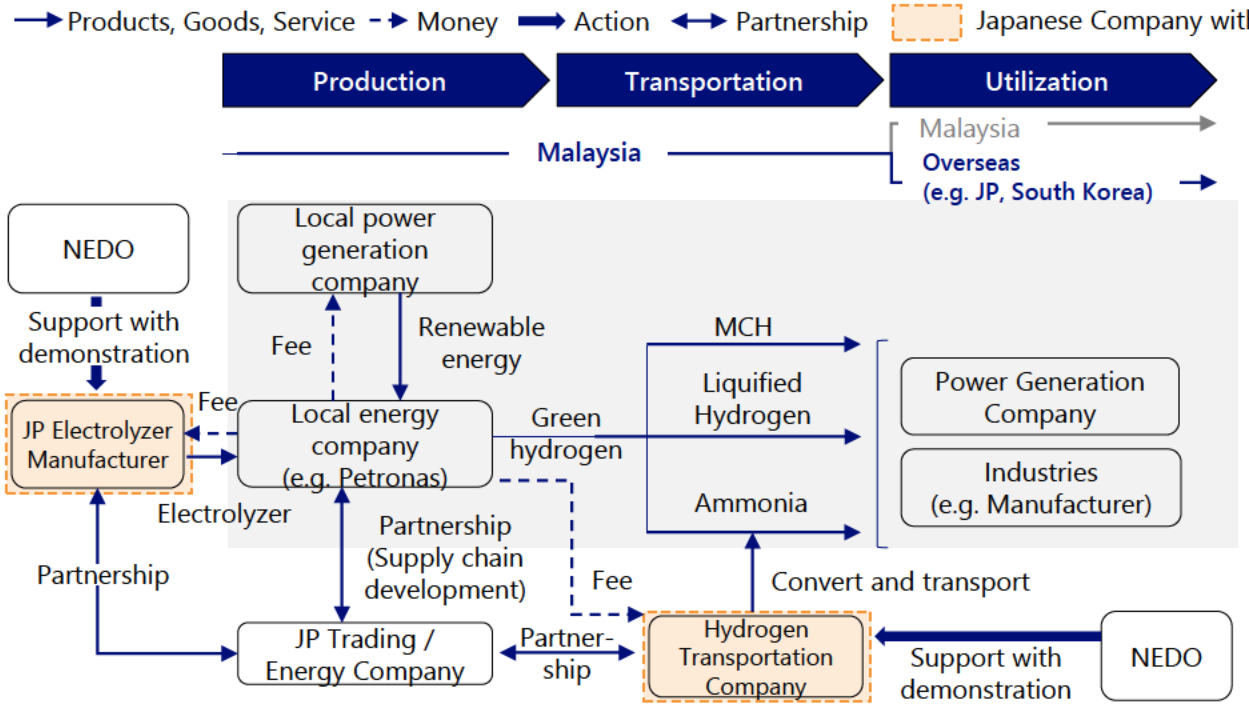
Local Company's Needs

- Malaysia aims to become a major exporter of ammonia / hydrogen, in which one of the drivers is expected to be the implementation of carbon tax and carbon credit in overseas countries (e.g. Japan, South Korea)
- To increase the amount of ammonia / hydrogen which can be exported overseas, local energy companies are aiming to receive technology which will enable efficient conversion from renewable energy to ammonia / hydrogen, as well as the technology for the transportation

Resource of Japanese Companies

- Electrolyzer manufacturer:
  - Provide electrolyzer for local energy companies, which enables the production of green hydrogen in a stable manner
- Hydrogen transportation company:
  - Provides energy carrier for safe and stable transportation
- Trading companies, energy companies
  - Support the development of overall supply chain from Malaysia to overseas companies as the business developer

Business Model (Domestic Production and Export of Green Hydrogen)



Item	Description
Product of JP Company with Technology	• Electrolyzer which helps produce green hydrogen in a stable manner • Energy carrier technology
Target Customer	• Local energy company (e.g. Petronas)
Partner	• Japanese trading company • Japanese energy company

Source: Created by NRI based on interviews and publicly available sources

Hydrogen / Ammonia (Indonesia) - Example of Business Model (Electrolyzer & Co-fire Power Generation)

Providing technology to support production and utilization of green hydrogen / ammonia will provide business opportunities for Japanese companies.

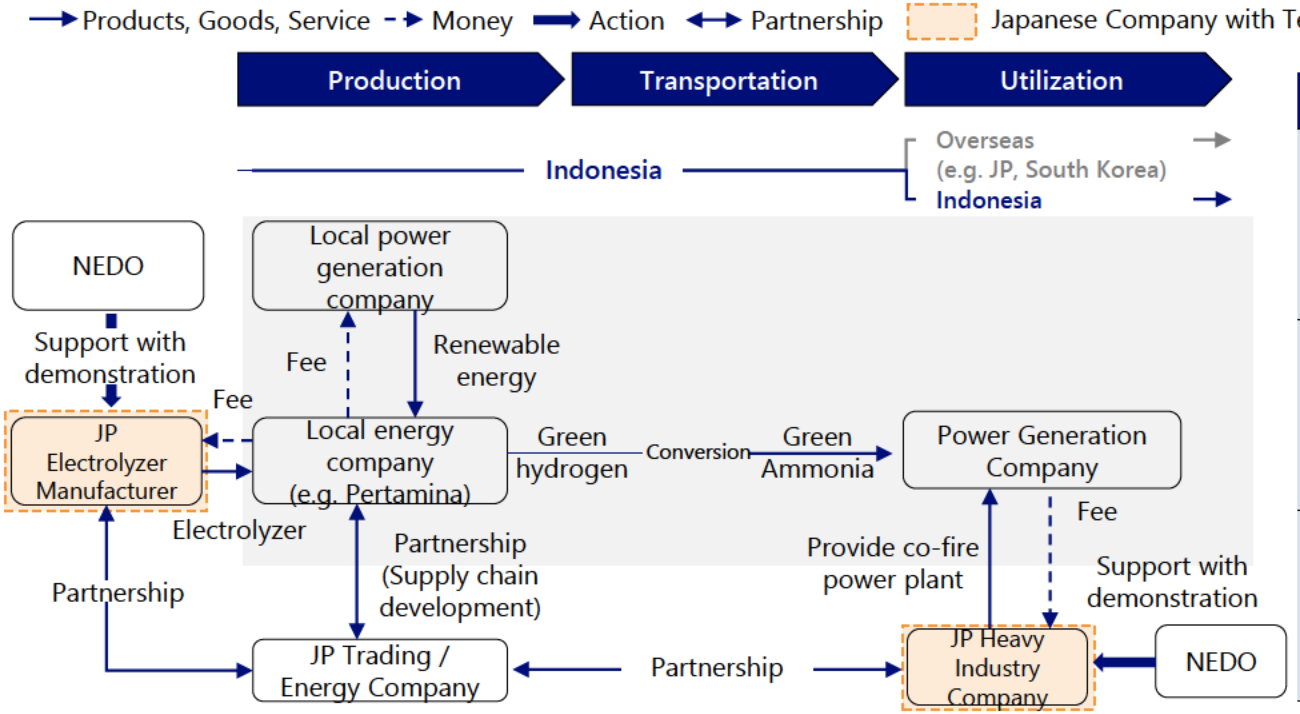
Local Company's Needs

- Indonesian energy companies aim to increase the supply of ammonia and hydrogen, to utilize the resources for CO2 reduction within the country
- For the supply of hydrogen and ammonia, one of the key requirements is technology to produce green hydrogen efficiently
- For the demand-side, technology to increase the amount of ammonia for co-fire power plants is required from overseas companies

Resource of Japanese Companies

- Electrolyzer manufacturer:
  - Provide electrolyzer for local energy companies, which enables the production of green hydrogen in a stable manner
- Heavy industry company
  - Provide the facility for ammonia co-fire power plant generation
- Trading companies, energy companies
  - Support the development of overall supply chain within Indonesia as the business developer

Business Model (Domestic Production and Domestic Utilization of Green Hydrogen / Ammonia)



Item	Description
Product of JP Company with Technology	• Electrolyzer which helps produce green hydrogen in a stable manner • Technology to develop co-fire power plant efficiently
Target Customer	• Electrolyzer: Local energy company such as Pertamina • Co-fire power plant: Power generation company
Partner	• Japanese trading company • Japanese energy company

Source: Created by NRI based on interviews and publicly available sources

CCS/CCUS (Malaysia) - Example of Business Model (Carbon Capture)

Providing CO2 capture in an energy and cost efficient manner to gas reservoirs, industries, and power generation will provide opportunities for JP companies.

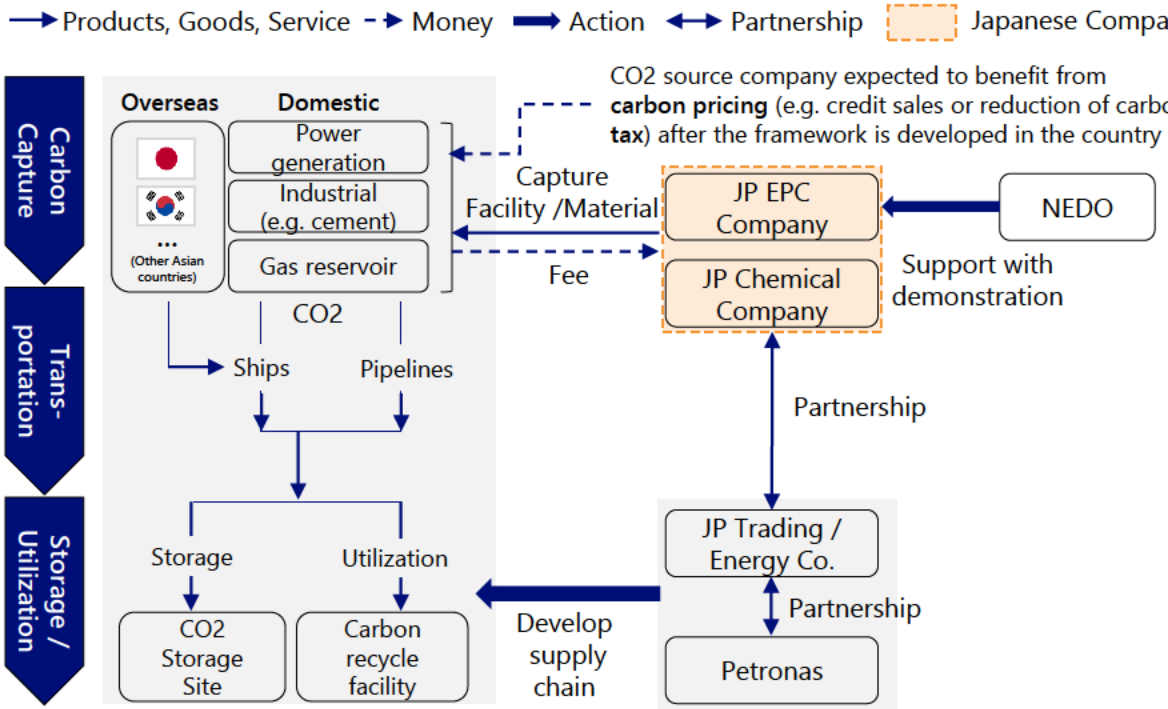
Local Company's Needs

- Malaysia aims to become a regional hub for CO2 storage in Asia, to function as a storage for both domestic and international CO2 sources
- For domestic CO2 sources, local companies require technology to capture carbon, in a cost and energy efficient manner
- Local companies are looking for partnership with overseas companies which has the above technology

Resource of Japanese Companies

- EPC company:
  - Provide carbon capture facility to the local companies
- Chemical company
  - Provide carbon capture materials to the local CO2 source company, which enables CO2 capture in an energy and cost efficient manner
- Trading companies, energy companies
  - Support the development of overall supply chain within Malaysia

Business Model (Carbon Capture Facility / Material)



Item	Description
Product of JP Company with Technology	• Carbon capture facility / material for CO2 source which enables CO2 capture in an energy and cost efficient manner
Target Customer	• Companies with CO2 emission such as; ◦ Power generation companies ◦ Industries which CO2 emission is hard to avoid (e.g. cement) ◦ Gas reservoirs
Partner	• Japanese trading company • Japanese energy company

Source: Created by NRI based on interviews and publicly available sources

CCS/CCUS (Thailand) - Example of Business Model (Carbon Capture)

Providing CO2 capture in an energy and cost efficient manner to industries and power generation companies will provide opportunities for JP companies.

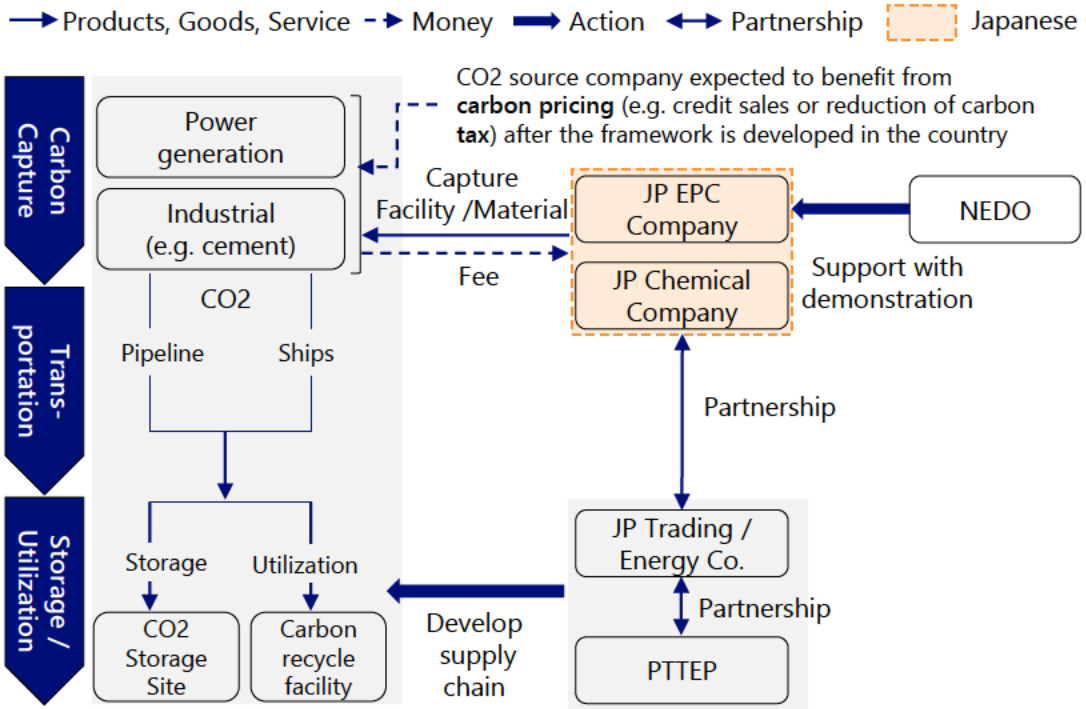
Local Company's Needs

- In Thailand, local energy companies and industry players are aiming to leverage CCS/CCUS across various industries, including fossil fuel power generation and industrial process (e.g. cement, chemicals)
- Within the supply chain, local companies require technology to capture carbon, in a cost and energy efficient manner
- Local companies are looking for partnership with overseas companies which has the above technology

Resource of Japanese Companies

- EPC company:
  - Provide carbon capture facility to the local companies
- Chemical company
  - Provide carbon capture materials to the local CO2 source company, which enables CO2 capture in an energy and cost efficient manner
- Trading companies, energy companies
  - Support the development of overall supply chain within Thailand

Business Model (Carbon Capture Facility / Material)



Item	Description
Product of JP Company with Technology	• Carbon capture facility / material for CO2 source which enables CO2 capture in an energy and cost efficient manner
Target Customer	• Companies with CO2 emission such as; ◦ Industries which CO2 emission is hard to avoid (e.g. cement) ◦ Power generation companies
Partner	• Japanese trading company • Japanese energy company

Source: Created by NRI based on interviews and publicly available sources

Renewable Energy (Indonesia) - Example of Business Model (Geothermal)

Solutions with technology to manage the power generation of renewable energy efficiently can develop opportunities for Japanese solution providers.

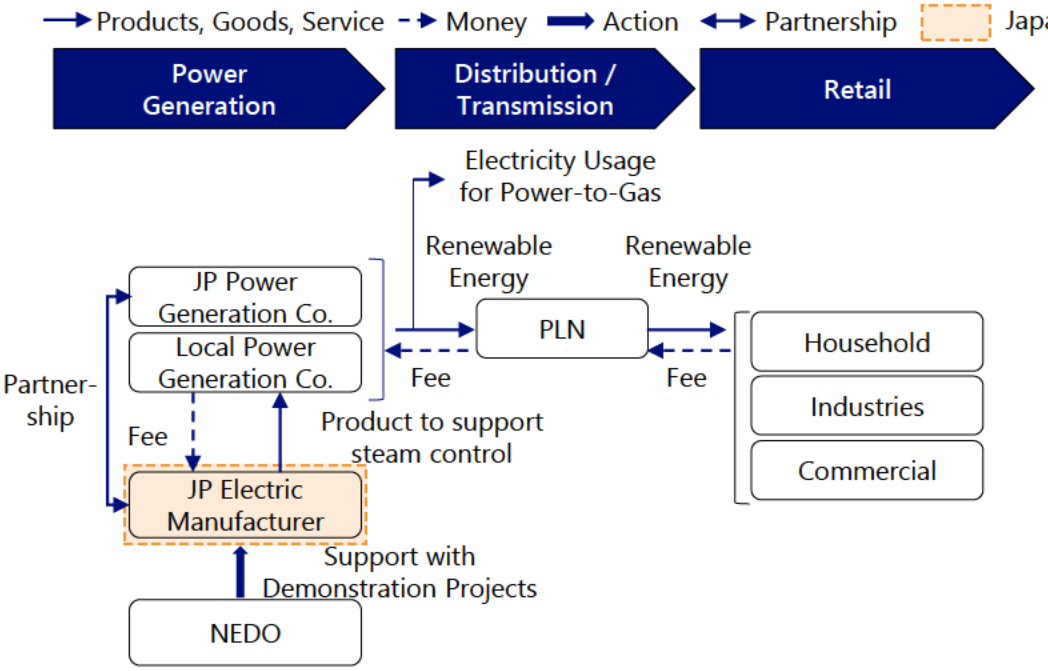
Local Company's Needs

- In Indonesia, power generation companies are aiming to increase the renewable energy power generation, for areas such as geothermal and solar power generation
- For geothermal power generation, one of the key issues is the stability, such as technology to control the amount of steam

Resource of Japanese Companies

- Electric manufacturer: Provide technology which supports with the control of steam for geothermal power generation
- Trading company: Invest in the power generation with local player, and support with the introduction of the Japanese solution provider

Business Model (Geothermal Power Generation)



Item	Description
Product of JP Company with Technology	• Steam control product (e.g. Intelligent steam control products which uses cloud and AI data to monitor the system efficiently)
Target Customer	• Local power generation company (e.g. IPP) which provides renewable energy power generation
Partner	• JP trading company

Source: Created by NRI based on interviews and publicly available sources

Renewable Energy (Philippines) - Example of Business Model (Wind Power)

Solutions with technology to manage the power generation of renewable energy efficiently can develop opportunities for Japanese solution providers.

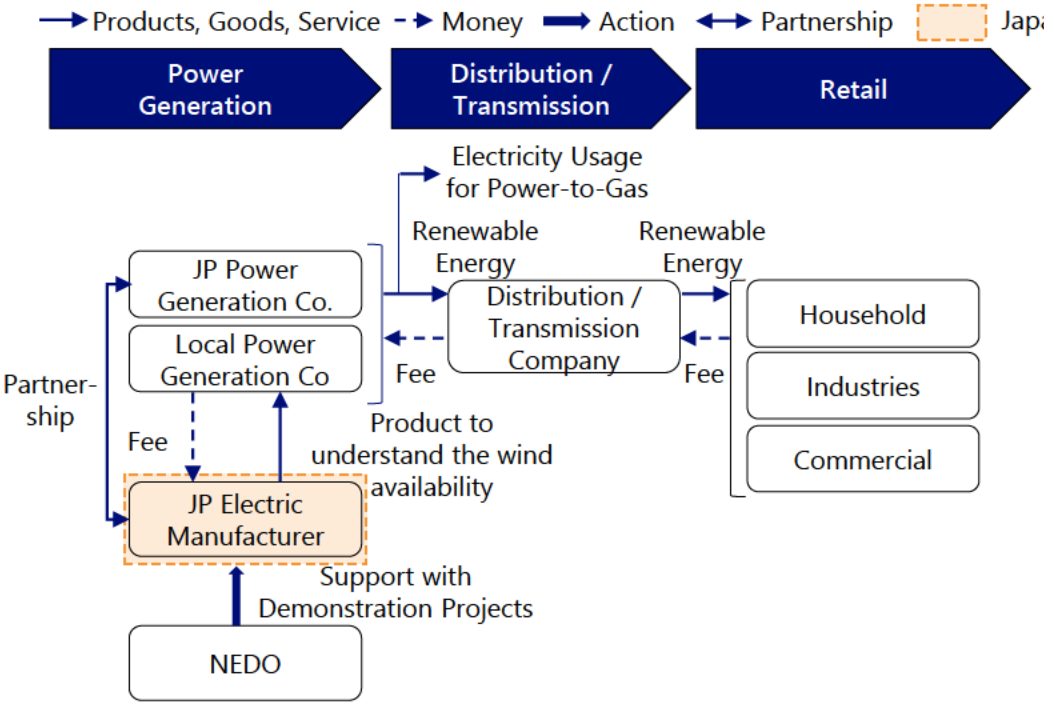
Local Company's Needs

- In the Philippines, power generation companies are aiming to increase renewable energy power generation such as solar power and wind power generation
- For wind power generation, one of the key issues is identifying the amount of wind available for power generation within specific areas

Resource of Japanese Companies

- Electric manufacturer: Provide technology which supports with the identification in terms of the amount of wind available
- Trading company: Invest in the power generation with local player, and support with the introduction of the Japanese solution provider

Business Model (Wind Power Generation)



Item	Description
Product of JP Company with Technology	• Product to understand the amount of wind available for wind power generation
Target Customer	• Local power generation company (e.g. IPP) which provides renewable energy power generation
Partner	• JP trading company

Source: Created by NRI based on interviews and publicly available sources

Renewable Energy (Vietnam) - Example of Business Model (Electrolyzer)

Solutions with technology to utilize the excess renewable energy efficiently will provide opportunities for Japanese companies.

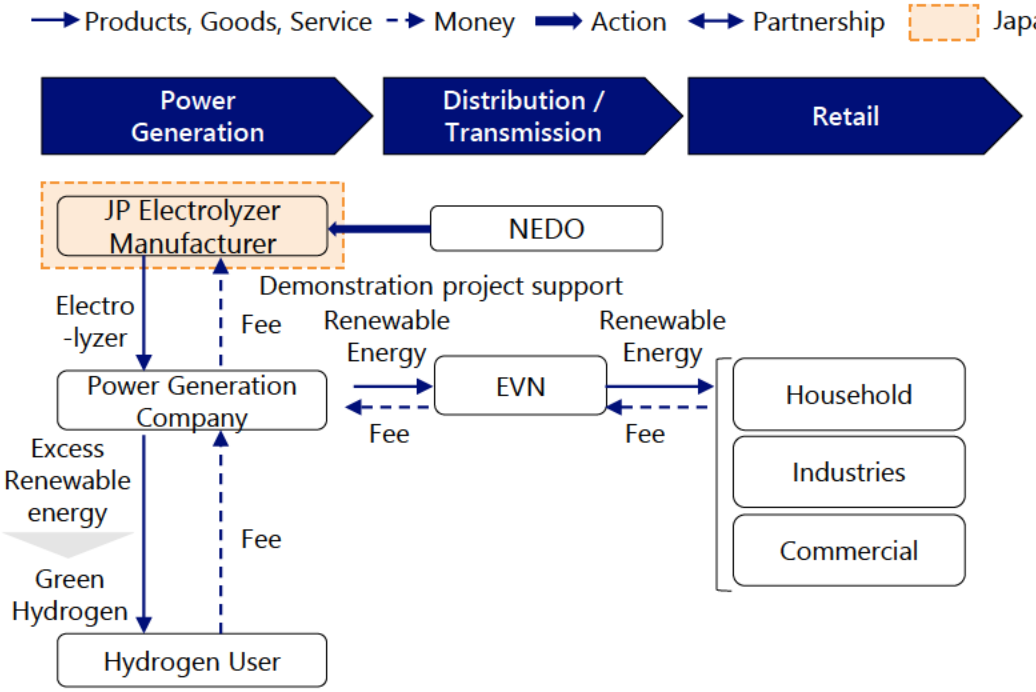
Local Company's Needs

- In Vietnam, renewable energy is aimed to be further implemented, in which availability of technology for the utilization of excess electricity generated from renewable energy is lacking
- Power generation companies are looking into technology which supports with the above, including technology which converts excess solar and wind power into green hydrogen

Resource of Japanese Companies

- Electrolyzer manufacturer: Provide electrolyzer which enables the conversion from renewable energy to green hydrogen

Business Model (Electrolyzer to Utilize Excess Electricity Effectively)



Item	Description
Product of JP Company with Technology	• Electrolyzer which helps produce green hydrogen in a stable manner
Target Customer	• Power generation company (e.g. EDL Gen)
Partner	• N/A

Source: Created by NRI based on interviews and publicly available sources

Renewable Energy (Laos) - Example of Business Model (Electrolyzer)

Solutions with technology to utilize the excess renewable energy efficiently will provide opportunities for Japanese companies.

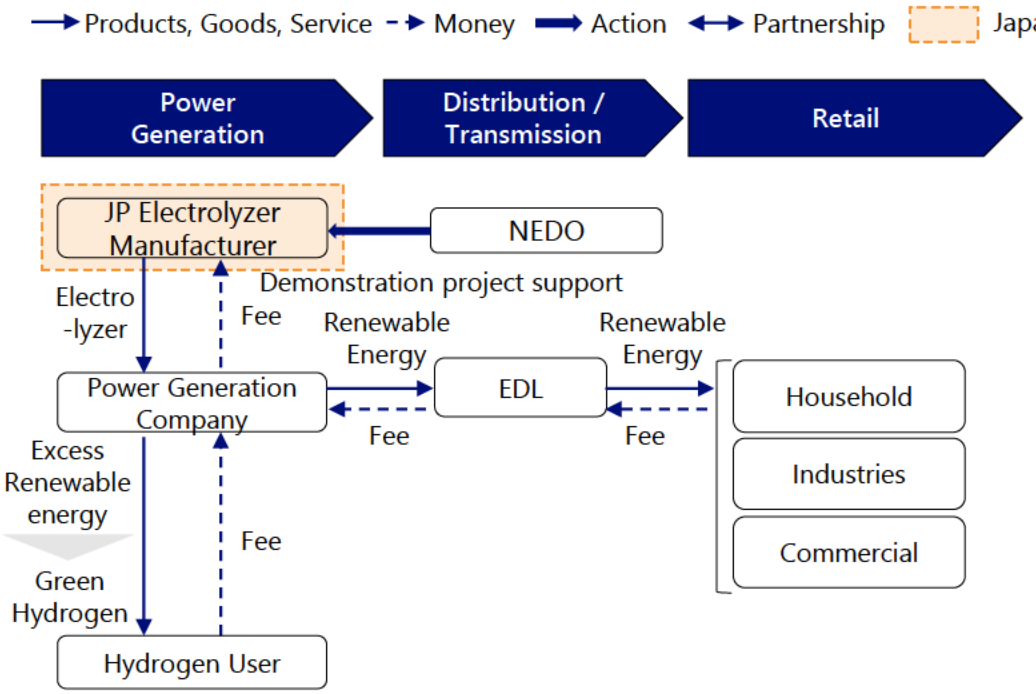
Local Company's Needs

- In Laos, the country has a large amount of renewable energy power generation capacity, in which availability of technology for the utilization of excess electricity generated from renewable energy is lacking
- Power generation companies are looking into technology which supports with the above, including technology which converts excess hydro power generation into green hydrogen

Resource of Japanese Companies

- Electrolyzer manufacturer: Provide electrolyzer which enables the conversion from renewable energy to green hydrogen

Business Model (Electrolyzer to Utilize Excess Electricity Effectively)



Item	Description
Product of JP Company with Technology	• Electrolyzer which helps produce green hydrogen in a stable manner
Target Customer	• Power generation company (e.g. EVN)
Partner	• N/A

Source: Created by NRI based on interviews and publicly available sources

Smart City (Philippines) - Example of Business Model (Mobility)

Providing solutions which supports with transportation issues may support the business development of Japanese companies.

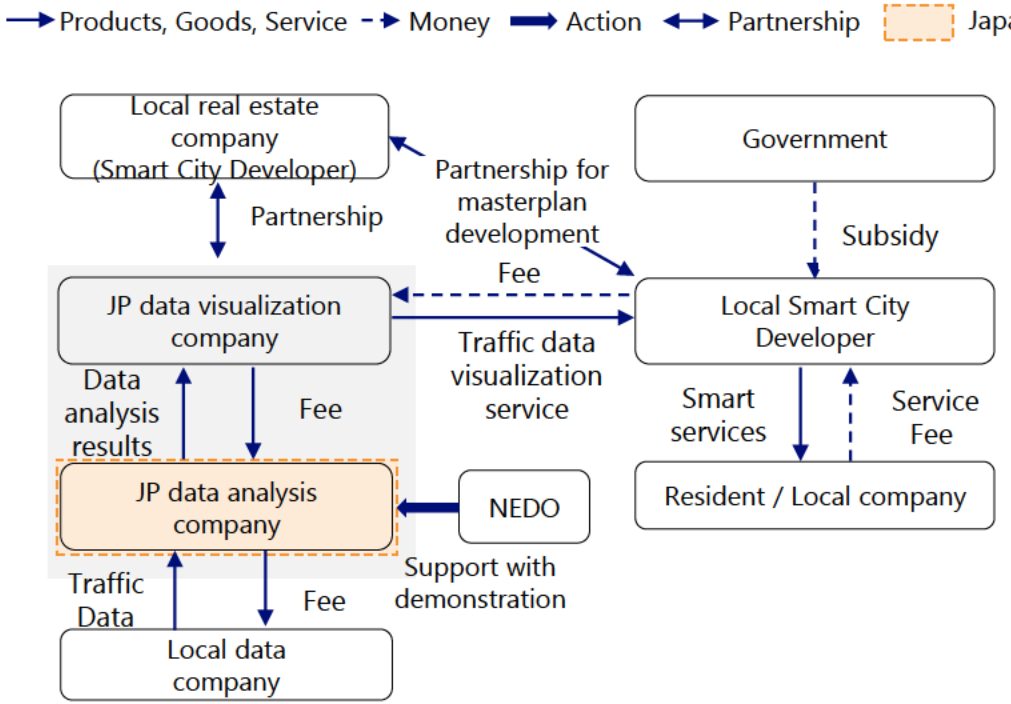
Local Company's Needs

- In the Philippines, smart city development is currently conducted by key players including real estate developers, in which key issues which need to be resolved are security, mobility, and energy efficiency
- Major players are aiming to develop smart solutions, which enables not only the wellbeing of the citizens but also to address issues regarding green and carbon neutrality

Resource of Japanese Companies

- Data analysis company:
  - Collects and analyzes the traffic data from local data company
- Data visualization company:
  - Utilizes the data and provides data visualization service for the residents (e.g. Provide suggestion on how to avoid the traffic congestion)

Business Model (Mobility Service for Smart Cities)



Item	Description
Product of JP Company with Technology	• Visualization services which supports resolving traffic congestion issues (e.g. GIS system which visualizes the amount of road traffic)
Target Customer	• Local smart city developer
Partner	• Mobility solution provider

Source: Created by NRI based on interviews and publicly available sources

Green Building (Thailand) - Example of Business Model (Energy Management)

Providing solutions which supports with energy saving / energy management may support the business development of Japanese companies.

Local Company's Needs

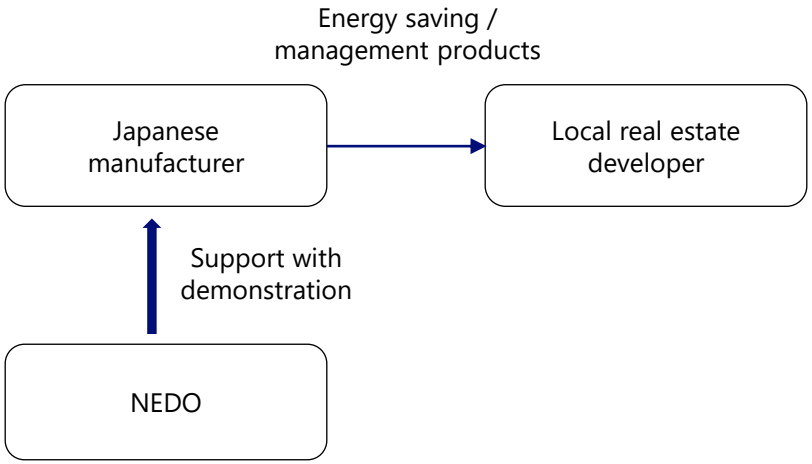
- In Thailand, many major real estate developers have set targets for the environment including GHG reduction and carbon neutrality
- To achieve the target, current technology is not sufficient, and hence local developers are looking into technology providers for GHG reduction
- Within the areas, energy saving and energy management are one of the core areas for the local company's needs

Resource of Japanese Companies

- Company which provides energy saving (e.g. air conditioners) and energy management products

Business Model (Energy Saving & Energy Management)

→ Products, Goods, Service - → Money ➡ Action ↔ Partnership ▭ Japanese Company with Technology



Item	Description
Product of JP Company with Technology	• Energy saving products (e.g. Air conditioners) • Energy management products (e.g. IoT equipped equipment devices and equipment, energy management software)
Target Customer	• Local developers which has interest in carbon neutral or GHG reduction
Partner	• N/A

Source: Created by NRI based on interviews and publicly available sources

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CCS / CCUS (Malaysia): Potential Value Proposition by Japanese Companies

Japanese technology can help address the issues regarding the cost and energy efficiency for CCS / CCUS, which are major issues for local companies.

High added value | Cost Reduction

Category	Issues / Needs of Local Companies	Example of Value Proposition by Japanese Companies	
		Benefit	Technology
Capture	Large amount of energy is required during the CO2 capture	Reduce energy during CO2 capture in emission source	Energy saving CO2 capture system
	CO2 capture cost is high	Reduce cost during capture in CO2 emission source	Low-cost CO2 capture system
Transportation	Economic efficiency of the vessels low	Increase efficiency in cross-border / domestic transportation	Multi-purpose vessels (e.g. Carry ammonia and LCO2)
	GHG emission during transportation	Reduce GHG emission in cross-border / domestic transportation	Clean energy fueled vessels (e.g. ammonia-fueled)
Storage	Safety and security of storage sites	Reduce the risk of leakage of CO2 when storing CO2 for long period	Storage and monitoring system for safe storage
Utilization	Cost reduction for carbon recycle		
	Adding value to the product manufactured	Has value added other than low GHG emission during production	Value-added carbon recycle products

Source: Created by NRI based on interviews and publicly available sources

CCS / CCUS (Malaysia): Example of Technology by Japanese Companies

Example of technologies provided by Japanese companies are the following.

Category	Overview of Technology	Solutions by Japanese Companies	
		Company Name	Description of Technology
Capture	Energy saving CO2 capture system	Nippon Steel Engineering	Energy saving carbon capture for industrial process using chemical absorption
		Kawasaki Heavy Industry & KEPCO	Energy saving carbon capture in power generation facility using solid absorption
	Low cost CO2 Capture System	Mitsubishi Heavy Industries	Lowered cost carbon capture in power generation facilities by utilizing small sized compressors (to reduce CAPEX) and automation / AI technology (to reduce OPEX)
		Chiyoda Corporation	Lowered cost carbon capture in power generation facilities
Trans-portation	Multi-purpose vessels	Mitsubishi Shipbuilding	Efficient transportation method by being able to carry both ammonia and LCO2
		Mitsui O.S.K Lines (MOL)	Efficient transportation method by being able to carry both ammonia and LCO2
	Clean energy fueled vessels	NYK Line	Lower GHG emission transportation by “ammonia-ready” (=able to use ammonia as fuel in the future) LNG fueled vessels
		Mitsui O.S.K Lines (MOL)	Lower GHG emission transportation by large scaled ammonia fuel vessel
		Kawasaki Kisen	Lower GHG emission transportation by ammonia fuel vessel
Storage	Monitoring and system for long-term storage	JGC	Construction of storage facility which enables stable long-term storage
		INPEX	Safe storage technology for large-scaled CO2 stored
Utilization	Value-added products	Chiyoda	CO2 reforming technology which enables manufacturing of gas in a energy efficient manner, using CO2 as an ingredient
		Mitsubishi Heavy Industries	CO2 reforming technology “electrofuel” which enables CO2 reduction when using the fuel as well

Source: Created by NRI based on news articles, METI, and company websites of Nippon Steel, KEPCO, MHI, RITE, MHI, MOL, NYK Line, JGC, INPEX, Chiyoda Corporation

Ammonia / Hydrogen (Malaysia): Potential Value Proposition by Japanese Companies

When developing green and blue ammonia / hydrogen, technological issues remain, in which Japanese technological solutions can support local companies.

High added value | Cost Reduction

Category	Issues / Needs of Local Companies	Example of Value Proposition by Japanese Companies: Benefit	Example of Value Proposition by Japanese Companies: Technology
Production	Enhancing efficiency and durability of electrolyzer (green ammonia / hydrogen)	Increase efficiency while maintaining reliability	Advanced electrolyzer technology
	High cost due to fluctuation of renewable energy (green ammonia / hydrogen)	Lower cost of production by efficiently utilizing RE	Hydrogen energy management system
	Gaining technology to control the CO2 emission (blue ammonia / hydrogen)	⇒**Refer to the business models in CCS / CCUS**	
Transportation/ Storage	Lack of specialized transportation vessels (ammonia / hydrogen)	Provide safe and efficient transportation	Specialized transportation vessels
	Development of transportation terminal (ammonia / hydrogen)	Increase the capacity for export / import of hydrogen / ammonia	Port terminal for ammonia / hydrogen
	Development of technology for safe large scale storage (ammonia / hydrogen)	Increase the safety of ammonia / hydrogen storage	High safety large scale storage tanks
Utilization	Increasing the amount which can be used for co-firing (ammonia / hydrogen)	Enable co-firing with higher % of ammonia / hydrogen	Ammonia / hydrogen co-firing
	Reducing the Nox from emission (ammonia)	Reduce the amount of Nox generated from ammonia	Ammonia(NH3) Removal Catalyst
	Reducing the cost for power generation utilization (ammonia/ hydrogen)		

Source: Created by NRI based on interviews and publicly available sources

Ammonia / Hydrogen (Malaysia): Example of Technology by Japanese Companies

Example of technologies provided by Japanese companies are the following.

Category	Overview of Technology	Solutions by Japanese Companies	
		Company Name	Description of Technology
Production	Advanced electrolyzer technology	Asahi Kasei	Large-scaled alkaline water electrolyzer “Aqualyzer”, which has high capability to adjust to fluctuation of power (Participated in over 150 projects and delivered total of 10GW worth of electrolyzers)
		Toshiba	PEM electrolyzer for converting renewable energy into green hydrogen, which has high capability to adjust to fluctuation of power
	Hydrogen Energy Management System	• ENEOS • Hokkaido Electric • JFE Engineering	Next-generation water electrolysis energy management system which seeks to reduce the cost of producing hydrogen by effectively using excess electricity from renewable energy
Trans-portation / Storage	Specialized transportation Vessels for ammonia / hydrogen	Mitsui O.S.K Lines (MOL)	Ammonia transportation vessels, such as a 35,000 cbm-type ammonia /LPG carrier
		Kawasaki Heavy Industries	Liquefied hydrogen carrier which is planned to be used to develop hydrogen supply chain
	Port terminal for ammonia / hydrogen	Kawasaki Heavy Industries	Terminal for liquified hydrogen which uses technology such as “loading arm system,” which is planned to be used to develop hydrogen supply chain
		IHI	Large scaled terminal which enables a large amount of ammonia to be imported into the country from overseas
	High safety large scale storage tanks	Kawasaki Heavy Industries	Storage system for liquified hydrogen, which is planned to be used to develop hydrogen supply chain
		Toyo Kanetsu	"Large-scale liquefied hydrogen storage tank" and "Ammonia storage tank" in order to reduce CO_2 emissions amid the urgent need to switch to next-generation energy with low environmental impact.
Utilization	Ammonia / hydrogen co-firing	IHI	Aiming to achieve the percentage of ammonia co-fired power generation to 20% by 2023
		Mitsubishi Heavy Industries	Aiming to increase the percentage of ammonia co-fired power generation to 50% by 2028
	Ammonia(NH3) Removal Catalyst	Nikki Universal	Ammonia removal catalysts that suppress the generation of these byproducts of NOx and N2O.

Source: Created by NRI based on news articles and company websites of Asahi Kasei, Toshiba, ENEOS, MOL, Sumitomo Corporation, Kawasaki Heavy Industries, IHI, Toyo Kanetsu, MHI, and Nikki Universal

CCS / CCUS (Thailand): Potential Value Proposition by Japanese Companies

Japanese technology can help address the issues regarding the cost and energy efficiency for CCS / CCUS, which are major issues for local companies.

High added value | Cost Reduction

Category	Issues / Needs of Local Companies	Example of Value Proposition by Japanese Companies	
		Benefit	Technology
Capture	Large amount of energy required	Reduce energy during capture in CO2 emission source	Energy saving CO2 capture system
	High CO2 capture cost	Reduce cost during capture in CO2 emission source	Low-cost CO2 capture system
	CO2 source has impurities apart from CO2	Remove impurities efficiently	High impurities removal technology
Transportation	Economic efficiency of the vessels low	Increase efficiency in transportation	Multi-purpose vessels (e.g. ammonia+LCO2)
	Safety of the pipeline transportation	Increase the safety level for pipeline	Durable materials to prevent leakage
Storage	Safety of the storage system	Reduce the risk of leakage of CO2 when storing CO2 for long period	Storage and monitoring system for safe storage
	Ensuring a stable monitoring system		
Utilization	Cost reduction for carbon recycle		
	Energy required during the production process	Reduce the amount of CO2 required during carbon recycle	Low CO2 carbon recycle

Source: Created by NRI based on interviews and publicly available sources

CCS / CCUS (Thailand): Example of Technology by Japanese Companies

Example of technologies provided by Japanese companies are the following.

Category	Overview of Technology	Solutions by Japanese Companies	
		Company Name	Description of Technology
Capture	Energy saving CO2 capture system	Nippon Steel Engineering	Energy saving carbon capture for industrial process using chemical absorption
		Kawasaki Heavy Industry & KEPCO	Energy saving carbon capture in power generation facility using solid absorption
	Low cost CO2 Capture System	Mitsubishi Heavy Industries	Lowered cost carbon capture in power generation facilities by utilizing small sized compressors (to reduce CAPEX) and automation / AI technology (to reduce OPEX)
		Chiyoda Corporation	Lowered cost carbon capture in power generation facilities
	High impurities removal technology	Nippon Steel Engineering	Energy saving carbon capture for industrial process using chemical absorption, which can collect CO2 from gas which has high proportion of impurities
		Mitsubishi Heavy Industries	Able to capture CO2 from gas with high amount of impurities efficiently, from industries such as steel manufacturing and waste burning
Trans-portation	Multi-purpose vessels	Mitsubishi Shipbuilding	Efficient transportation method by being able to carry both ammonia and LCO2
		Mitsui O.S.K	Efficient transportation method by being able to carry both ammonia and LCO2
	Strong materials to prevent CO2 leakage (pipeline)	Nippon Steel	Seamless steel pipes which was primarily used for oil reservoirs, which has high durability in deep underground areas
Storage	Storage and monitoring system for safe storage	JGC	Construction of storage facility which enables stable long-term storage
		INPEX	Safe storage technology for large-scaled CO2 stored
Utilization	Low energy carbon recycle	Toyo Engineering	Make chemical products from methanol, which can be made from the CO2 captured during CCUS, and hydrogen which comes from renewable energy, which uses reduced amount of energy during the process
		Asahi Kasei	Make polycarbonate using CO2 as an ingredient, in which the amount of energy required during the process is reduced

Source: Created by NRI based on news articles, METI, and company websites of Nippon Steel, KEPCO, MHI, RITE, MHI, MOL, JGC, INPEX, Chiyoda Corporation

Green manufacturing (Thailand): Potential Value Proposition by Japanese Companies

Implementation of energy management and energy saving solutions still remain a key issue, in which Japanese technologies can support with the issues.

High added value | Cost Reduction

Category	Issues / Needs of Local Companies	Example of Value Proposition by Japanese Companies	
		Benefit	Technology
Energy Management	Making equipment IoT ready	Make the equipment IoT ready	IoT ready machine / equipment
	Utilizing cloud system which can collect data in a structured manner	Visualize the energy utilized, to optimize the energy usage	Energy management system
	Implementation of AI technology to analyse the data collected		
	Integrating data in different divisions		
Energy saving	Robotics with more durability	Enable robotics with higher durability	High durability robotics
	Usage of equipment with lower energy consumption	Reduces the energy consumed	Energy saving compressors
Green energy	High initial investment cost for renewable energy (e.g. solar)	Reduces the cost of initial investment	Low cost solar power
	Instability of battery technology	Stabilizes the storage battery	Storage battery
	High cost of storage battery	Reduces the cost required for storage battery	
	Lack of technology for usage of hydrogen in factory	Enables the usage of hydrogen in factory	Hydrogen power generation

Source: Created by NRI based on interviews and publicly available sources

Green manufacturing (Thailand): Example of Technology by Japanese Companies

Example of technologies provided by Japanese companies are the following.

Category	Overview of Technology	Solutions by Japanese Companies	
		Company Name	Description of Technology
Energy management	IoT ready machine / equipment	Panasonic	HD-PLC solutions, which build network for equipment management from existing power lines
		Mitsubishi Electric	Programmable controller to connects equipment to network for data management and optimization
	Energy management system	Yokogawa Electric	Factory energy management system that collect and accumulate data, analyze data for further improvement, optimize operation patterns and energy consumption, and execute the control device
		Panasonic	Energy management that can reduce energy, optimally manage locally generated and stored energy. Panasonic also helps monitor these equipment from remote locations
Energy saving	High durability robotics	Fujitsu	Automatic machines to deal with fluctuations in demand and labor shortages with post-implementation and operational support
		Mitsubishi Electric System & Service	Construction and operation industrial robot systems with aftersales service
	Energy saving compressors	Enetech	Energy saving compressors
		Hitachi Industrial Equipment Systems	Energy saving compressors
		KDDI	Energy saving compressors
Green energy	Low cost solar power	Panasonic	Industrial PV power generation system
	Storage battery	Marubeni Eneble	Industrial large lithium-ion storage battery that can secure a stable power supply
		Eneman	High performance off-grid battery system that can ensure stable supply
	Hydrogen power generation	MHI	Hydrogen manufacturing and gas power generation facility which enables the usage of hydrogen for fuel
		Air Water Plant & Engineering	Hydrogen gas generator for on-site gas supply to manufacturers of optical fibers, steel, solar batteries cells, etc.

Source: Created by NRI based on news articles and company websites of Panasonic, Mitsubishi Electric, Yokogawa Electric, Fujitsu, Enetech, Hitachi, KDDI, Marubeni Eneble, Eneman, MHI, Air Water Plant & Engineering

Green Building (Thailand): Potential Value Proposition by Japanese Companies

Implementation of energy management and energy saving solutions still remain a key issue, in which Japanese technologies can support with the issues.

High added value | Cost Reduction

Category	Issues / Needs of Local Companies	Example of Value Proposition by Japanese Companies	
		Benefit	Technology
Energy Saving / Energy Management	Lack of IoT equipped equipment	Connect the devices and equipment to utilize the data efficiently	IoT Systems
	Limited choice of energy management systems (e.g. usage of AI for analysis)	Optimize the energy usage, by understanding how the energy is used	Energy management system
	Energy control and management is not centralized		
Green Energy	Battery storage too expensive to install for solar power generation	Reduce the cost to install battery storage	Low cost battery storage system
	Wind turbine too expensive to install		
Green Materials	Limited amount of certified green materials	Reduce the GHG emission reduction within scope 3	Certified materials for GHG reduction

Source: Created by NRI based on interviews and publicly available sources

Green Building (Thailand): Example of Technology by Japanese Companies

Example of technologies provided by Japanese companies are the following.

Category	Overview of Technology	Solutions by Japanese Companies	
		Company Name	Description of Technology
Energy Saving / Energy Management	IoT equipped machines	Mitsubishi Electric	Provides IoT platform and IoT ready devices to connect the devices to the cloud system
		Panasonic	Provides IoT platform and IoT ready devices to connect the devices to the cloud system
	Energy Management System	Hitachi	Provides energy management system for the building to monitor, analyze, control, and report the energy utilized for improvement
		Mitsubishi Electric	Provides energy management system to save energy, improve the comfort of the building tenant, and improve the value of the property.
Green Energy	Low cost battery storage system	Next Energy	Provides storage battery for power generated in the building, in which the storage is set as one unit, resulting in enabling lower cost
		Idemitsu Energy Solution	Provides storage battery for power generated in the building, utilizing lead-acid as a material, which helps with the cost reduction.
Green Material	Certified materials for GHG reduction	JFE Steel	Provides concrete which has reduced CO2 during production process by 75%
		Takenaka	Provides cement which has reduced CO2 during production process by 60%

Source: Created by NRI based on news articles and company webpages of Mitsubishi Electric, Panasonic, Hitachi, Next Energy, Idemitsu, JFE Steel, Takenaka

Renewable Energy (Indonesia): Potential Value Proposition by Japanese Companies

Issues for renewable energy differ across the power generation type, in which Japanese solutions can support with addressing the issues.

High added value | Cost Reduction

Category	Issues / Needs of Local Companies	Example of Value Proposition by Japanese Companies: Benefit	Example of Value Proposition by Japanese Companies: Technology
Power Generation	Geothermal: High investment cost for exploration drilling	Lower the investment cost required for exploratory drilling	Low cost drilling technology
	Solar: High cost of energy storage	Lower investment cost for energy storage	Low cost storage battery
	Lack of know-how for waste management regarding the renewable energy equipment	Circular model for waste coming from the equipment	Recycling system for equipment
	Solar module technology of local company is low (Needs to have 40% local products)	Provide advanced technology for solar power generation	Solar power module technology
Distribution / Transmission	Electricity loss during distribution/transmission	Stabilizes the grid for distribution / transmission	Grid stabilization system
	Instability for grid, especially for low voltage		
Retail	Development of new technology to utilize excess energy	Utilize excess electricity for green solutions	Electricity to hydrogen / ammonia

Source: Created by NRI based on interviews and publicly available sources

Renewable Energy (Indonesia): Example of Technology by Japanese Companies

Example of technologies provided by Japanese companies are the following.

Category	Overview of Technology	Solutions by Japanese Companies	
		Company Name	Description of Technology
Power Generation	Low cost drilling technology	Mitsubishi Material	Cutter for drilling the ground using "polycrystalline diamond compact" which enables cheaper and faster drilling when developing the geothermal power plants.
		INPEX Drilling	Prevents lost circulation when drilling to reduce the cost and risks when drilling to develop geothermal plants.
	Low cost storage battery	Mitsubishi Electric, Obayashi, GS Yuasa	Low cost storage battery system, which reduced the initial and running cost by optimizing the capacity in the facility
		NGK	A megawatt-level energy storage system that uses sodium and sulfur, which is large scaled and cost competitive compared to other storage batteries
	Recycling technology for equipment	Next Energy	Uses recycling / reuse technology and purchase unnecessary used modules, identify and sell only reliable
		Marubeni	Provide an information sharing platform utilizing blockchain, to efficiently collect used solar panels and reuse/recycle efficiently.
	Solar power module technology	Nagase	Solar power module production technology
		Next Energy & Resource	Solar power module production technology
Distribution/ Transmission	Grid stabilization system	Hitachi	Stabilize the power grid utilizing the technology "OpenVQ" system, resulting in reduction of power loss and increasing the power distribution capacity
		Mitsubishi Electric	Stabilize the power grid, to maintain the quality of the power grid operation.
Retail	Electricity to hydrogen / ammonia	Hitachi Zosen	Produce hydrogen from excess electricity and water
		Toshiba	Produce hydrogen from excess electricity and water

Source: Created by NRI based on news articles and company webpages of Mitsubishi Material, INPEX, Mitsubishi Electric, NGK, Next Energy, Marubeni, Nagase, Hitachi, Hitachi Zosen, Toshiba

Ammonia / Hydrogen (Indonesia): Potential Value Proposition by Japanese Companies

When developing green and blue ammonia / hydrogen, technological issues remain, in which Japanese technological solutions can support local companies.

High added value | Cost Reduction

Category	Issues / Needs of Local Companies	Example of Value Proposition by Japanese Companies	
		Benefit	Technology
Production	Low stability due to fluctuation of renewable energy (Green ammonia / hydrogen)	Stabilize the production when using renewable energy	Advanced PEM electrolyzer technology
	High cost due to fluctuation of renewable energy (green ammonia / hydrogen)		
	Requires large amount of energy for Harber-Bosh process (ammonia)	Reduce the amount of energy required to manufacture ammonia	New ammonia manufacturing process
Transportation/ Storage	Lack of specialized transportation vessels (ammonia / hydrogen)	Provide safe and efficient transportation	Specialized transportation vessels
	Requires large amount of energy for conversion from ammonia to hydrogen	Reduce the amount of energy required for conversion	Photocatalytic reactors
	Development of technology for safe storage (ammonia / hydrogen)	Increase the safety of ammonia / hydrogen storage	High safety storage tanks
Utilization	Increasing the amount which can be used for co-firing (ammonia / hydrogen)	Enable co-firing with higher % of ammonia / hydrogen	Ammonia / hydrogen co-firing
	Improving the performance when using hydrogen for gas-turbines	Maintain performance when utilizing hydrogen	Combustion technology with high adaption
	Reducing the Nox from emission (ammonia)	Reduce the amount of Nox generated from ammonia	Ammonia(NH3) Removal Catalyst
	Need to develop infrastructure for industrial (e.g. steel) and FCV usage	Enable usage in steel manufacturing process	Steel production facility with ammonia usage

Source: Created by NRI based on interviews and publicly available sources

Ammonia / Hydrogen (Indonesia): Example of Technology by Japanese Companies

Example of technologies provided by Japanese companies are the following.

Category	Overview of Technology	Solutions by Japanese Companies	
		Company Name	Description of Technology
Production	Advanced electrolyzer technology	Asahi Kasei	Large-scaled alkaline water electrolyzer “Aqualyzer”, which has high capability to adjust to fluctuation of power (Participated in over 150 projects and delivered total of 10GW worth of electrolyzers)
		Toshiba	PEM electrolyzer for converting renewable energy into green hydrogen, which has high capability to adjust to fluctuation of power
	New ammonia manufacturing process	JGC	Developed a new ammonia synthesis catalyst that is highly active at low temperature and pressure; and reduces the energy consumption
Trans-Portation / Storage	Specialized transportation Vessels for ammonia / hydrogen	Mitsui O.S.K Lines	Ammonia transportation vessels, such as a 35,000 cbm-type ammonia /LPG carrier
		Kawasaki Heavy Industries	Liquefied hydrogen carrier which is planned to be used to develop hydrogen supply chain
	Photocatalytic reactors	Sumitomo Corporation	Produces hydrogen with lower energy, lower cost and higher efficiency than ordinary pyrolysis.
	High safety storage tanks	Kawasaki Heavy Industries	Storage system for liquified hydrogen, which is planned to be used to develop hydrogen supply chain
		Toyo Kanetsu	"Large-scale liquefied hydrogen storage tank" and "Ammonia storage tank" in order to reduce CO_2 emissions amid the urgent need to switch to next-generation energy with low environmental impact.
Utilization	Ammonia / hydrogen co-firing	IHI	Aiming to achieve the percentage of ammonia co-fired power generation to 20% by 2023
		Mitsubishi Heavy Industries	Aiming to increase the percentage of ammonia co-fired power generation to 50% by 2028
	Combustion technology with high adaption	Kawasaki	Enables the existing natural gas turbine to be utilized without modification to its main body, and the whole turbine system to be capable of adapting to the hydrogen's unique combustion property.
		MHI	Enables co-firing of hydrogen and gas in a sustainable manner
	Ammonia(NH3) Removal Catalyst	Nikki Universal	Ammonia removal catalysts that suppress the generation of these byproducts of NOx and N2O.
	Steel production facility with ammonia usage	Nippon Steel	Enables to utilize hydrogen in the production process while enabling an efficient steel manufacturing

Source: Created by NRI based on news articles and company webpages of Asahi Kasei, Toshiba, JGC, MOL, Sumitomo Corporation, Kawasaki Heavy Industries, Toyo Kanetsu, IHI, MHI, Nikki Universal, Nippon Steel

Renewable Energy (Vietnam): Potential Value Proposition by Japanese Companies

Issues for renewable energy differ across the power generation type, in which Japanese solutions can support with addressing the issues.

High added value | Cost Reduction

Category	Issues / Needs of Local Companies	Example of Value Proposition by Japanese Companies	
		Benefit	Technology
Power Generation	(Waste-to-energy) Difficult to secure materials sufficiently	Able to secure raw materials more efficiently	Regionally independent system
	High investment cost for storage battery	Lower investment cost for energy storage	Low cost storage battery
	(Solar) Instability of power generation		
	(Wind) Instability of power generation, without hybrid with other types (e.g. hydro)		
	Lack of know-how for pumped storage hydro power	Able to adjust the supply for hydro	Pumped hydro power generation
Distribution	Increasing the capacity of transmission line:	Increase the volume for transmission	Grid stabilizing system
Retail	Development of new technology to utilize excess energy	Utilize excess electricity for green solutions	Electricity to hydrogen/ ammonia

Source: Created by NRI based on interviews and publicly available sources

Renewable Energy (Vietnam): Example of Technology by Japanese Companies

Example of technologies provided by Japanese companies are the following.

Category	Overview of Technology	Solutions by Japanese Companies	
		Company Name	Description of Technology
Power Generation	Regionally independent system	Erex	Provides service to develop the supply chain for biomass power generation, including the diversification of the materials and ensuring sustainable supply
		Sumitomo Corporation	Imports biomass materials, to support biomass power plant power generation facilities in receiving materials sustainably
	Low cost storage battery	Mitsubishi Electric, Obayashi, GS Yuasa	Low cost storage battery system, which reduced the initial and running cost by optimizing the capacity in the facility
		NGK	A megawatt-level energy storage system that uses sodium and sulfur, which is large scaled and cost competitive compared to other storage batteries
	Reservoir hydro-power generation	TEPCO	Power generation utilizing reservoir-based and pumped storage hydro, as well as solar power generation
		J-Power	Power generation utilizing reservoir-based and pumped storage hydro, as well as solar power generation
Distribution	Grid stabilizing system	Hitachi, TEPCO	Stabilize the power grid utilizing the technology “OpenVQ” system, resulting in reduction of power loss and increasing the power distribution capacity
Retail	Electricity to hydrogen / ammonia	Hitachi Zosen	Produce hydrogen from excess electricity and water
		Toshiba	Produce hydrogen from excess electricity and water

Source: Created by NRI based on news articles and company webpages of Erex, Sumitomo Corporation, Mitsubishi Electric, NGK, TEPCO, J-Power, Hitachi, Hitachi Zosen, Toshiba

Renewable Energy (Philippines): Potential Value Proposition by Japanese Companies

Regarding the issues and needs of local companies, the potential value proposition by Japanese companies are the following.

High added value | Cost Reduction

Category	Issues / Needs of Local Companies	Example of Value Proposition by Japanese Companies	
		Benefit	Technology
Power Generation	Geothermal: High initial investment for drilling	Lower the investment cost required for drilling	Low cost drilling technology
	Geothermal: Difficult to control the steam	Efficiently control and manage the steam	Intelligent steam control system
	Wind: Data collection for identification of suitable land for wind is too expensive	Able to collect wind data in a cost efficient manner	Low cost wind data collection system
	Solar: High cost of energy storage	Lower investment cost for energy storage	Low cost storage battery
	Biomass & Waste-to-energy: Difficult to secure materials sufficiently	Able to secure raw materials more efficiently	Regionally independent system
	Wind & Hydro: Instability due to seasonality		
Distribution / Transmission	Instability / electricity loss during distribution/transmission	Stabilizes the grid for distribution / transmission	Grid stabilization system
	Insufficient capacity for distribution / transmission:		

Source: Created by NRI based on interviews and publicly available sources

Renewable Energy (Philippines): Example of Technology by Japanese Companies

Example of technologies provided by Japanese companies are the following.

Category	Overview of Technology	Solutions by Japanese Companies	
		Company Name	Description of Technology
Power Generation	Low cost drilling technology	Mitsubishi Material	Cutter for drilling the ground using "polycrystalline diamond compact" which enables cheaper and faster drilling when developing the geothermal power plants.
		INPEX Drilling	Prevents lost circulation when drilling to reduce the cost and risks when drilling to develop geothermal plants.
	Intelligent steam control system	Mitsubishi Heavy Industries	O&M system which uses cloud data to monitor the steam, and can utilize remote control system when issues occur.
		Toshiba Energy Systems	Trouble prevention system using AI / IoT technology, which helps predict issues arising from the steam, and prevent beforehand.
	Low cost wind data collection system	Obayashi	Wind data collection using a small sized floating data collection object, which can collect data in a cost efficient way compared to towers
		Japan Weather Association	Wind data collection using a small sized floating data collection object ("BuoyLidar"), which can collect data in a cost efficient way compared to towers
	Low cost storage battery	NGK	A megawatt-level energy storage system that uses sodium and sulfur, which is large scaled and cost competitive compared to other storage batteries
	Regionally independent system	Erex	Provides service to develop the supply chain for biomass power generation, including the diversification of the materials and ensuring sustainable supply
		Sumitomo Corporation	Imports biomass materials, to support biomass power plant power generation facilities in receiving materials sustainably
Distribution/ Transmission	Grid stabilization system	Hitachi	Stabilize the power grid utilizing the technology "OpenVQ" system, resulting in reduction of power loss and increasing the power distribution capacity
		Mitsubishi Electric	Stabilize the power grid, to maintain the quality of the power grid operation.

Source: Created by NRI based on news articles, JOGMEC, Japan Weather Association, and company webpages of MHI, Obayashi, NGK, Erex, Sumitomo Corporation, Hitachi, Mitsubishi Electric

Smart City (Philippines): Potential Value Proposition by Japanese Companies

Key issues for smart city development are regarding energy, security, and mobility in which Japanese solutions are available to help address the issues.

High added value | Cost Reduction

Category	Issues / Needs of Local Companies	Example of Value Proposition by Japanese Companies: Benefit	Example of Value Proposition by Japanese Companies: Technology
Energy	Lack of connectivity for smart grid technology	Able to monitor and utilize the data efficiently	Smart meter / smart grid
	Limited area and lack of safety monitoring system for large size battery for city supply	Smaller sized storage batteries for the smart city	Small-sized storage battery
	Difficult for individuals to install solar panel at the households	Lower the price for solar panel installation	Low price solar panel technology
	High initial investment for energy management in and IoT conversion	Lower the price for the installation of energy management	Low price energy management system
	Human errors from manual reporting system		
Security	Lack of natural disaster management system	Enhance the resilience towards natural disasters	Natural disaster prevention system
	Lack of responsive and automated security system	Automate the security system for real-time data usage	Real time security system
Mobility	Lack of connected transportation system and parking identify system for private driver	Automatic connected system for parking	Parking lot monitoring system

Source: Created by NRI based on interviews and publicly available sources

Smart City (Philippines): Example of Technology by Japanese Companies

Example of technologies provided by Japanese companies are the following.

Category	Overview of Technology	Solutions by Japanese Companies	
		Company Name	Description of Technology
Energy	Smart grid technology	Hitachi	Provides analytics system to support the smart grid implementation
		Yokogawa	Provides community energy management system leveraging smart grids
	Small-sized storage battery	Panasonic	Small-sized storage battery for solar power generation
		Kyosera	Small-sized storage battery for solar power generation
	Low price solar panel technology	Panasonic	Industrial PV power generation system
	Low price energy management system	I Grid Solutions	Provides energy management system in a cost efficient manner
Security	Natural disaster prevention system	Hitachi	Offers solutions on disaster prevention in smart city through AI solutions
		NEC Corporation	Provides services such as disaster prevention dashboard for residents, flood detection service, water level monitoring service (reservoirs, rivers, etc.), and reliable news system
	Real time security system	Ryomo	Provides real time monitoring system for children
		Minebea Mitsumi	Provides real time security monitoring system for smart cities
Mobility	Parking lot monitoring system	Ryomo	Provides real time monitoring system for availability of parking lots
		Minebea Mitsumi	Provide parking sensor to detect available parking lots

Source: Created by NRI based on news articles and company webpages of Hitachi, Yokogawa, Panasonic, Kyosera, I Grid, Ryomo, Minebea Mitsumi

Renewable Energy (Laos): Potential Value Proposition by Japanese Companies

Wide range of issues and needs across power generation types, in which the Japanese companies' solutions can help address the issues.

High added value | Cost Reduction

Category	Issues / Needs of Local Companies	Example of Value Proposition by Japanese Companies	
		Benefit	Technology
Power Generation	Hydro: Instability based on seasonality		
	Solar: Instability based on lack of storage systems, given the high price of battery storage	Able to store the excess power during sunny period, in a cost efficient manner	Low price battery storage system
	Biomass: Instability based on fluctuation of raw material (sugarcane) availability	Increase the variety of biomass power generation materials	Alternative biomass power generation
	Hybrid (Hydro & Solar): Difficult to regulate, as hydro is mostly run-of river	Able to adjust the supply for hydro, by using reservoir	Hybrid using reservoir or pumped hydro
	Geothermal: Lack of understanding on feasibility and supply capacity	Able to evaluate the potential of geothermal power generation	Exploration of geothermal potential
Distribution / Transmission	Energy loss during transmission	Reduce loss during distribution transmission	Grid stabilizing system
	Limited volume for transmission	Increase the volume for transmission	
Retail	Can't fully utilize excess electricity as difficult to anticipate surplus energy		
	Development of new technology to utilize excess energy	Utilize excess electricity for green solutions	Electricity to hydrogen / ammonia

Source: Created by NRI based on interviews and publicly available sources

Renewable Energy (Laos): Example of Technology by Japanese Companies

Example of technologies provided by Japanese companies are the following.

Category	Overview of Technology	Solutions by Japanese Companies	
		Company Name	Description of Technology
Power Generation	Low price battery storage system	Mitsubishi Electric, Obayashi, GS Yuasa	Low cost storage battery system, which reduced the initial and running cost by optimizing the capacity in the facility
		NGK	A megawatt-level energy storage system that uses sodium and sulfur, which is large scaled and cost competitive compared to other storage batteries
	Regionally independent system	Erex	Provides service to develop the supply chain for biomass power generation, including the diversification of the materials and ensuring sustainable supply
		Sumitomo Corporation	Imports biomass materials, to support biomass power plant power generation facilities in receiving materials sustainably
	Reservoir hydro-power generation	TEPCO	Power generation utilizing reservoir-based and pumped storage hydro, as well as solar power generation
		J-Power	Power generation utilizing reservoir-based and pumped storage hydro, as well as solar power generation
	Exploration of geothermal potential	J-Power	Exploration, development, and operation of geothermal power plants
		Kyushu Electricity	Exploration, development, and operation of geothermal power plants
Distribution/ Transmission	Grid stabilizing system	Hitachi, TEPCO	Stabilize the power grid utilizing the technology “OpenVQ” system, resulting in reduction of power loss and increasing the power distribution capacity
Utilization	Electricity to hydrogen / ammonia	Hitachi Zosen	Produce hydrogen from excess electricity and water
		Toshiba	Produce hydrogen from excess electricity and water

Source: Created by NRI based on news articles and company webpages of Obayashi, NGK, Erex, Sumitomo Corporation, TEPCO, J-Power, Kyushu Electricity, Hitachi Zosen, Toshiba

調査概要

調査サマリ

Task 1:　　重要分野の独自仮説の深掘り・検証

Task 2 & 3: 事業オプションのモデルの策定・検証

既存事例の整理

CCS / CCUS (Malaysia): Partnerships with Petronas (1/3)

Petronas has shown interest in partnership with Japanese and European companies, for both specific technology and supply chain development.

Key Partnerships for Petronas with Overseas and Domestic Companies

Partner Country	Partner Name	Partner Description	Partnership Type	Timeline	Details
Japan	• Japan Petroleum Exploration	• Oil and gas producer	• MoU	• Jan 22~	• Explore CCS opportunities, CO_2 storage solutions by identifying suitable methods of carbon capture, storage, transportation, estimation of emission and capture volumes for inside and outside Malaysia
Japan	• Mitsui O.S.K. Lines	• Logistics service provider	• MoU	• Feb 22~	• Explore opportunities in liquefied CO_2 transportation for CCUS value chain in Asia Pacific and Oceania regions
Japan	• Mitsui & Co.	• General trader, logistics and financing services provider	• MoU	• Jun 22~	• Conduct feasibility studies on CCS value chain in various industries, evaluation of CO_2 storage sites in Malaysia, CO_2 transportation, and technology in direct air capture
Norway	• DNV Group AS	• Assurance and risk management services provider	• MoU	• July 22~	• Address challenges of CCUS deployment in safety, environment, risk, technology, qualification of storage sites, legislation, regulation, capability development, and commercial areas
UK	• Shell PLC	• Oil and gas producer	• Joint Study and Collabo -ration Agreement	• Jan 22~	• Conduct the joint CCS area development plan study on decarbonisation service for CO_2 storage solutions in Malaysia and the region

Source: Created by NRI based on company webpage of Petronas, DNV

CCS / CCUS (Malaysia): Partnerships with Petronas (2/3)

Korean companies aim to enhance partnership with Petronas, by forming a team of Korean companies in which each company has strength in different areas.

Key Partnerships for Petronas with Overseas and Domestic Companies

Partner Country	Partner Name	Partner Description	Partnership Type	Timeline	Details
Korea	• POSCO International Corporation	• General trader, energy and resource development service provider	• MoU	• Dec 21~	• Explore the opportunities in CCS technologies and CO_2 storage solutions with performing technical maturation activities in Malaysia
Korea	• POSCO Engineering & Construction	• Engineering and Construction service provider			
Korea	• Samsung Engineering	• Engineering service provider	• MoU	• Aug 22~	• Conduct feasibility studies on a full value chain related to CO_2 capture, transport and storage by evaluating potential CO_2 storage sites in Malaysia, exploring other areas across CCS value chain, and strengthening cross-border CO_2 transportation
Korea	• Samsung Heavy Industries	• Shipbuilder			
Korea	• SK Earthon	• Oil and gas producer			
Korea	• SK Energy	• Oil producer and gas station operator			
Korea	• GS Energy Corporation	• Oil, gas and renewable energy producer			
Korea	• Lotte Chemical Corporation	• Chemicals producer			

Source: Created by NRI based on company webpage of Petronas

CCS / CCUS (Malaysia): Partnerships with Petronas (3/3)

US companies provide advanced technology which includes digital twin, autonomous operations.

Key Partnerships for Petronas with Overseas and Domestic Companies

Partner Country	Partner Name	Partner Description	Partnership Type	Timeline	Details
US & Malaysia	• SumiSaujana TCM Chemicals Sdn Bhd	• Joint venture between ➢ Sumisaujana-Malaysian oil and gas distributor ➢ TCM Chemicals-US chemicals producer	• Commercia-lisation Agreement	• Nov 21~	• Launch the proprietary corrosion inhibitor technology for suppressing corrosion in steel pipelines to facilitate natural gas transportation from high CO_2 gas field
US	• ExxonMobil	• Oil producer and natural gas supplier	• MoU	• Nov 21~	• Explore CCS opportunities by assessing the viability of potential CCS projects in Malaysia and identify suitable technology for potential application
US	• Baker Hughes Company	• Technology solution provider	• MoU	• Nov 21~	• Develop operational excellence, technological developments specifically for hydrogen, CCUS, digital solutions, and sustainability and emissions management
US	• Honeywell International	• Engineering service and technology solution provider	• MoU	• Mar 22~	• Develop carbon-neutral energy solutions including CCS technology, Digital Twin, and Remote Autonomous Operations
US	• Schlumberger Limited	• Oilfield service provider	• MoU	• Mar 22~	• Explore opportunities in sustainability, digital and Internet of Things, R&D projects with key initiatives e.g., CCS center setup, cloud-based data repository for carbon storage, CO_2 separation technologies, etc.

Source: Created by NRI based on company webpage of Petronas

Ammonia / Hydrogen (Malaysia): Partnerships with Petronas (1/2)

Petronas partners with overseas companies mainly for the development of production plants and infrastructure and transition to clean ammonia.

Key Partnerships for Petronas with Overseas and Domestic Companies

Partner Country	Partner Name	Partner Description	Partnership Type	Timeline	Details
Japan	• ENEOS Corporation	• Petroleum company	• MoU	• Sep'21	• Hydrogen production and its transportation in methylcyclohexane (MCH) form
Japan	• JERA Co., Inc.	• Joint venture between TEPCO Fuel & Power (Electric power companies)	• MoU	• Feb'21	• Establish supply chains for green fuels such as ammonia and hydrogen
South Korea	• Samsung C&T Corporation	• Construction and engineering company	• MoU	• May'22	• Building and operating hydrogen-related infrastructure
Canada/ Japan	• Inter Pipeline and Itochu	• multinational petroleum transportation and infrastructure limited partnership and trading services	• MoU	• May'22	• Production of thousands of metric tonnes per day of blue ammonia and blue methanol
India	• Karnataka Government	• Ceremonial head to govern the Southwest Indian state of Karnataka	• MoU	• Jul'22	• Setting up Hydrogen and Ammonia production plants in Mangaluru with an associated solar power unit

Source: Created by NRI based on news articles and company webpage of Petronas, Saura Energy, JERA

Ammonia / Hydrogen (Malaysia): Partnerships with Petronas (2/2)

Petronas partners with domestic partners, mainly for joint development of clean hydrogen ecosystem and supply chain.

Key Partnerships for Petronas with Overseas and Domestic Companies

Partner Country	Partner Name	Partner Description	Partnership Type	Timeline	Details
Malaysia	• Tenaga Nasional	• Multinational electricity company	• MoU	• Aug'22	• Producing green hydrogen fuel for power generation and stepping up efforts to jointly construct a green hydrogen ecosystem
Malaysia	• Sarawak Energy	• Electric utility company	• MoU	• Nov'20	• Scaling up and venture into energy export with hydrogen as an energy carrier to meet global clean energy demand

Source: Created by NRI based on news articles and company webpage of Sarawak Energy

Renewable Energy (Indonesia): Partnership with Medco Power (1/2)

Partnership for geothermal developed to enhance maintenance and operation.

Key Partnerships for Medco Power with Overseas and Domestic Companies

Partner Country	Partner Name	Partner Description	Partnership Type	Timeline	Details
Indonesia	• Salim Group	• Consumer food producer	• Joint Development Agreement	• Oct'21	• Collaborate on developing cross-border pilot project for exporting solar PV power with expected capacity of 670 MWp and equivalent of 100 MW non-intermittent electricity from Indonesia to Singapore
Singapore	• Pacificlight Power Pte Ltd.	• Electric power generator			
Indonesia	• PT Pertamina Geothermal Energy	• Geothermal power generator	• Head of Agreement (HoA)	• Dec'21	• Collaborate on developing 5 geothermal power projects with total capacity of 495 MW with evaluating economics of a joint business model and establishing timelines and milestones starting from exploration, exploitation, to operation
Japan	• INPEX Corporation	• Oil and gas producer	• Joint operating agreement	• Apr'13	• Co-invest in Sarulla Operations Ltd to jointly operate and maintenance on Sarulla geothermal power plants with total capacity of 330 MW located in North Sumatra, Indonesia
Japan	• ITOCHU Corporation	• General trader with multiple business areas e.g., machinery, textiles, aerospace, energy, and logistics.			
Japan	• Kyushu Electric Power Co., Inc	• Electric power generator			
US	• Ormat Technologies, Inc.	• Geothermal power generator			

Source: Created by NRI based on news articles and company webpage of Pertamina, Kyushu Electric, Sarulla Operations

Renewable Energy (Indonesia): Partnership with Medco Power (2/2)

Partnership for geothermal developed to enhance maintenance and operation.

Key Partnerships for Medco Power with Overseas and Domestic Companies

Partner Country	Partner Name	Partner Description	Partnership Type	Timeline	Details
Philippines	• Solar Philippines	• Solar power generator	• Joint venture agreement	• 2019	• Collaborate on developing solar farm projects with a capacity of 50 MW in East and West Bali of Indonesia
US	• Ormat Technologies, Inc.	• Geothermal power generator	• Joint venture agreement	• July'19	• Co-invest in the Ijen geothermal project company holding license to develop a 110 MW geothermal power project in East Java of Indonesia with Ormat's commitment to additional funding for the exploration and development

Source: Created by NRI based on news articles

Ammonia / Hydrogen (Indonesia): Partnership with Pertamina (1/2)

Pertamina partners with overseas companies mainly for enhancing production capacity, developing supply chain, and transition to clean ammonia.

Key Partnerships for Pertamina with Overseas and Domestic Companies

Partner Country	Partner Name	Partner Description	Partnership Type	Timeline	Details
Japan & Indonesia	• Mitsubishi Corporation • PT Pupuk Indonesia	• Trading company • Fertilizer company	• Cooperation Agreement	• 2022~	• Developed agreement to develop the Green Hydrogen and Green Ammonia Value Chain and Carbon Capture Utilization and Storage (CCUS) businesses.
Japan	• TEPCO	• Power generation company	• Joint study agreement	• 2022~	• Signed a joint study agreement (JSA) on the development of green hydrogen and green ammonia to combine Pertamina's geothermal power generation technology and TEPCO HD's hydrogen production technology to achieve cost-competitive green hydrogen & green ammonia production and transportation
Japan	• JGC	• EPC company	• MoU	• 2022~	• conduct a joint study aiming at future commercialization and consider a wide range of joint projects in fields as hydrogen, ammonia, CCUS, and biogas.
US	• Chevron	• Energy company	• Cooperation Agreement	• 2022~	• Agreement for lower carbon hydrogen development, production, storage, and transport • Also, agree on partnership for carbon offsets through nature-based solutions; carbon capture, utilization, and storage (CCUS);

Source: Created by NRI based on company webpage of Pertamina, JGC

Ammonia / Hydrogen (Indonesia) : Partnership with Pertamina (2/2)

Pertamina is also seeking for methods to develop hydrogen with low CO2 emission, leveraging partnership with French company.

Key Partnerships for Pertamina with Overseas and Domestic Companies

Partner Country	Partner Name	Partner Description	Partnership Type	Timeline	Details
France	• Air Liquide	• Industrial gases and services	• Joint study agreement	• 2022~	• Signed a Memorandum of Understanding (MoU) with the objective to explore the technological solutions which can support the decarbonization of Pertamina's activities in Indonesia, including low-carbon hydrogen and carbon capture solutions

Source: Created by NRI based on news articles

Philippines (Renewable Energy): Partnership with Aboitiz

Partnership includes power generation facility development and storage batteries.

Key Partnerships for Aboitiz with Overseas and Domestic Companies

Partner Country	Partner Name	Partner Description	Partnership Type	Timeline	Details
Japan	• JERA	• Power generation company	• Investment	2021~	• Acquired 27% stake for Aboitiz Power
Japan	• JGC	• EPC Company	• Contract for construction of solar power generation facility	2021~	• JGC to provide EPC services for the solar power generation facility in Bugallon, Pangasinan
Japan	• Hitachi Energy	• EPC Company	• Contract for construction of battery storage system	2022~	• Hitachi to provide EPC service for a 20MW/20MWh battery storage system, set to go online in 2024.
China & Philippines	• Sumec Engineering	• EPC Company	• Contract for construction of solar power generation facility	2022~	• The 2 companies to provide EPC services for the solar power generation facility Laoag and Laoag 2 solar power project
	• Hansei Corporation	• EPC / O&M Company			
USA	United States Trade and Development Agency	• Government agency	• Grant for feasibility study	2022~	• Provides grant to identify potential project sites and provide technical and economic analysis for 3GW of wind turbine generation projects

Source: Created by NRI based on company webpage of Aboitiz Power and news articles

Philippines (Renewable Energy): Partnership with Meralco (1/4)

Meralco partners with domestic players to enhance the supply capacity for RE.

Key Partnerships for Meralco with Overseas and Domestic Companies

Partner Country	Partner Name	Partner Description	Partnership Type	Timeline	Details
Philippines	• Island Wind Energy Corporation	• Wind energy producer	• Power supply agreement	• 2018	• Collaborate on supply of a 150-MW wind energy for Meralco from the project based in Rizal, Philippines
Philippines	• First Gen Hydro Power Corporation	• Power generator	• Power supply agreement	• Sep'19	• Collaborate on supply of a 100-MW energy for Meralco from geothermal power plants
Philippines	• Energy Development Corporation	• Power generator			
Philippines	• Power Sector Assets and Liabilities Management Corporation	• State-owned financial service provider	• Power supply agreement	• Oct'21	• Collaborate on supply of a 90-MW energy for Meralco from Unified Leyte Geothermal Power Plant under the emergency procurement up to July'22

Source: Created by NRI based on news articles

Philippines (Renewable Energy): Partnership with Meralco (2/4)

JP players support with both construction and operation of power plants.

Key Partnerships for Meralco with Overseas and Domestic Companies

Partner Country	Partner Name	Partner Description	Partnership Type	Timeline	Details
Japan	• Marubeni Corporation	• General trader and construction service provider	• Joint venture agreement	• Apr'19	• Establish Special purpose company for the financing, design, engineering, establishment, construction, development, operation and maintenance of electric power distribution system for New Clark City, Philippines
Japan	• Kansai Electric Power Co.	• Power distributor			
Japan	• Chubu Electric Power Co.	• Power distributor			
Philippines	• Bases Conversion and Development Authority	• State-owned infrastructure developer			
Japan	• Idemitsu Kosan	• Oil and chemicals producer	• Joint development agreement	• 2020	• Develop a business model for PowerSource First Bulacan Solar e.g., hybrid power plants combined with batteries and power generation stations for self-consumption at buildings' rooftop
Japan	• Mitsui & Co.	• General trader, logistics and financing services provider	• Joint venture agreement	• Jun'21	• Establish PH Renewables Inc. for operation of a 75 MWac solar power plant in Rizal, Philippines

Source: Created by NRI based on news articles, company webpage of Idemitsu

Philippines (Renewable Energy): Partnership with Meralco (3/4)

JP players support with both construction and operation of power plants.

Key Partnerships for Meralco with Overseas and Domestic Companies

Partner Country	Partner Name	Partner Description	Partnership Type	Timeline	Details
Japan	• Mitsubishi Motors	• Car producer	• Cooperation agreement	• Jul'19	• Conduct the joint study on vehicle-to-grid (V2G) technology application in Philippine for allowing EV to charge and supply electricity to a building
Japan	• Ajinomoto	• Food and seasonings producer	• Service agreement	• Feb'22	• Collaborate on rooftop solar PV panels installation by Meralco in the plant in Bulacan, Philippines
Korea	• Seochang Electric Communication	• Energy system solution provider	• Research and Development	• Jun'22	• Establish an on-grid hybrid power service with a 50-KW peak solar PV system and a 300-KW-hour energy storage system (ESS) in Cavite, Philippines
Singapore	• Vena Energy	• Power generator	• Joint venture agreement	• Feb'22	• Establish Nuevo Solar Energy Corp. for the joint development, construction and operation of a 68 MWac solar power plant in Ilocos Norte, Philippines

Source: Created by NRI based on news articles, company webpage of Meralco

Philippines (Renewable Energy): Partnership with Meralco (4/4)

US players provide support on advanced technologies including smart grid tech.

Key Partnerships for Meralco with Overseas and Domestic Companies

Partner Country	Partner Name	Partner Description	Partnership Type	Timeline	Details
US	• General Electric Company (GE)	• Technology and financial services provider	• Cooperation agreement	• Oct'12	• Support on the electric meters and system integration services in the electric distribution network for the utility's data management and analysis requirements
US	• Trilliant	• Smart grid systems service provider	• Cooperation agreement	• 2013	• Support on Smart Grid Communications Platform by integrating the advanced intelligence into the prepaid metering system for consumers' real-time data, and power supply's quality and reliability
US	• City of dreams	• Casino and resort operator	• Memoran-dum of agreement	• Jul'19	• Collaborate on rooftop solar PV panels installation by Meralco in the resort
US	• Amber Kinetics	• Energy storage provider	• Cooperation agreement	• Nov'21	• Implement the testing of long-duration flywheel energy storage system with 4-hour discharge duration, non-degradation in performance, long lifespan, and the clocking in at a 30-year design life

Source: Created by NRI based on news articles and company webpage of GE

Smart City (Philippines): Partnership with Ayala Land (1/3)

Wide range of partnership observed, primarily for infrastructure development.

Key Partnerships for Ayala with Overseas and Domestic Companies

Partner Country	Partner Name	Partner Description	Partnership Type	Timeline	Details
Philippines	• BPI Card Finance Corporation	• Financial service provider	• Cooperation agreement	• Dec'13	• Collaborate on modernizing transport systems for the Light Rail Transit (LRT) and Metro Rail Transit (MRT) lines in Metro Manila by financing, designing, constructing, the implementation and operation of a contactless automatic fare collection system (AFCS) based on smart card technology
Hong Kong	• First Pacific	• Investment holding company			
Philippines	• Globe Telecom Inc.	• Telecommunication service provider			
Philippines	• Meralco Financial Services	• Marketing and advertising services provider			
Singapore	• MSI Global	• Land transport solution provider			
Philippines	• Smart communication Inc.	• Wireless communication, digital services provider			
Singapore	• SMRT Corporation	• Public transport operator			
Philippines	• SM Prime Holdings	• Real estate developer	• Joint master plan	• Jul'15	• Develop a portion of the South Road Properties (SRP) in Cebu City spanning the 26 hectares for traditional office, business-process outsourcing office, shopping-center leasing and residential condominiums

Source: Created by NRI based on news articles and company webpage of Ayala and SM Prime

Smart City (Philippines): Partnership with Ayala Land (2/3)

Data center projects are one of focus areas, partnering with Singapore companies.

Key Partnerships for Ayala with Overseas and Domestic Companies

Partner Country	Partner Name	Partner Description	Partnership Type	Timeline	Details
US	• Global Electric Transport LLC	• Electric transport solution provider	• Cooperation agreement	• Dec'21	• Collaborate on Integrated EV charging system installation at Ayala Malls and providing electric shuttle buses called COMETs in Davao and Manila City with intent to expand the network of electric shuttle, EV charger nationwide
Philippines	• GREENSTRuM	• Electric vehicle (EV) charger provider			
Philippines	• Integrated Micro-Electronics Inc.	• Electronic devices provider			
China	• TGOOD LINCHR	• EV charging infrastructure service provider			
Philippines	• Globe Telecom Inc.	• Telecommunication service provider	• Joint venture agreement	• Mar'22	• Co-invest in KarmanEdge, Inc. for the development, construction and operation of data centre projects up to 100MW capacity to expand a digital ecosystem in the country
Singapore	• ST Telemedia Global Data Centre	• Data centre provider			

Source: Created by NRI based on company website of ST Telemedia and news Articles

Smart City (Philippines): Partnership with Ayala Land (3/3)

Energy saving is also a focus area, in which Japanese trading companies support.

Key Partnerships for Ayala with Overseas and Domestic Companies

Partner Country	Partner Name	Partner Description	Partnership Type	Timeline	Details
Japan	• Mitsubishi Corporation	• General trader with multiple business areas e.g., Petroleum and gas, Chemicals, Metals, Materials, Food etc.	• Joint venture agreement	• Nov'11	• Co-invest in Philippine Integrated Energy Solutions Inc. to implement "district cooling systems" for energy-saving in Ayala Land's mixed-use developments in Makati, Mintinlupa, Cebu, Davao, Cagayan de Oro and Quezon City
Hong Kong	• First Pacific	• Investment holding company	• Consortium agreement	• Sep'15	• Collaborate on operation and maintenance of the 20.7-kilometer LRT1 line in Metro Manila stretching from the Muñoz station in Quezon City to the Baclaran station in Pasay City
US	• Macquarie Infrastructure Holdings	• Oil and gas distributor, air transportation, airport services provider			
Spain	• Acciona SA	• Engineering and construction services provider for infrastructure, renewable energy	• Power supply agreement	• Jan'22	• Provide renewable energy supply and third-generation domestic solar-powered systems to 100 households in El Nido, Palawan City
US	• Flow Holdings	• Digital infrastructure solution provider	• Framework agreement	• May'22	• Develop and operate carrier-neutral data centres to support increase in data consumption, digitization, 5G connectivity, and data localization trends in the country

Source: Created by NRI based on news articles

Renewable Energy (Laos) – Partnerships with Electricite du Laos (1/2)

Enhancement of transmission system an issue, which Chinese companies are the primary partners.

Key Partnerships for Electricite du Laos with Overseas and Domestic Companies

Partner Country	Partner Name	Partner Description	Partnership Type	Timeline	Details
Japan	• Tokyo Electric Power Company Holdings	• Power generation, transmission, and distribution company	• Agreement	• 2021	• Support on power grid operation in Lao PDR through knowledge sharing on power utility management from 2021-2024
China	• China Southern Power Grid	• Power transmission and distribution company	• Joint venture	• 2020	• Established Electricite du Laos Transmission Company Ltd., a joint venture entity, which has control of Lao PDR's power grid and the rights to purchase and sell power in Lao PDR, including power from renewable energy • In 2021, Electricite du Laos Transmission Company has 25 years concession agreement (Build-Operate-Transfer) with Lao PDR government to invest, construct, and operate power grids (≥230 kV), and implement grid interconnection projects between Lao PDR and neighboring countries
Singapore	• Keppel Electric	• Power generation company	• Power purchase agreement	• 2021	• Import up to 100MW of renewable hydropower from Lao PDR to Singapore via Thailand and Malaysia using existing interconnectors under an import trial
Thailand	• Electricity Generating Authority of Thailand	• Power generation and transmission company	• Memorandum of Understanding	• 2019	• Establish Xayaburi hydropower plant in Lao PDR to supply electricity to Thailand

Source: Created by NRI based on company webpage of EDL, Keppel Electric, and news articles

Renewable Energy (Laos) – Partnerships with Electricite du Laos (2/2)

EDL also conducts partnership to enhance the export of electricity to neighboring countries.

Key Partnerships for Electricite du Laos with Overseas and Domestic Companies

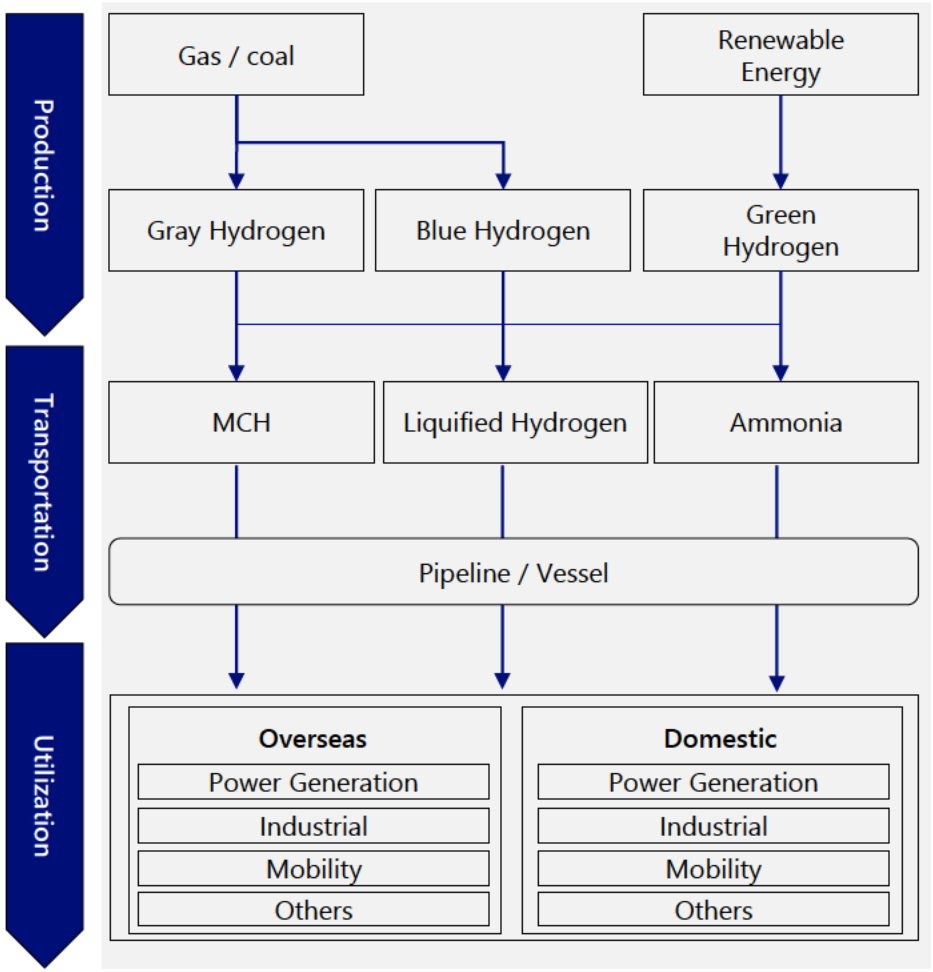
Partner Country	Partner Name	Partner Description	Partnership Type	Timeline	Details
Thailand	• B.Grimm Power Plc	• Conglomerate in healthcare, energy, building and industrial systems, real estate, e-commerce, and transport industry	• Memorandum of Understanding	• 2022	• Sign MoU with EDL-Gen, part of Electricite du Laos, to jointly explore the feasibility of developing hydropower, wind power, solar energy, transmission systems and power trading in domestic and overseas markets
Thailand	• Electricity Generating Public Company Limited	• Power generation company	• Power purchase agreement	• 2022	• Establish Nam Theun 1 hydropower plant in Bolikhamxay province, Lao PDR. It has power purchase agreements with EGAT of Thailand and Electricite Du Laos for 27 years
Cambodia	• Electricity authority of Cambodia	• Power transmission and distribution company	• Power purchase agreement	• 2020	• Cambodia will purchase 500 MW from hydro power and 2,400 MW from coal-fired power project throughout 2020-2027
Lao PDR	• Lao Telecommunication	• Telecommunication company	• Memorandum of Cooperation	• 2022	• Agrees to connect electricity bills payment system with M-Money Mobile Wallet service and conduct feasibility of transportation projects such as creating an electric vehicle charging station
Vietnam	• N/A	• N/A	• N/A	• 2022	• Électricité du Laos is working on connecting the Laotian power grid with 27 connection points of Vietnam's grid

Source: Created by NRI based on news articles

事業モデルの整理

Key area can be categorized under production, transportation, and utilization, in which issues and needs of local players is the following.

Overview of Hydrogen / Ammonia Supply Chain



Source: Created by NRI based on interviews

Key Issues and Needs of Local Players

Item	Description
Production	• Enhancing efficiency and durability of electrolyzer (green ammonia / hydrogen) • High cost due to fluctuation of renewable energy (green ammonia / hydrogen) • Gaining technology to control the CO2 emission (blue ammonia / hydrogen)
Transportation	• Lack of specialized transportation vessel (ammonia / hydrogen) • Development of transportation terminal (ammonia / hydrogen) • Development of technology for safe large scale storage (ammonia / hydrogen)
Utilization	• Increasing the amount which can be used for co-firing (ammonia / hydrogen) • Reducing the Nox from emission (ammonia) • Reducing the cost for power generation utilization (ammonia / hydrogen)

Hydrogen / Ammonia (Malaysia) - Example of Business Model (Green Hydrogen Export)

Providing technology to support production and transportation will provide business opportunities for Japanese companies.

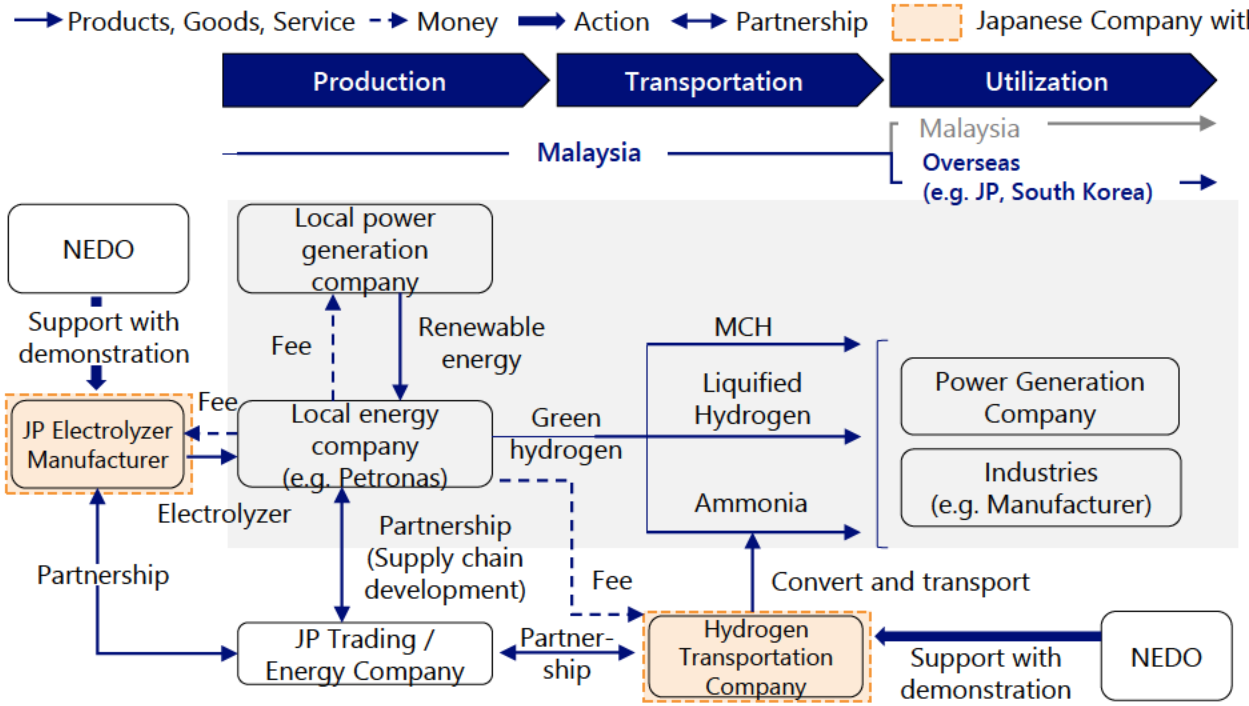
Local Company's Needs

- Malaysia aims to become a major exporter of ammonia / hydrogen, in which one of the drivers is expected to be the implementation of carbon tax and carbon credit in overseas countries (e.g. Japan, South Korea)
- To increase the amount of ammonia / hydrogen which can be exported overseas, local energy companies are aiming to receive technology which will enable efficient conversion from renewable energy to ammonia / hydrogen, as well as the technology for the transportation

Resource of Japanese Companies

- Electrolyzer manufacturer:
  - Provide electrolyzer for local energy companies, which enables the production of green hydrogen in a stable manner
- Hydrogen transportation company:
  - Provides energy carrier for safe and stable transportation
- Trading companies, energy companies
  - Support the development of overall supply chain from Malaysia to overseas companies as the business developer

Business Model (Domestic Production and Export of Green Hydrogen)

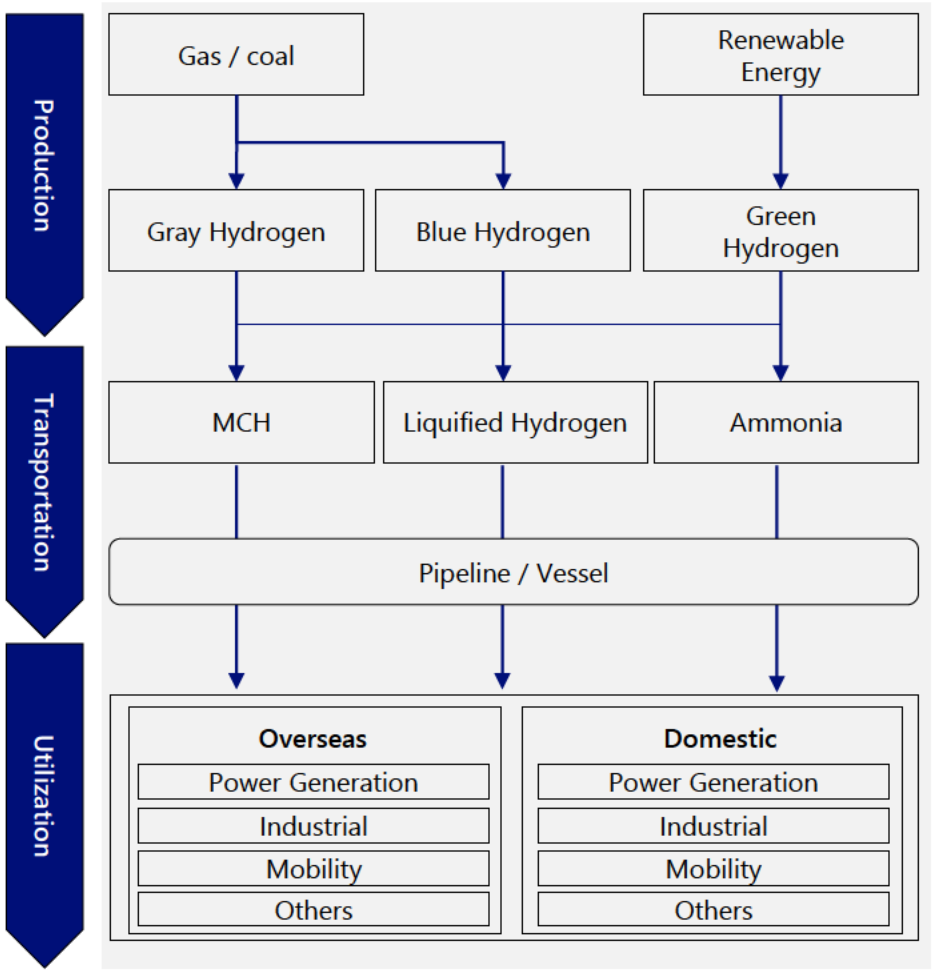


Item	Description
Product of JP Company with Technology	• Electrolyzer which helps produce green hydrogen in a stable manner • Energy carrier technology
Target Customer	• Local energy company (e.g. Petronas)
Partner	• Japanese trading company • Japanese energy company

Source: Created by NRI based on interviews and publicly available sources

Key area can be categorized under production, transportation, and utilization, in which issues and needs of local players is the following.

Overview of Hydrogen / Ammonia Supply Chain



Source: Created by NRI based on interviews

Key Issues and Needs of Local Players

Item	Description
Production	• Low stability due to fluctuation of renewable energy (Green ammonia / hydrogen) • High cost due to fluctuation of renewable energy (green ammonia / hydrogen) • Requires large amount of energy for Harber Bosh process (ammonia)
Transportation	• Lack of specialized transportation vessels (ammonia / hydrogen) • Requires large amount of energy for conversion from ammonia to hydrogen • Development of technology for safe storage (ammonia / hydrogen)
Utilization	• Increasing the amount which can be used for co firing (ammonia / hydrogen) • Improving the performance when using hydrogen for gas turbines • Reducing the Nox from emission (ammonia) • Need to develop infrastructure for industrial (e.g. steel) and FCV usage

Hydrogen / Ammonia (Indonesia) - Example of Business Model (Electrolyzer & Co-fire Power Generation)

Providing technology to support production and utilization of green hydrogen / ammonia will provide business opportunities for Japanese companies.

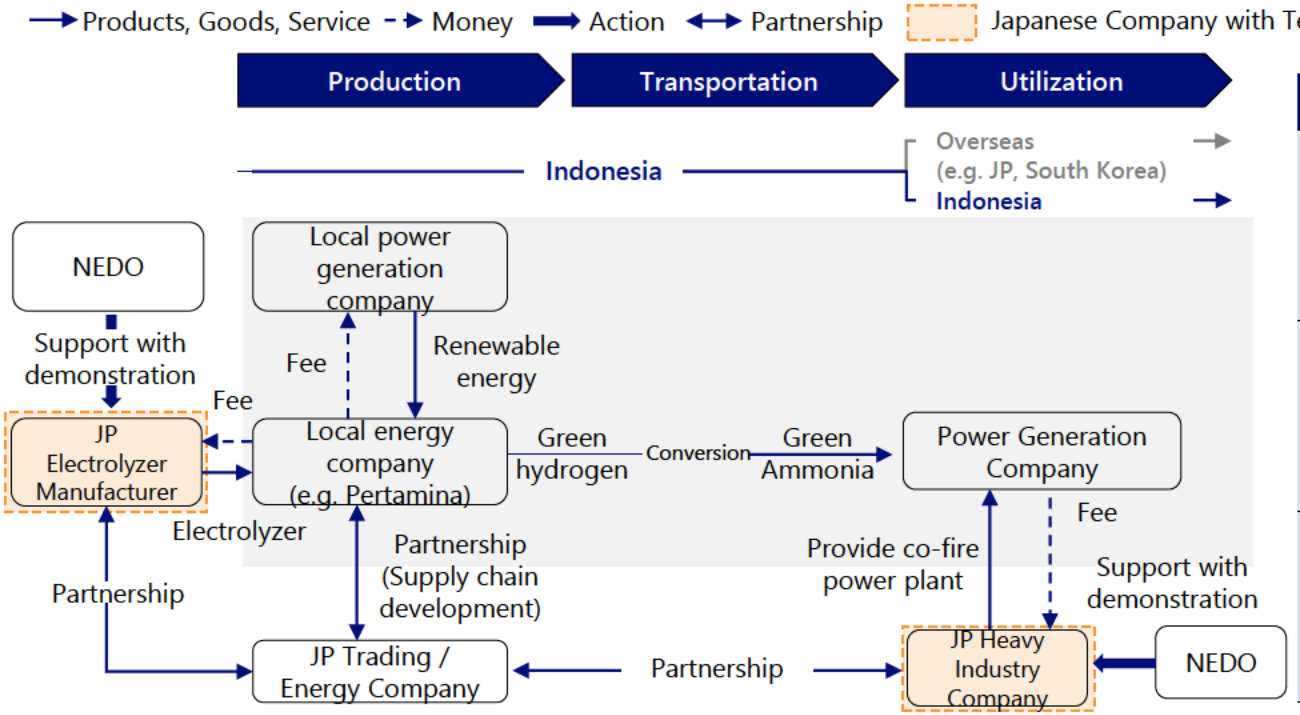
Local Company's Needs

- Indonesian energy companies aim to increase the supply of ammonia and hydrogen, to utilize the resources for CO2 reduction within the country
- For the supply of hydrogen and ammonia, one of the key requirements is technology to produce green hydrogen efficiently
- For the demand-side, technology to increase the amount of ammonia for co-fire power plants is required from overseas companies

Resource of Japanese Companies

- Electrolyzer manufacturer:
  - Provide electrolyzer for local energy companies, which enables the production of green hydrogen in a stable manner
- Heavy industry company
  - Provide the facility for ammonia co-fire power plant generation
- Trading companies, energy companies
  - Support the development of overall supply chain within Indonesia as the business developer

Business Model (Domestic Production and Domestic Utilization of Green Hydrogen / Ammonia)

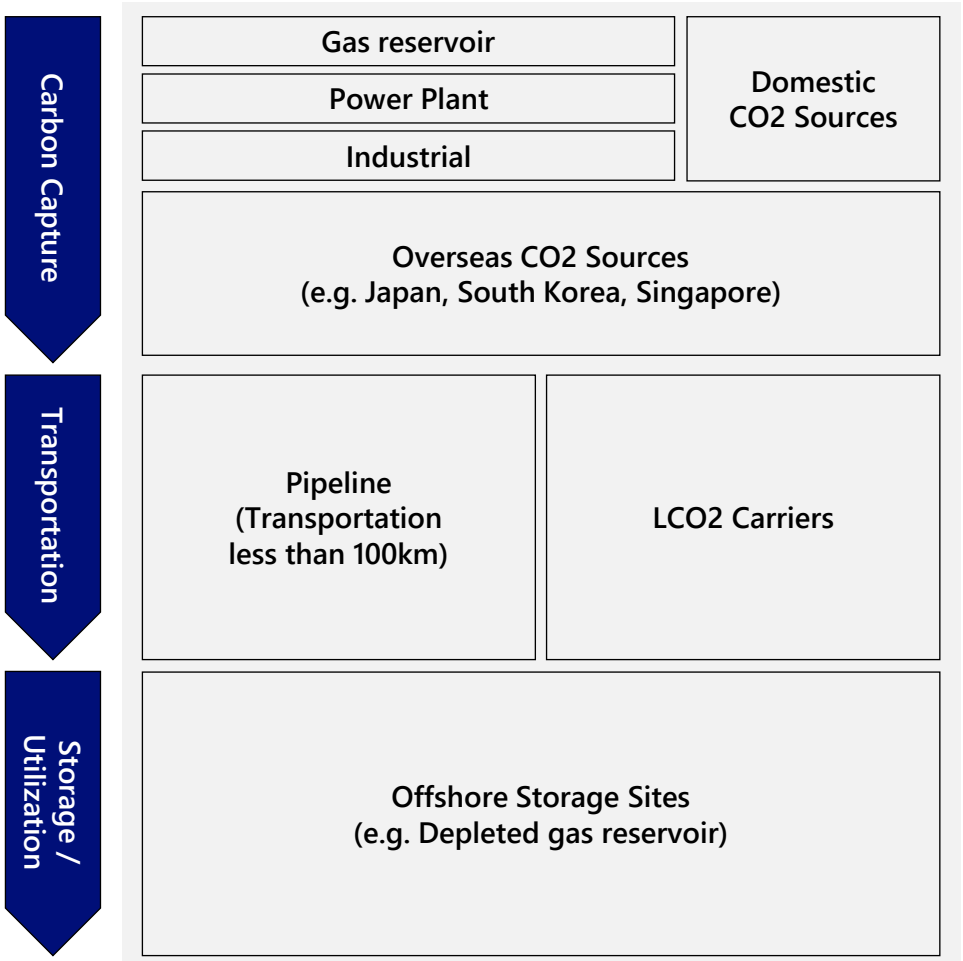


Item	Description
Product of JP Company with Technology	• Electrolyzer which helps produce green hydrogen in a stable manner • Technology to develop co-fire power plant efficiently
Target Customer	• Electrolyzer: Local energy company such as Pertamina • Co-fire power plant: Power generation company
Partner	• Japanese trading company • Japanese energy company

Source: Created by NRI based on interviews and publicly available sources

For CCS/CCUS in Malaysia, issues and needs of local players are the following.

Overview of CCS / CCUS Supply Chain



Source: Created by NRI based on interviews

Key Issues and Needs of Local Players

Item	Description
Carbon Capture	• Large amount of energy required during CO2 capture • High CO2 capture cost
Transportation	• Economic efficiency of the vessels low • GHG emission during transportation
Storage	• Safety and security of storage sites
Utilization	• Cost reduction for carbon recycle • Adding value to the product manufactured

CCS/CCUS (Malaysia) - Example of Business Model (Carbon Capture)

Providing CO2 capture in an energy and cost efficient manner to gas reservoirs, industries, and power generation will provide opportunities for JP companies.

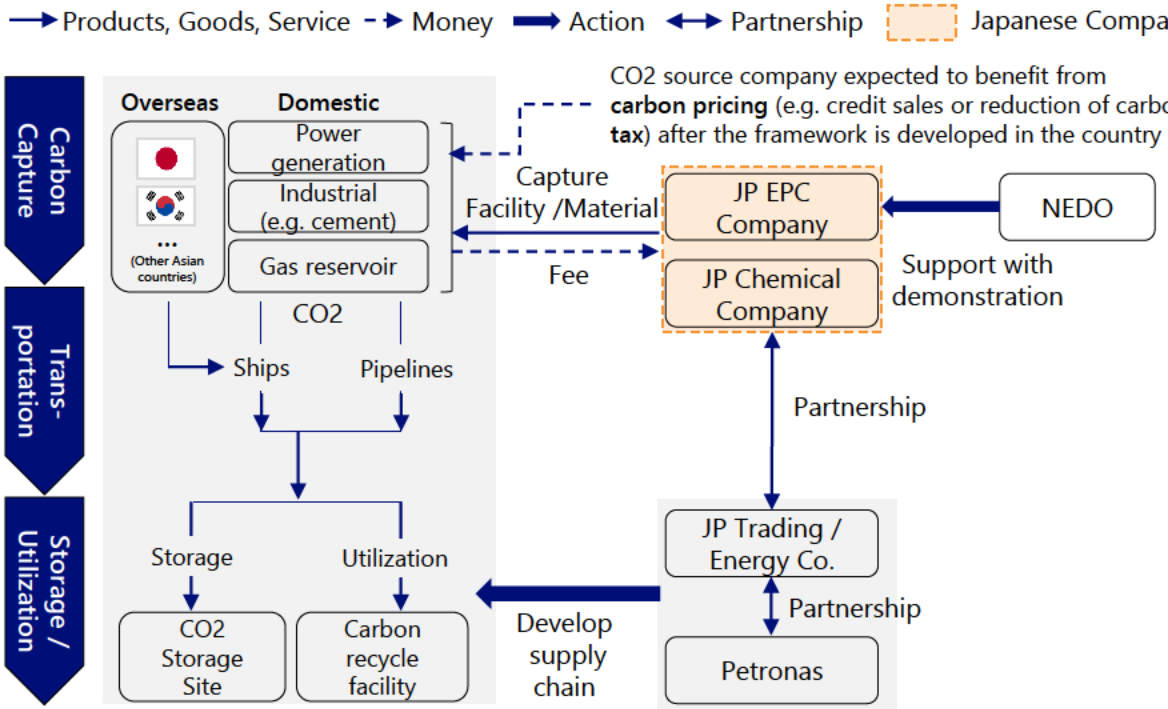
Local Company's Needs

- Malaysia aims to become a regional hub for CO2 storage in Asia, to function as a storage for both domestic and international CO2 sources
- For domestic CO2 sources, local companies require technology to capture carbon, in a cost and energy efficient manner
- Local companies are looking for partnership with overseas companies which has the above technology

Resource of Japanese Companies

- EPC company:
  - Provide carbon capture facility to the local companies
- Chemical company
  - Provide carbon capture materials to the local CO2 source company, which enables CO2 capture in an energy and cost efficient manner
- Trading companies, energy companies
  - Support the development of overall supply chain within Malaysia

Business Model (Carbon Capture Facility / Material)



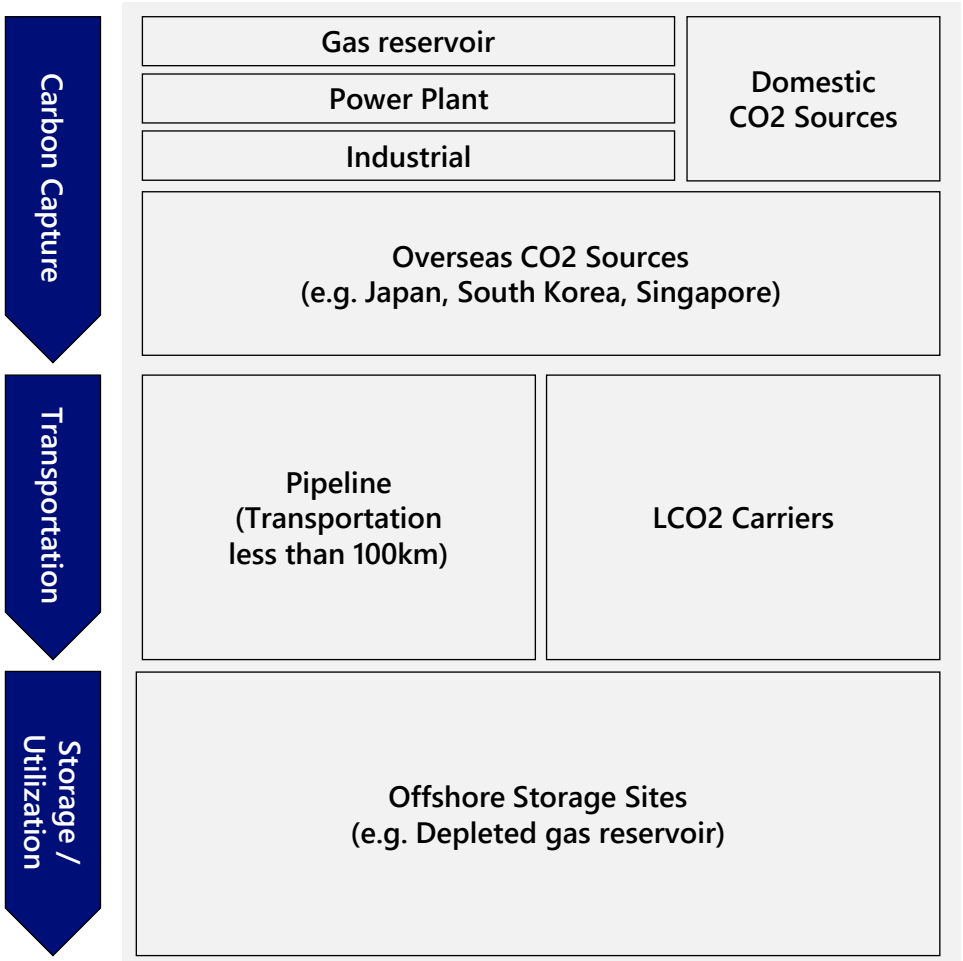
Item	Description
Product of JP Company with Technology	• Carbon capture facility / material for CO2 source which enables CO2 capture in an energy and cost efficient manner
Target Customer	• Companies with CO2 emission such as; ◦ Power generation companies ◦ Industries which CO2 emission is hard to avoid (e.g. cement) ◦ Gas reservoirs
Partner	• Japanese trading company • Japanese energy company

Source: Created by NRI based on interviews and publicly available sources

Issues and Needs of Local Players: CCS/CCUS - Thailand

Key area can be categorized under carbon capture, transportation, storage / utilization, in which issues and needs of local players is the following.

Overview of CCS / CCUS Supply Chain



Key Issues and Needs of Local Players

Item	Description
Carbon Capture	• Large amount of energy required • High CO2 capture cost • CO2 source has impurities apart from CO2
Transportation	• Economic efficiency of the vessels low • Safety of the pipeline transportation
Storage	• Safety of the storage system • Ensuring a stable monitoring system
Utilization	• Cost reduction for carbon recycle • Energy required during the production process

Source: Created by NRI based on interviews

CCS/CCUS (Thailand) - Example of Business Model (Carbon Capture)

Providing CO2 capture in an energy and cost efficient manner to industries and power generation companies will provide opportunities for JP companies.

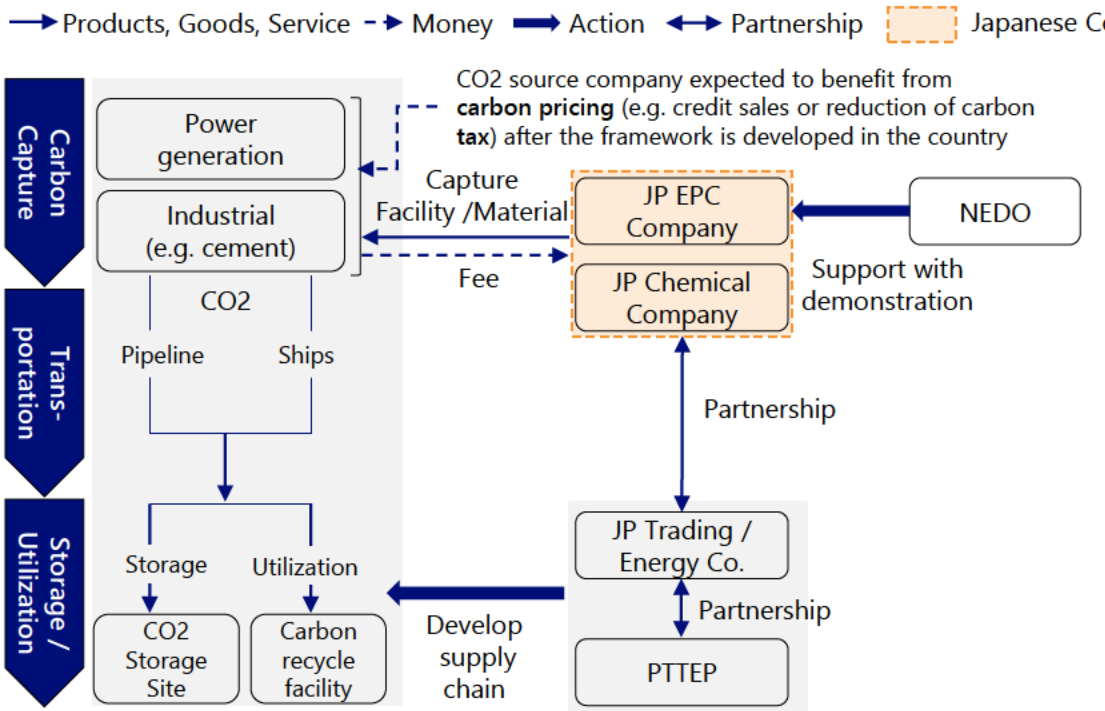
Local Company's Needs

- In Thailand, local energy companies and industry players are aiming to leverage CCS/CCUS across various industries, including fossil fuel power generation and industrial process (e.g. cement, chemicals)
- Within the supply chain, local companies require technology to capture carbon, in a cost and energy efficient manner
- Local companies are looking for partnership with overseas companies which has the above technology

Resource of Japanese Companies

- EPC company:
  - Provide carbon capture facility to the local companies
- Chemical company
  - Provide carbon capture materials to the local CO2 source company, which enables CO2 capture in an energy and cost efficient manner
- Trading companies, energy companies
  - Support the development of overall supply chain within Thailand

Business Model (Carbon Capture Facility / Material)

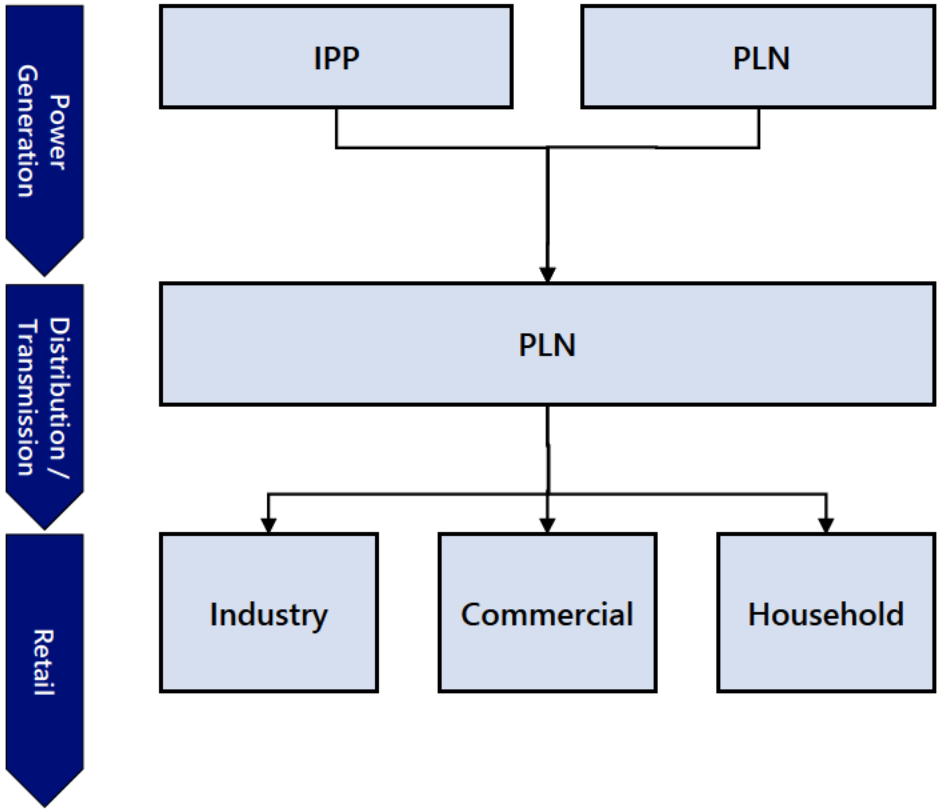


Item	Description
Product of JP Company with Technology	• Carbon capture facility / material for CO2 source which enables CO2 capture in an energy and cost efficient manner
Target Customer	• Companies with CO2 emission such as; ◦ Industries which CO2 emission is hard to avoid (e.g. cement) ◦ Power generation companies
Partner	• Japanese trading company • Japanese energy company

Source: Created by NRI based on interviews and publicly available sources

For renewable energy in Indonesia, issues and needs of local players are the following.

Overview of Electricity Supply Chain in Indonesia



Key Issues and Needs of Local Players

Item		Description
Power Generation	Geothermal	• High investment cost for exploration drilling
	Solar	• High cost of energy storage • Solar module technology of local company is low (Needs to have 40% local products)
	Waste Management	• Lack of know how for waste management regarding the renewable energy equipment
	Hydro	• Instability due to seasonality
Distribution / Transmission		• Electricity loss during distribution/transmission • Instability for grid, especially for low voltage
Retail		• Development of new technology to utilize excess energy

Source: Created by NRI based on Ministry of Energy and Mineral Resources (MEMR), interviews

Renewable Energy (Indonesia) - Example of Business Model (Geothermal)

Solutions with technology to manage the power generation of renewable energy efficiently can develop opportunities for Japanese solution providers.

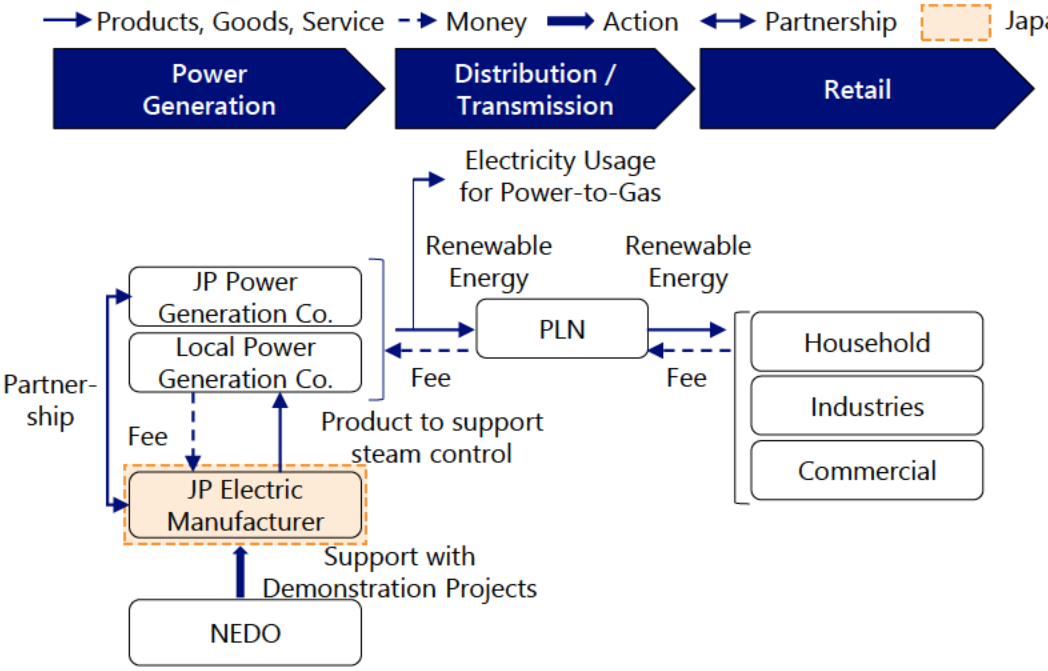
Local Company's Needs

- In Indonesia, power generation companies are aiming to increase the renewable energy power generation, for areas such as geothermal and solar power generation
- For geothermal power generation, one of the key issues is the stability, such as technology to control the amount of steam

Resource of Japanese Companies

- Electric manufacturer: Provide technology which supports with the control of steam for geothermal power generation
- Trading company: Invest in the power generation with local player, and support with the introduction of the Japanese solution provider

Business Model (Geothermal Power Generation)

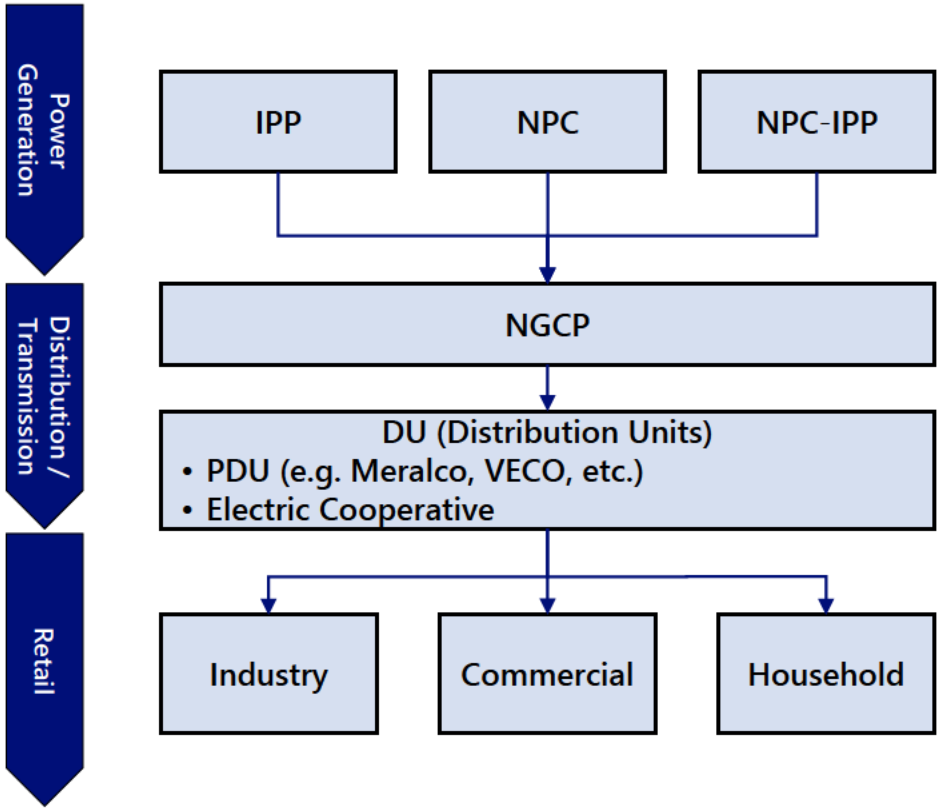


Item	Description
Product of JP Company with Technology	• Steam control product (e.g. Intelligent steam control products which uses cloud and AI data to monitor the system efficiently)
Target Customer	• Local power generation company (e.g. IPP) which provides renewable energy power generation
Partner	• JP trading company

Source: Created by NRI based on interviews and publicly available sources

For renewable energy in Philippines, issues and needs of local players are the following.

Overview of Electricity Supply Chain in Philippines



Key Issues and Needs of Local Players

Item		Description
Power Generation	Geothermal	• High initial investment for drilling • Difficult to control the steam
	Wind	• Data collection for identification of suitable land is too expensive • Instability due to seasonality
	Solar	• High cost of energy storage
	Biomass	• Difficult to secure materials sufficiently
	Hydro	• Instability due to seasonality
Distribution / Transmission		• Instability / electricity loss during distribution/transmission • Insufficient capacity for distribution / transmission:

Source: Created by NRI based on METI, interviews

Renewable Energy (Philippines) - Example of Business Model (Wind Power)

Solutions with technology to manage the power generation of renewable energy efficiently can develop opportunities for Japanese solution providers.

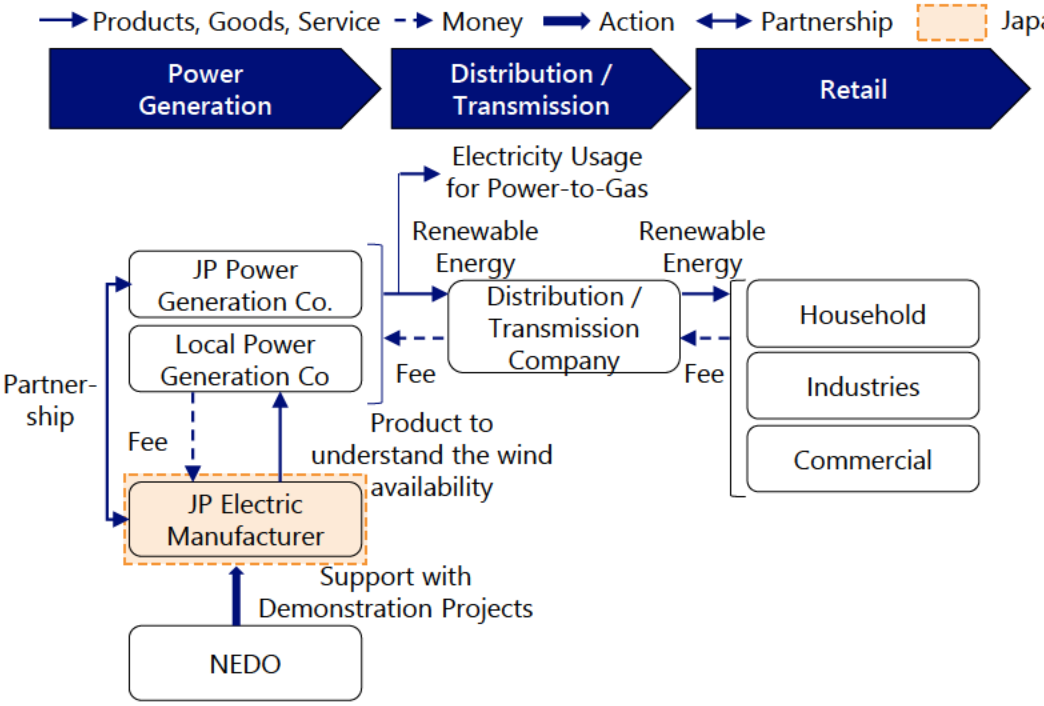
Local Company's Needs

- In the Philippines, power generation companies are aiming to increase renewable energy power generation such as solar power and wind power generation
- For wind power generation, one of the key issues is identifying the amount of wind available for power generation within specific areas

Resource of Japanese Companies

- Electric manufacturer: Provide technology which supports with the identification in terms of the amount of wind available
- Trading company: Invest in the power generation with local player, and support with the introduction of the Japanese solution provider

Business Model (Wind Power Generation)

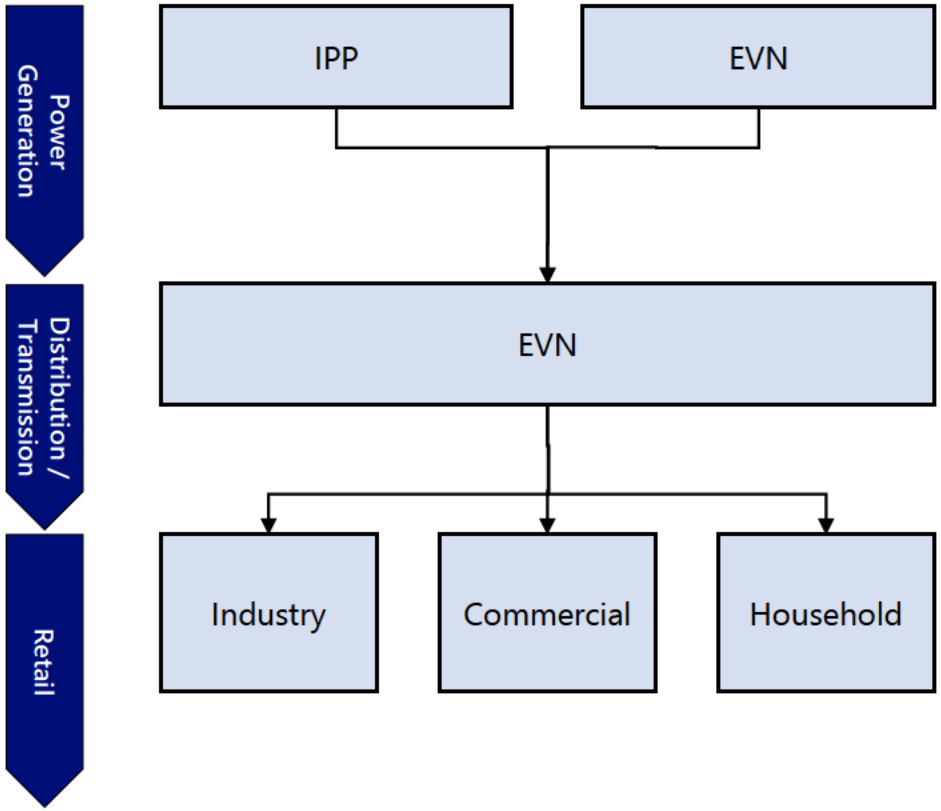


Item	Description
Product of JP Company with Technology	• Product to understand the amount of wind available for wind power generation
Target Customer	• Local power generation company (e.g. IPP) which provides renewable energy power generation
Partner	• JP trading company

Source: Created by NRI based on interviews and publicly available sources

For renewable energy in Vietnam, issues and needs of local players are the following.

Overview of Electricity Supply Chain in Vietnam



Key Issues and Needs of Local Players

Item		Description
Power Generation	Solar	• Lack of storage systems
	Hydro	• Technology for pumped storage hydropower system
	Wind	• Limitation on land availability for the project development
	Waste	• Insufficient supply of waste
Distribution / Transmission		• Increasing the capacity of transmission line • Interconnection with the nation's grid line:
Retail		• Availability of technology for the utilization of excess electricity generated from the renewable energy

Source: Created by NRI based on JEPIC and interviews

Renewable Energy (Vietnam) - Example of Business Model (Electrolyzer)

Solutions with technology to utilize the excess renewable energy efficiently will provide opportunities for Japanese companies.

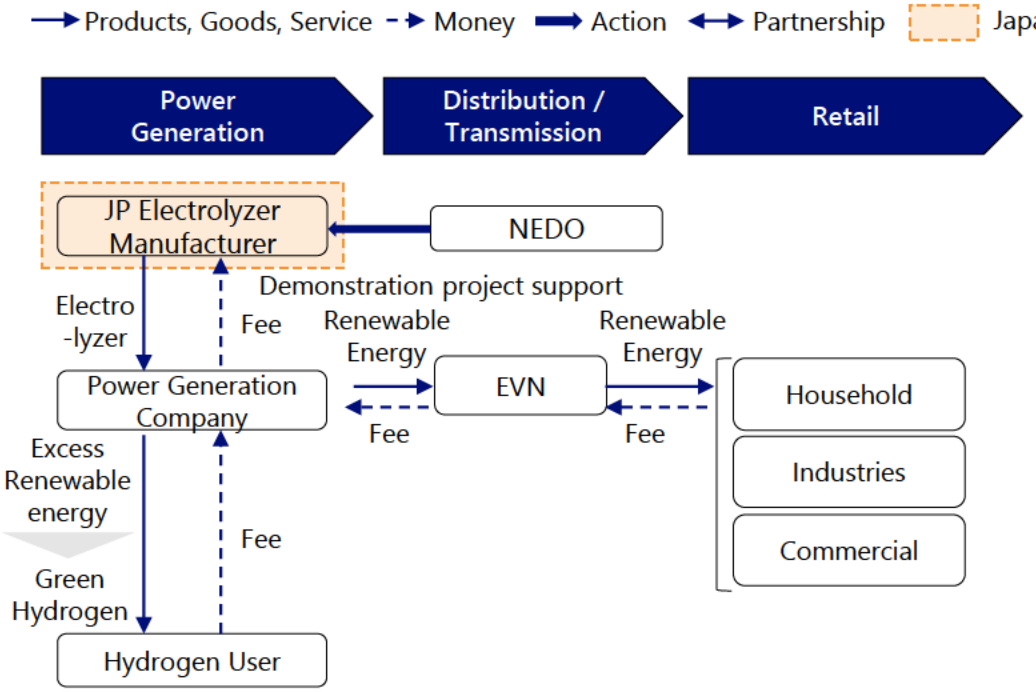
Local Company's Needs

- In Vietnam, renewable energy is aimed to be further implemented, in which availability of technology for the utilization of excess electricity generated from renewable energy is lacking
- Power generation companies are looking into technology which supports with the above, including technology which converts excess solar and wind power into green hydrogen

Resource of Japanese Companies

- Electrolyzer manufacturer: Provide electrolyzer which enables the conversion from renewable energy to green hydrogen

Business Model (Electrolyzer to Utilize Excess Electricity Effectively)

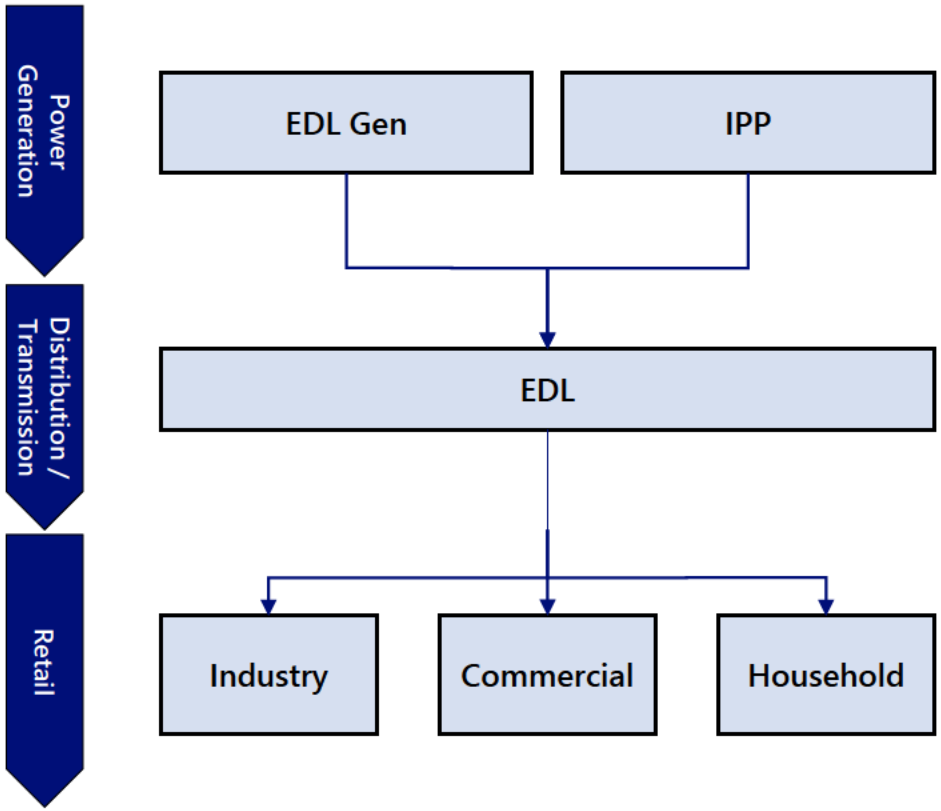


Item	Description
Product of JP Company with Technology	• Electrolyzer which helps produce green hydrogen in a stable manner
Target Customer	• Power generation company (e.g. EDL Gen)
Partner	• N/A

Source: Created by NRI based on interviews and publicly available sources

For renewable energy in Laos, issues and needs of local players are the following.

Overview of Electricity Supply Chain in Laos



Key Issues and Needs of Local Players

Item		Description
Power Generation	Geothermal	• Lack of understanding on feasibility and supply capacity
	Solar	• Instability based on lack of storage systems, given the high price of battery storage
	Biomass	• Instability based on fluctuation of raw material availability
	Hydro	• Instability based on seasonality • Difficult to regulate, as hydro is mostly run of river
Distribution / Transmission		• Energy loss during transmission • Limited volume for transmission
Retail		• Can't fully utilize excess electricity as difficult to anticipate surplus energy • Development of new technology to utilize excess energy

Source: Created by NRI based on JICA and interviews

Renewable Energy (Laos) - Example of Business Model (Electrolyzer)

Solutions with technology to utilize the excess renewable energy efficiently will provide opportunities for Japanese companies.

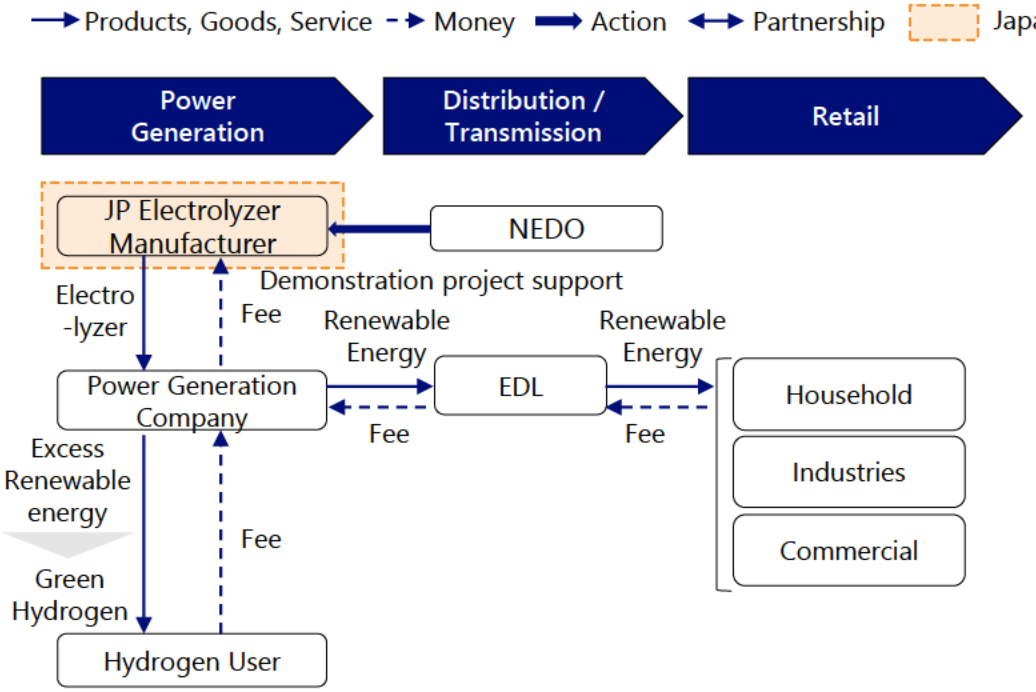
Local Company's Needs

- In Laos, the country has a large amount of renewable energy power generation capacity, in which availability of technology for the utilization of excess electricity generated from renewable energy is lacking
- Power generation companies are looking into technology which supports with the above, including technology which converts excess hydro power generation into green hydrogen

Resource of Japanese Companies

- Electrolyzer manufacturer: Provide electrolyzer which enables the conversion from renewable energy to green hydrogen

Business Model (Electrolyzer to Utilize Excess Electricity Effectively)



Item	Description
Product of JP Company with Technology	• Electrolyzer which helps produce green hydrogen in a stable manner
Target Customer	• Power generation company (e.g. EVN)
Partner	• N/A

Source: Created by NRI based on interviews and publicly available sources

Key issues and needs by local players in the Philippines is the following.

Example of Key Areas for Smart City in ASEAN

Civic & Social	• Inclusive & Equitable Growth
Health & Well-being	• Housing & Home
Security	• Personal Safety & Security
Quality Environment	• Water, Waste & Sanitation
Built Infrastructure	• Mobility • Urban Resilience
Industry & Innovation	• Education

Key Issues and Needs of Local Players in the Philippines

Item	Description
Security	• Lack of natural disaster management system • Lack of responsive and automated security system
Mobility	• Lack of connected transportation system • System which supports with the visualization of traffic (e.g. GIS enabled system for identifying parking lots)
Housing & Home	• Lack of connectivity for smart grid technology • Limited area and lack of safety monitoring system for large size battery for city supply • Difficult for individuals to install solar panel at the households • High initial investment for energy management in and IoT conversion

Source: Created by NRI based on ASEAN Secretariat and interviews

Smart City (Philippines) - Example of Business Model (Mobility)

Providing solutions which supports with transportation issues may support the business development of Japanese companies.

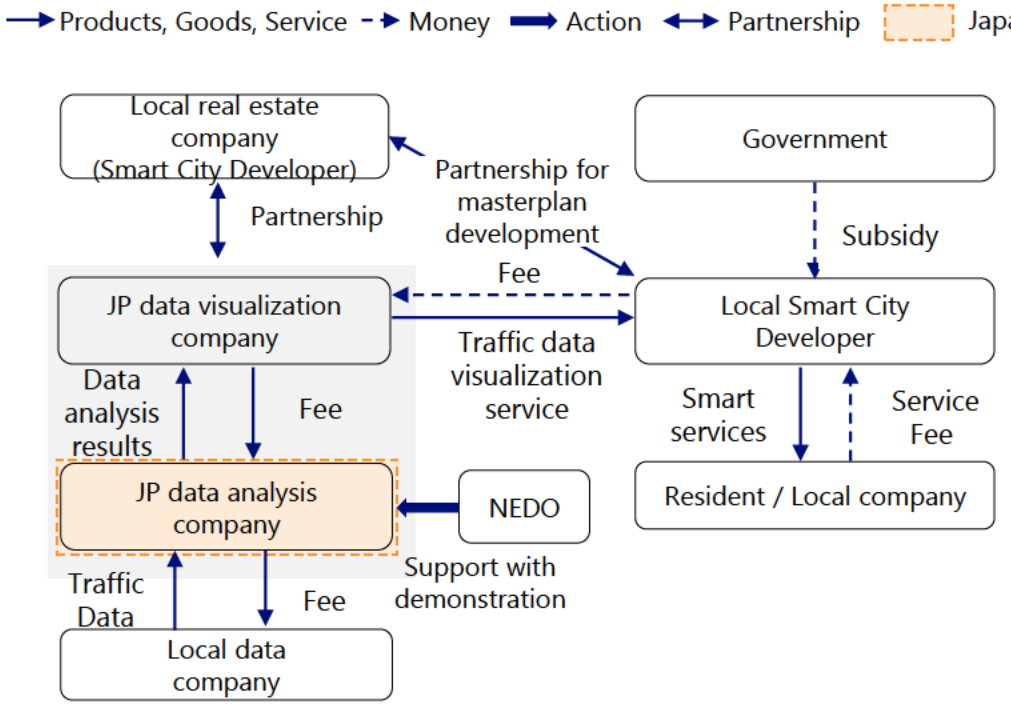
Local Company's Needs

- In the Philippines, smart city development is currently conducted by key players including real estate developers, in which key issues which need to be resolved are security, mobility, and energy efficiency
- Major players are aiming to develop smart solutions, which enables not only the wellbeing of the citizens but also to address issues regarding green and carbon neutrality

Resource of Japanese Companies

- Data analysis company:
  - Collects and analyzes the traffic data from local data company
- Data visualization company:
  - Utilizes the data and provides data visualization service for the residents (e.g. Provide suggestion on how to avoid the traffic congestion)

Business Model (Mobility Service for Smart Cities)

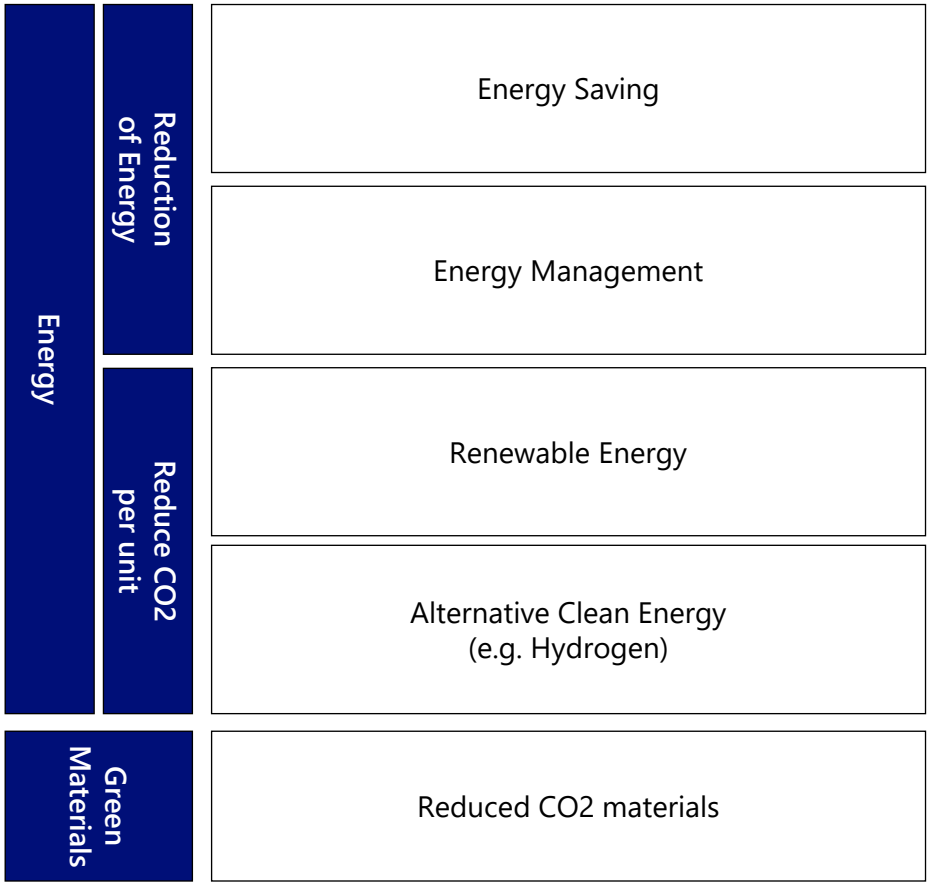


Item	Description
Product of JP Company with Technology	• Visualization services which supports resolving traffic congestion issues (e.g. GIS system which visualizes the amount of road traffic)
Target Customer	• Local smart city developer
Partner	• Mobility solution provider

Source: Created by NRI based on interviews and publicly available sources

Key areas for green building solutions include energy and green materials, in which issues and needs of local players are the following.

Overview of Green Building Solutions



Key Issues and Needs of Local Players

Item	Description
Energy Management	• Lack of IoT equipped equipment • Limited choice of energy management systems (e.g. usage of AI for analysis) • Energy control and management is not centralized
Renewable Energy	• Battery storage too expensive to install for solar power generation • Wind turbine too expensive to install
Green Materials	• Limited amount of certified green materials

Source: Created by NRI based on interviews

Green Building (Thailand) - Example of Business Model (Energy Management)

Providing solutions which supports with energy saving / energy management may support the business development of Japanese companies.

Local Company's Needs

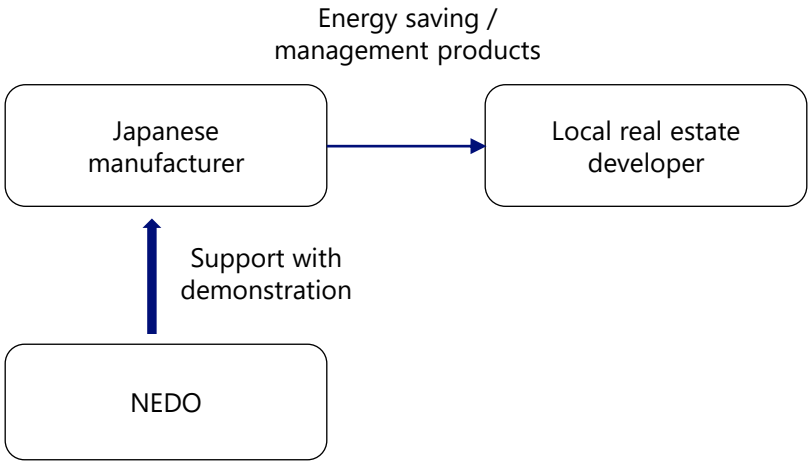
- In Thailand, many major real estate developers have set targets for the environment including GHG reduction and carbon neutrality
- To achieve the target, current technology is not sufficient, and hence local developers are looking into technology providers for GHG reduction
- Within the areas, energy saving and energy management are one of the core areas for the local company's needs

Resource of Japanese Companies

- Company which provides energy saving (e.g. air conditioners) and energy management products

Business Model (Energy Saving & Energy Management)

→ Products, Goods, Service - → Money ➡ Action ↔ Partnership ▭ Japanese Company with Technology



Item	Description
Product of JP Company with Technology	• Energy saving products (e.g. Air conditioners) • Energy management products (e.g. IoT equipped equipment devices and equipment, energy management software)
Target Customer	• Local developers which has interest in carbon neutral or GHG reduction
Partner	• N/A

Source: Created by NRI based on interviews and publicly available sources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