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Powering Prosperity and Enabling Sustainability in South East Asia

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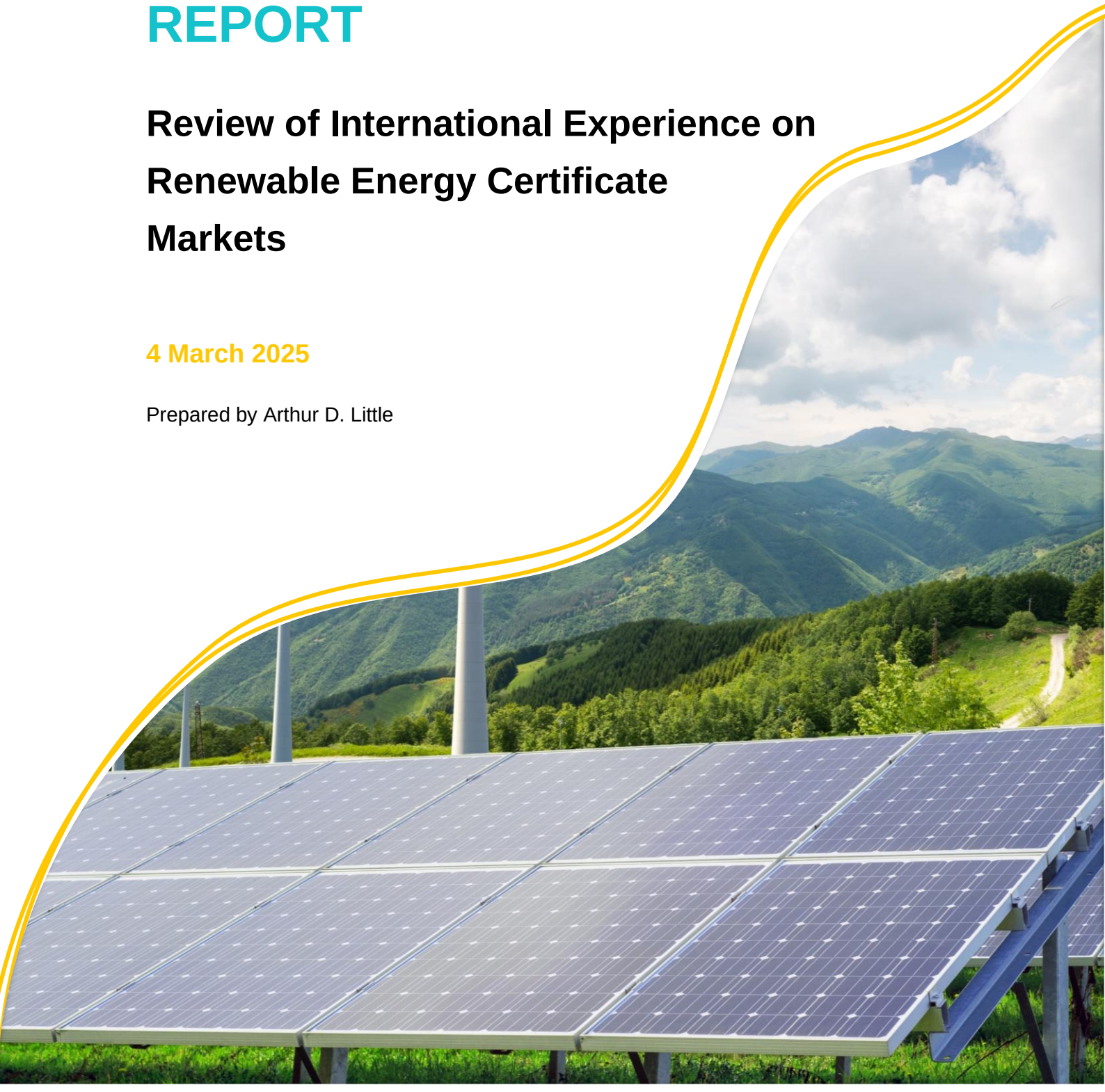
ARTHUR D LITTLE

REPORT

Review of International Experience on Renewable Energy Certificate Markets

4 March 2025

Prepared by Arthur D. Little



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1. Introduction and Project Background

1.1 Introduction

To address the key questions, achieve the objectives, and effectively establish a **Voluntary Renewable Energy Market (VREM)** in the Philippines, the project is structured into three interconnected scopes. Each scope addresses critical aspects of VREM development, from market assessment to developing a suitable VREM policy for the Philippines, ensuring a comprehensive and actionable roadmap.

The project's scopes align with a logical progression depicted in Figure 1 below:

- **Scope A** addresses the local supply and demand context;
- **Scope B** integrates international best practices; and
- **Scope C** combines findings into an actionable policy framework, with stakeholder workshops ensuring validation and collaboration.

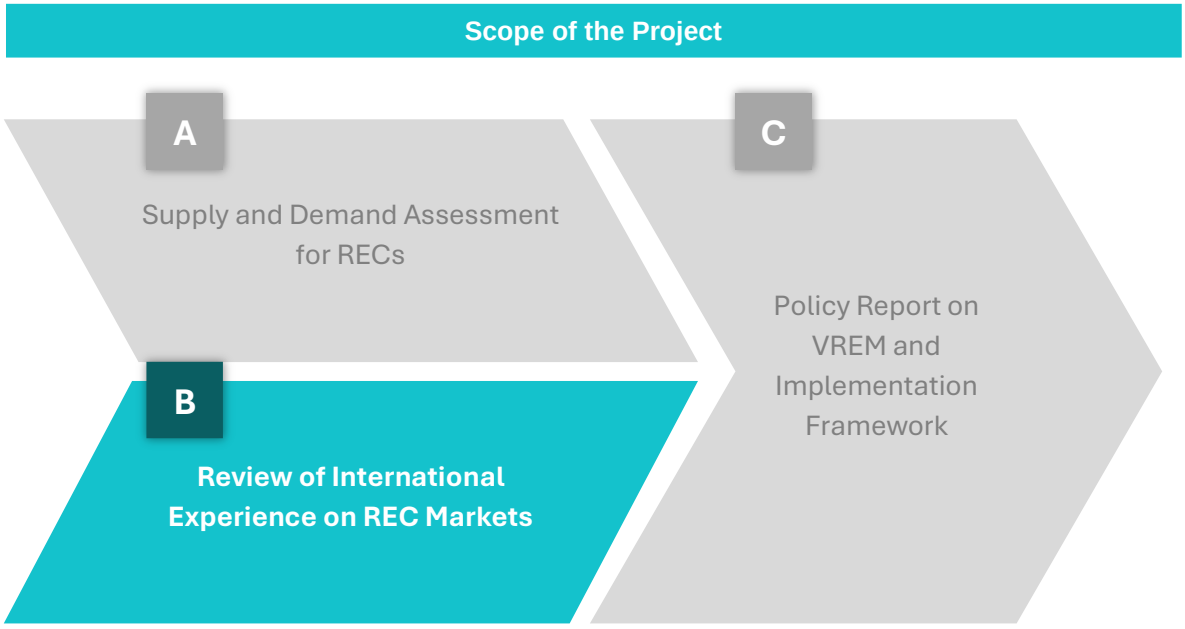

Figure 1 | Scope of the Project

This report focuses on the **Scope B: Review of International Experience on Renewable Energy Certificate (REC) Markets**. It builds on the foundational insights from Scope A by focusing on global benchmarks and best practices. This scope explores the operational structures, market drivers, and regulatory frameworks of established REC markets globally. The goal is to develop REC models, best practices, and tailored strategies suited to the Philippine context, ensuring the VREM aligns with international standards and builds on proven methods for success.

The key deliverables under the Review of International Experience on RE Certificate Markets include:

- The rationale for selecting jurisdictions based on their relevance and success in the REC market implementation.
- An analysis of operational frameworks of selected jurisdictions, focusing on governance, certification, and trading mechanisms.
- Insights into REC demand drivers and market dynamics, including trends in pricing and corporate sustainability commitments.
- A study on processes of claiming, verification, and surrendering of RECs, with a focus on integrating voluntary RECs into mandatory markets.
- An evalutation of the impact of REC markets on renewable energy (RE) capacities, assessing how global markets have accelerated capacity growth.
- Lessons learned from international markets and their applicability to the Philippines, identifying tailored recommendations for VREM implementation.

By synthesizing global experiences, the **Scope B: Review of International Experience on RE Certificate Markets ensures that the Philippine VREM** benefits from tested strategies while addressing local market needs and challenges. This scope positions the VREM framework for success and enhances the country's energy transition efforts.

2. Executive Summary

2.1 Cross Country Analysis

Across the five benchmarked jurisdictions, key indicators for a successful voluntary REC market were identified, along with potential options for each. These insights inform the design of an optimal VREM model for the Philippines. Figure 2 and Figure 3 highlight the diverse approaches taken to develop and advance REC markets.

Key indicators	Viet Nam	Singapore	Australia	California	Germany	Philippines Current State
Period in Operation (Years)	6	12	23	23	24	5
1 Market Type	Fully Voluntary	Fully Voluntary	Mandatory & Voluntary	Mandatory & Voluntary	Fully Voluntary	Mandatory
2 Market Platforms	Fully Voluntary, Single Platform	Fully Voluntary. Single Platform	Mandatory & Voluntary, Single Platform	Mandatory & Voluntary, Single Platform	Fully Voluntary, Single Platform	Mandatory, Single platform
3 Operational Framework & Verification System	Renewable Energy Transition, I-REC standards, cert retirement system	I-REC & TIGR standards, cert retirement system	Renewable Energy Target (RET), REC registry	Renewable Portfolio Standard (RPS), WREGIS, bilateral contracts	Guarantee of Origins Register	RPS, PREM
4 International or Local Markets	Both international and local trade	Internation-al purchasing to meet local demand	Primarily local consumption	Primarily local consumption	Both internation-al and local trade	Limited to local market

Figure 2 | Cross-Country Analysis of each Jurisdiction's REC Market (1/2)

Key indicators	Viet Nam	Singapore	Australia	California	Germany	Philippines Current State
5 Key Stakeholders	Ministry of Industry and Trade (MOIT)	Energy Market Authority	Clean Energy Regulator (CER)	CEC & CPUC[1]	Federal Environmental Agency (UBA)	DOE
6 Carbon Credit & REC Synergy	CCs and RECs can be generated by the same entity, provided generation are from distinct activities					No integration with carbon credit market
7 REC Demand Drivers and Market Dynamics	RE100, CSR Initiatives	SG Green Plan, RE100, CSR Initiatives	RET, RE100, Progressive culture	RPS, RE100, Progressive Culture	RE100, CSR Initiatives, Eco-Consciousness	Compliance driven by RPS targets
8 Pricing Dynamics	Contract-based pricing	Local spot pricing	Local spot pricing, price ceiling for STCs	Contract-based pricing	Contract-based Pricing	Regulated within compliance market *REC price: PHP 240*
9 Stimulate REC Supply	Substantial increase in RE generation	Increasing demand for RE generation	Moderate increase in RE generation	Consistent growth in RE generation	EU sustainability leader in RE production	Eligible local RE generators

Figure 3 | Cross-Country Analysis of Each Jurisdiction's REC Market (2/2)

2.1.1 Market Type

The key consideration in establishing a REC market is determining the appropriate market structure - whether it should be mandatory, voluntary, or a hybrid model. An overview of each market type can be found below.

Mandatory Market:

- **Regulated Participation** – RE generators must produce and sell RECs to meet quotas under the Renewable Portfolio Standards (RPS)
- **Compliance-Driven Demand** – Utilities and businesses are required to buy RECs, ensuring a stable market demand
- **Government Oversight** – Authorities enforce compliance, impose penalties, and adjust targets

Voluntary Market:

- **Corporate-Led Adoption** – Businesses buy RECs for sustainability and environmental, social, and governance (ESG) goals
- **Market-Driven Demand** – REC prices fluctuate based on supply and corporate interest
- **Flexible Participation** – Participation is voluntary, with no mandates

Hybrid Market:

- **Hybrid Participation** – Obligated entities are required to produce and sell RECs while voluntary contributions are incentivized
- **Hybrid Demand Dynamic** – Demand is influenced by market interactions between liable and voluntary entities
- **Government Oversight** – Authorities enforce compliance, set penalties and incentives, and adjust targets

The benchmarked jurisdictions have adopted a combination of market types tailored to the needs and structure of their domestic REC markets. While a mandatory market ensures consistent REC demand, integrates with national renewable energy targets, and drives investment in renewables, it may also impose additional costs on businesses and require enhanced government enforcement and compliance mechanisms.

Conversely, a voluntary market introduces demand uncertainty and may require additional government incentives to encourage REC adoption. Despite these challenges, all benchmarked jurisdictions have implemented a voluntary market to promote corporate participation and provide companies with flexibility in meeting ESG goals. Additionally, engagement with international corporations expands opportunities for international REC trade.

To leverage the benefits of both models, many jurisdictions have adopted a hybrid approach, this ensured steady REC demand while supporting renewable energy targets through both mandatory

and voluntary participation. However, a key challenge of this approach is maintaining a steady increase in REC supply, as both market segments compete for a limited pool of RECs.

To illustrate these dynamics, two case studies were selected: Germany, representing a fully voluntary market, and Australia, exemplifying a hybrid model.

Voluntary Market Example: Germany

As a purely voluntary market, Germany has no mandatory requirement for **Guarantee of Origin (GO)** trading. Instead, its demand is driven by strong corporate commitments and an eco-conscious society. As a global sustainability leader with high environmental awareness, major German corporations set ambitious targets and actively contribute to the market. Notably, the country's automotive manufacturers play a key role in advancing these initiatives.

Germany's voluntary market model encourages corporate participation and provides flexibility in meeting their Environmental, Sustainability, and Governance (ESG) goals while also expanding international REC trade opportunities. However, the absence of mandatory participation creates demand uncertainty, necessitating strong incentives to drive adoption.

Hybrid Market Example: Australia

On the other hand, Australia serves as a strong example of a hybrid market, having introduced its mandatory REC market before expanding into the voluntary market. The country established its REC market through the **Renewable Energy Target (RET)** in 2000. After observing successful renewable energy and REC adoption within the mandatory market, Australia further developed and incentivized voluntary participation, notably increasing its RET in 2009 in response to rapid renewable energy growth.

A key milestone in Australia's voluntary market development occurred in 2011 when the RET was split into the **Large-scale Renewable Energy Target (LRET)** and the **Small-scale Renewable Energy Scheme (SRES)**, creating the **Large-scale Generation Certificate (LGC)** and **Small-scale Technology Certificate (STC)** schemes. In addition to LGCs for RE facilities' large-scale generation, STCs were introduced to incentivize small-scale technology investments, enabling small businesses and households to participate in REC trading. Additional policies and incentives were released post 2011 to further drive the adoption of renewable energy and REC trade across mandatory and voluntary markets. Furthermore, Australia's voluntary market is driven by strong corporate demand, supported by a highly eco-conscious population and progressive culture. As a result, Australia maintains consistent REC demand and RET contributions, although the consistently high demand has led to an undersupply of STC's, resulting in consistently high STC pricing.

2.1.2 Market Platforms

The development of REC market platforms must encompass the holistic needs of the market. An analysis of various jurisdictions has identified two potential approaches to REC platform development, considering both mandatory and voluntary markets.

Single Platform:

- **Centralized Data** – A single, unified platform stores all transactions, retirements, and issuance data
- **Data Consistency** – Standardized formats and tracking rules across the country/markets

Multiple Platforms:

- **Platform Diversity** – Platforms are designed to fit needs of specific markets better
- **Platform Specialization** – Presents an opportunity to integrate or focus on specific technologies based on market needs

When considering a hybrid REC market model, each platform approach has its own merits and demerits. A single platform for both mandatory and voluntary markets offers centralized data aggregation and lowers barrier to entry for participants. However, utilizing a centralized platform creates a single point of failure, limiting innovation in platforms, and slowing system upgrades.

Alternatively, multiple platforms allow for customization and specialization, catering to the specific needs of each market. However, this approach fragments data, complicates nationwide data aggregation, and creates inconsistencies in verification and quality control.

While no observed jurisdictions have multiple platforms split between mandatory and voluntary markets, jurisdictions provide valuable insights on establishing an efficient and scalable marketplace. For instance, Singapore utilizes blockchain technology to enhance trading efficiency and facilitate cross-border transactions, expanding Singapore's VREM locally and internationally.

2.1.3 Operational Framework & Verification System

Regarding operational framework and **verification systems**, a country's selection of REC Standards needs balancing between global and local market needs for optimal market impact. In this assessment, options were explored on adopting an international framework such as I-REC and TIGR, or whether to further develop a local REC framework.

International Framework:

- **Global Market Access** – Enables cross-border REC trade, attracting international buyers and investors
- **Standardized Framework** – Ensures credibility, transparancy, and compatibility with established global REC mechanisms
- **Supports Corporate Sustainability** – Aligns with multinational companies' ESG targets, driving demand

Local Framework:

- **Custom-fit for Regulations** – Designed to comply with national energy policies
- **Local Participation** – Supports small RE projects and local businesses in meeting sustainability goals
- **Market Control & Flexibility** – Allows government to set unique rules, pricing mechanisms, and compliance measures tailed to Philippine energy needs

Aligning with international frameworks enhances REC credibility, facilitates international trade, and attracts foreign investment. However, compliance with global REC standards can also reduce regulatory flexibility. Conversely, a local framework allows for tailored regulations and policies but limits market participation to domestic players and requires additional efforts to establish credibility.

Singapore exemplifies a market that integrates international frameworks for REC certification, adopting both I-REC and TIGR standards. REC redemptions in Singapore exceed issuances by a factor of 10, highlighting the country's heavy reliance on REC imports to meet corporate demand, which far surpasses domestic supply. By aligning with international frameworks, Singapore increases REC availability and addresses market imbalances. However, this dependence on imported RECs—often priced lower than domestic RECs—can reduce the competitiveness of local producers, who typically command a price premium.

Australia, in contrast, operates under a **strong local framework** with minimal international trade. While it recognizes I-REC for international certification, Australian projects must choose between registering for either the local or international market, prohibiting dual participation. This restriction limits the availability of Australian RECs in the global market. Australia's REC ecosystem is entirely managed by the **Clean Energy Regulator (CER)**, which oversees local regulations, protocols, standards, and trading platforms tailored to support the Renewable Energy Target (RET) and voluntary market. This localized approach ensures self-reliance in REC supply and allows for policy customization. However, it also restricts Australia's ability to address over- or under-supply due to its minimal integration with international REC trading.

When designing an **operational framework**, there are additional items to be considered, namely registry and trading operations. When considering registry operation, there are two main options.

Government-Run:

- Government-developed protocols and standards for REC issuance

Outsourced:

- Appointed agencies devloping protocols and standards for REC issuance

Government-run and outsourced registry options have their own unique set of pros and cons. Government-run registries can ensure strict compliance and better policy integration but requires more oversight by the government. Outsourced registries are more market-driven and efficient but have potential conflicts between private and public interests.

For **trading systems**, there are three options that can be utilized for adoption.

OTC/PPA:

- Buyers partner with utilities for trading **Over The Counter (OTC)** or through **Power Purchase Agreements (PPAs)**

Trading Platforms:

- Trading platforms that house RECs and facilitate transactions can leverage emerging technologies such as blockchain

Service Providers:

- Service providers facilitate trades between buyers and sellers

When evaluating trading systems, each option presents distinct advantages and drawbacks. OTC/PPAs offer tailored agreements and stable pricing between entities but lack price and volume transparency. Trading platforms enhance market transparency and efficiency but demand continuous technological innovation. Service providers facilitate supply aggregation and guided trading, yet they pose risks of market manipulation.

2.1.4 International or Local Markets

Engaging in international trade offers both opportunities and risks for domestic producers and corporations. This analysis examines these factors from two perspectives—buyer and seller—by comparing local and international trade, highlighting their respective advantages and drawbacks.

Firstly, from the **buyer perspective**:

Local Trade:

- Buyers exclusively purchase RECs from domestic renewable energy projects

International Trade:

- Buyers purchase RECs from both domestic and international renewable energy projects

Local trade offers buyers a simplified regulatory landscape but limits options to the domestic market and exposes them to local market conditions. In contrast, international trade provides access to a broader REC supply at potentially lower prices. However, sourcing internationally may cannibalize local REC supply, leading to potential backlash for not supporting domestic renewable energy providers.

From the **seller perspective**, similar insights to its pros and cons can be observed:

Local Trade:

- Selling RECs exclusively to the domestic market

International Trade:

- Selling to both domestic and international markets

Sellers engaged in local trade support domestic sustainability efforts but remain dependent on local supply and demand dynamics, lacking international market access to help balance fluctuations. In contrast, international trade offers a broader demand pool, improving supply-demand balance. However, it requires adherence to global REC standards, reducing regulatory flexibility and potentially limiting compatibility with the local market.

2.1.5 Key Stakeholders

In determining the optimal stakeholder structure for establishing the VREM, insights from other jurisdictions highlight the importance of a lean framework for end-to-end process optimization. Benchmarking analysis has identified two potential options for REC market governance.

Single Governing Body:

- **Streamlined Reporting Structure** – Liable entities and other key participants report to one authority
- **Centralized Data** – All transactions, retirements, and issuance data housed under one unified platform
- **Simplified Auditing and Compliance** – Easier for participants to adhere to compliance checks

Multiple Governing Bodies:

- **Specialized Entities** – Specific governing bodies tailored to specific portions of the VREM
- **Specified Data Reporting** – Specialized databases can be made to separate market functions or archetypes

Utilizing a single governing body streamlines issuance, data reporting, and governance, ensuring a simplified end-to-end process. However, it also introduces a single point of failure, where errors, outages, disruptions, or scandals could impact the entire market. In contrast, multiple governing bodies offer flexibility and specialization for specific regions or market archetypes, though this approach can lead to market fragmentation, increased complexity, and additional barriers to entry.

Some examples from various jurisdictions illustrate these approaches. Australia, Germany, Singapore, and Vietnam employ a single governing body for their REC markets. Meanwhile, California utilizes a dual-body system, with the **California Energy Commission (CEC)** and the **California Public Utilities Commission (CPUC)** managing separate market functions, with the CPUC overseeing public utilities.

2.1.6 Carbon Credit & REC Synergy

Like RECs, carbon credits play a key role in carbon abatement programs and sustainability initiatives. Many consumers leverage both to meet their ESG goals, making participation in both schemes an appealing opportunity for producers. However, this raises the risk of double counting, necessitating effective countermeasures. Striking a balance between domestic priorities and international integration is essential when establishing double counting rules. From a **supplier's perspective**, two key approaches can be considered for the treatment and generation of carbon credits and RECs.

Allowing Both:

- **Reasoning** – Acknowledges the distinct environmental benefits between reducing carbon emissions and increasing renewable energy supply
- **Limited Application** – It is uncommon to allow both based on observations on current international certifications and standards

Only Allowing One:

- **Reasoning** – Recognizes the environmental benefits of RECs and carbon credits simultaneously
- **International Application** – International frameworks such as I-REC, TIGR, and the European Energy Certificate System (EECS) prohibit both carbon credits and RECs to be issued for the same unit of electricity produced

Both approaches present compelling arguments. Allowing participation in both markets can boost supply and provide greater financial support for renewable energy producers. However, it may restrict international REC trading and require additional efforts to establish credibility in global markets. Conversely, limiting participation to a single scheme facilitates international trade access and enhances market credibility, potentially attracting foreign direct investment. However, this model necessitates strict government oversight to prevent double counting.

A key takeaway from all studied jurisdictions—Australia, California, Germany, Singapore, and Vietnam—is that **they all prohibit claiming both schemes** for the same unit of renewable energy generated.

2.1.7 REC Demand Drivers and Market Dynamics

Even with guaranteed demand in the mandatory market, jurisdictions must actively implement policies to stimulate REC demand in the voluntary market to accelerate national climate goals. This can be achieved through penalty-driven or incentive-driven policies, each targeting the three key REC market participants—corporations, producers, and consumers—as outlined in Table 6 below.

	Penalty-Driven Policies	Incentive-Driven Policies
Corporations	Legally binding mandates including penalties such as fines and exclusion from public contracts	Governmental support such as tax breaks and subsidies for corporations that adopt sustainability commitments
Producers	Corporations required to purchase emission allowances of pay increased taxes for non-renewable energy production	Feed-In Tariffs, market premiums or other programs to reduce barriers to entry for new producers
Consumers	Additional surcharge for non-environmentally friendly goods	Training courses, curriculum, and projects to promote sustainability awareness

Table 6: Summary of Entities and Applications of Penalty and Incentive Driven Policies

While penalty-driven policies ensure compliance and sustain REC demand and supply, they may not always be the most efficient approach. These policies can undermine consumer and investor confidence, raising concerns about greenwashing, lower-quality RECs, and rising costs, which may trigger resistance and backlash.

Conversely, incentive-based policies encourage corporations to exceed national sustainability targets, fostering long-term market growth. However, this approach comes with trade-offs, including a delayed impact between implementation and results, as well as increased reliance on government funding. While incentive-driven policies offer greater potential benefits, their effectiveness remains uncertain, as success hinges on their ability to drive meaningful behavioral change among market participants.

2.1.8 Stimulate REC Supply

REC supply and renewable energy generation share a synergistic relationship, underscoring the need for continuous support for renewable energy development. This not only boosts REC issuance but also strengthens REC's role in expanding renewable energy capacity. Renewable energy growth can be driven through local or international initiatives, particularly via grid-connected projects.

Local Initiatives:

- **Public-Private Collaboration –** Joint investments between the government and private sector to accelerate RE project development
- **Infrastructure & Technology Support –** Enhancing grid capacity and integrating advanced RE technologies to increase generation efficiency of domestic producers
- **Financing & Investment Incentives –** Offering subsidies, low-interest loans, and tax benefits to encourage RE project expansion

International Initiatives:

- **International Frameworks –** Align with globally-recognized frameworks, such as I-REC, to ensure credibility and interoperability of RECs across different countries
- **Emerging Technology –** Develop cross-border trading platforms utilizing blockchain technology for increased accessibility
- **International Grid Infrastructure –** Invest in cross-border infrastructure, such as regional interconnectors or high-voltage direct current (HVDC) cables, for easier import of renewable energy. However, this may not be applicable for the Philippines due to its geographical location.

Local initiatives play a vital role in driving economic growth, enhancing operational capacity, and ensuring self-sustainability while meeting national renewable energy targets. For example, California-based Meta actively partners to support renewable energy generation. However, these initiatives often face challenges such as limited international expertise and operational guidance, leading to inefficiencies that could be mitigated through global collaboration. Additionally, they frequently require significant government funding, typically offset by higher consumer taxes, as seen in jurisdictions like California and Germany.

While leveraging international expertise, investment capital, and surplus supply can strengthen local REC markets, it also introduces risks of economic and operational dependency on foreign partners. A clear example is Singapore, which, due to limited land capacity, relies heavily on international sources for renewable energy and REC supply. This dependency highlights the trade-off between local self-sufficiency and international reliance in renewable energy strategies.

Beyond partnerships, governments can explore additional approaches to expand REC supply and meet domestic demand, as demonstrated in the following examples.

Distributed Renewable Energy:

- RECs from decentralized generation sources such as rooftop solar, industrial cogeneration, and microgrids

Waste-to-Energy & Industrial Byproducts:

- RECs from facilities converting waste, landfill gas, or industrial byproducts into renewable electricity

Corporate PPAs with Embedded RECs:

- Private Power Purchase Agreements (PPAs) where RE generation is bundled with RECs

Carbon-Abatement Linked RECs:

- RECs from projects tied to carbon markets, such as CDM, SDM, JCM, or other carbon offset mechanisms – depending on allowance in the relevant policies and standards

International REC Imports:

- RECs sourced from global markets (I-REC, TIGR, GO, including bilateral agreements), allowing access to diverse supply

While these options expand REC sources and accessibility to the REC market, it comes at the cost of additional frameworks and regulations to overcome complications such as sustainability and double counting concerns.

2.1.9 Pricing Dynamics

Accessibility to REC trading is a key success factor in the REC market, with pricing dynamics and dominant trading channels playing a crucial role. Analysis of various jurisdictions reveals three primary pricing models: Local Spot Pricing, Contract-Based Pricing, and Government-Regulated Pricing.

Local Spot Pricing:

- **Trading Channel** – Trading Platforms or Exchanges
- **Pricing -** Determined by **supply-demand relationships** in wholesale REC market
- **Technology** - May utilize emerging technology, e.g. blockchain

Contract Based Pricing:

- **Trading Channel –** Trading Contracts

- **Pricing** - Determined by **market players engaged in REC Trade**

Government-Regulated Pricing:

- **Trading Channel –** Government Regulations and Policies
- **Pricing** - Determined through measures such as **price floors and price ceilings**

Each pricing model influences market accessibility, price stability, and overall participation, shaping different jurisdictions' approach to REC trading.

Local spot pricing, adopted by Germany, Singapore, and Australia through online exchanges and trading platforms, offers real-time price discovery and flexibility. This model enables participants to respond dynamically to market signals but also introduces high price volatility, which can create financial risks that may deter buyers and sellers. Additionally, it requires advanced digital infrastructure to support necessary trading tools.

In contrast, contract-based pricing, present in all jurisdictions, ensures greater price stability by allowing buyers and sellers to negotiate prices. While this reduces financial risk, it limits market flexibility, as long-term contracts prevent real-time responsiveness to price fluctuations. Furthermore, the lack of transparency in price trends and trading volumes can hinder overall market efficiency.

Despite their differences, both local spot pricing and contract-based pricing are driven by supply-demand dynamics, which can lead to price imbalances. For instance, Singapore experiences high price premiums due to insufficient REC issuance, while Vietnam faces low REC prices due to an oversupply of renewable energy.

To mitigate such imbalances, government-regulated pricing can be explored. This model provides a controlled framework, ensuring investment stability and cost predictability by setting defined price ranges. However, it requires strong regulatory oversight, adding administrative complexity. Among the analyzed jurisdictions, only Australia has adopted this model through a price ceiling on its STC scheme, ensuring affordable REC prices for buyers.

2.1.10 Key Success Factors

Overall, the benchmarking analysis has identified 7 key success factors that contribute to a thriving and growing REC market, highlighting the crucial role of government in market development. Figure 4 outlines these key factors and the necessary actions to ensure long-term REC market success.

Key Success Factor	Details	Action
1 **Strong Policy and Regulatory Framework**	• Clear and well-defined **regulatory guidelines** • Harmonization between **voluntary and mandatory** REM • Adoption of **international standards** • Well-structured **compliance** and enforcement mechanisms	• **Define clear rules** for REC issuance, trading, and verification • **Align VREM with REM policies** to prevent regulatory conflicts
2 **Stable and Growing Market Demand**	• **Gov.-led initiatives** to encourage corporate participation • **Incentives** for voluntary REC adoption • Engagement with **RE100 and selected non-RE100 companies**	• **Provide incentives** (tax breaks, subsidies) for REC adoption • **Partner with and support** RE100 firms and multinationals to boost demand
3 **Efficient and Transparent Trading Platform**	• **Centralized and automated** REC trading platform • Integration with **blockchain or digital tracking systems** • Compatibility with **global REC platforms** • **Simplify market** participation	• **Enhance PREMS** for seamless REC tracking and trading • **Integrate with I-REC and TIGR** for global market access
4 **Price Stability and Market Liquidity**	• Mechanisms to **prevent price volatility**, such as price floors, auction-based pricing, or long-term PPAs • **Balanced supply-demand** dynamic • Incentives for **long-term REC purchase**	• Introduce **auction-based pricing and price floors** • Promote **long-term PPAs** for REC price security
5 **Robust Renewable Energy Supply Pipeline**	• Investments in **renewable energy infrastructure** • **Financial support** for new RE projects • **Grid enhancements** for efficient transmission and distribution	• Offer **grants and loans** for RE project development • **Upgrade grid capacity** to support higher RE integration
6 **Stakeholder Engagement and Awareness**	• Active **participation of stakeholders** in VREM discussions • Nationwide **awareness campaigns** • **Public-private partnerships** • Technical Working Groups to **refine VREM policies**	• **Organize TWGs to align VREM policies** with market needs • **Launch awareness campaigns** to drive REC adoption
7 **International Market Integration**	• Recognition and compatibility with **intl. REC trading systems** • Develop **cross-border REC trading** agreements • Align with **global carbon markets** • **Leverage Singapore** as a key REC buyer	• **Secure bilateral trading** deals with high-demand countries • **Align with JCM, ITMOs, and carbon markets** for expansion

Figure 4 | Key Success Factors for VREM Development

3. Jurisdiction 1: Viet Nam

3.1 Summary and Market Overview

3.1.1 Viet Nam REC Market Summary

Viet Nam has rapidly emerged as a renewable energy leader within the Association of Southeast Asian Nations (ASEAN), contributing approximately 69% of the region's solar and wind energy production in 2022.

Operationally, Viet Nam lacks laws mandating renewable energy generation. While the Prime Minister's National Green Growth Strategy sets renewable energy targets, there are no legal requirements for entities to produce renewable energy. As a result, Viet Nam's renewable energy growth relies entirely on the voluntary market.

To facilitate renewable energy attribute trading, Viet Nam follows the I-REC standard, with the Green Certificate Company (GCC) serving as the authorized local issuer. GCC oversees the issuance, verification, and redemption of I-RECs, while transactions occur primarily through authorized service providers that connect buyers and sellers, ensuring credibility and traceability.

I-REC demand in Viet Nam is voluntary, driven by multinational corporations committed to sustainability initiatives such as RE100 and the Clean Energy Investment Accelerator (CEIA). Increasing public awareness and corporate responsibility have further propelled REC adoption as proof of environmental commitment. However, despite rising interest, Viet Nam faces an oversupply in its I-REC market, leading to notably low I-REC prices—below 1 USD per MWh.

Viet Nam's favorable investment climate, strengthened by government incentives and policies, has positioned the country as a prime destination for renewable energy investments, accelerating its renewable energy development.

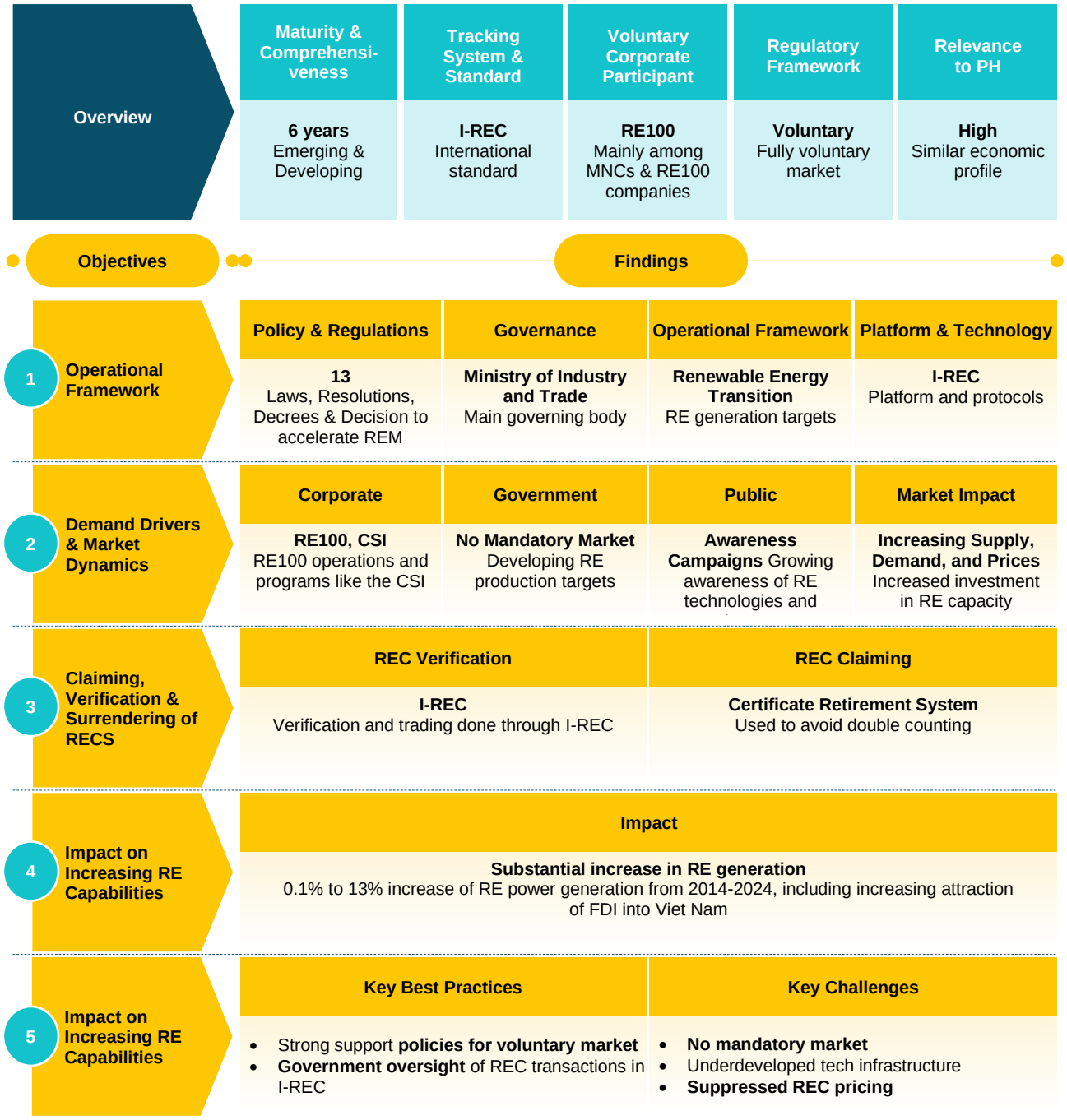

Figure 5 | Summary of Viet Nam's REC Market

3.1.2 Overview of Viet Nam's Carbon Abatement Initiatives

Viet Nam's carbon reduction efforts are led by the Ministry of Natural Resources and Environment, with a national target of achieving net-zero carbon emissions by 2050. These initiatives focus on

two key areas: the National Carbon Market and Renewable Energy. Figure provides an overview of Viet Nam's carbon abatement initiatives and their interconnections.

National Carbon Market:

- Viet Nam is implementing a cap-and-trade mechanism for emissions allowances trading with a pilot established by 2025 and fully operational by 2028
- Viet Nam is currently developing frameworks for generating and trading carbon credits from domestic projects to offset emissions beyond allocated allowances and to be integrated into international systems

Renewable Energy:

- Viet Nam has significantly grown their renewable energy production, particularly in solar and wind energy
- Viet Nam facilitates the issuance and trading of RECs through platforms aligned with international standards such as I-REC and TIGR

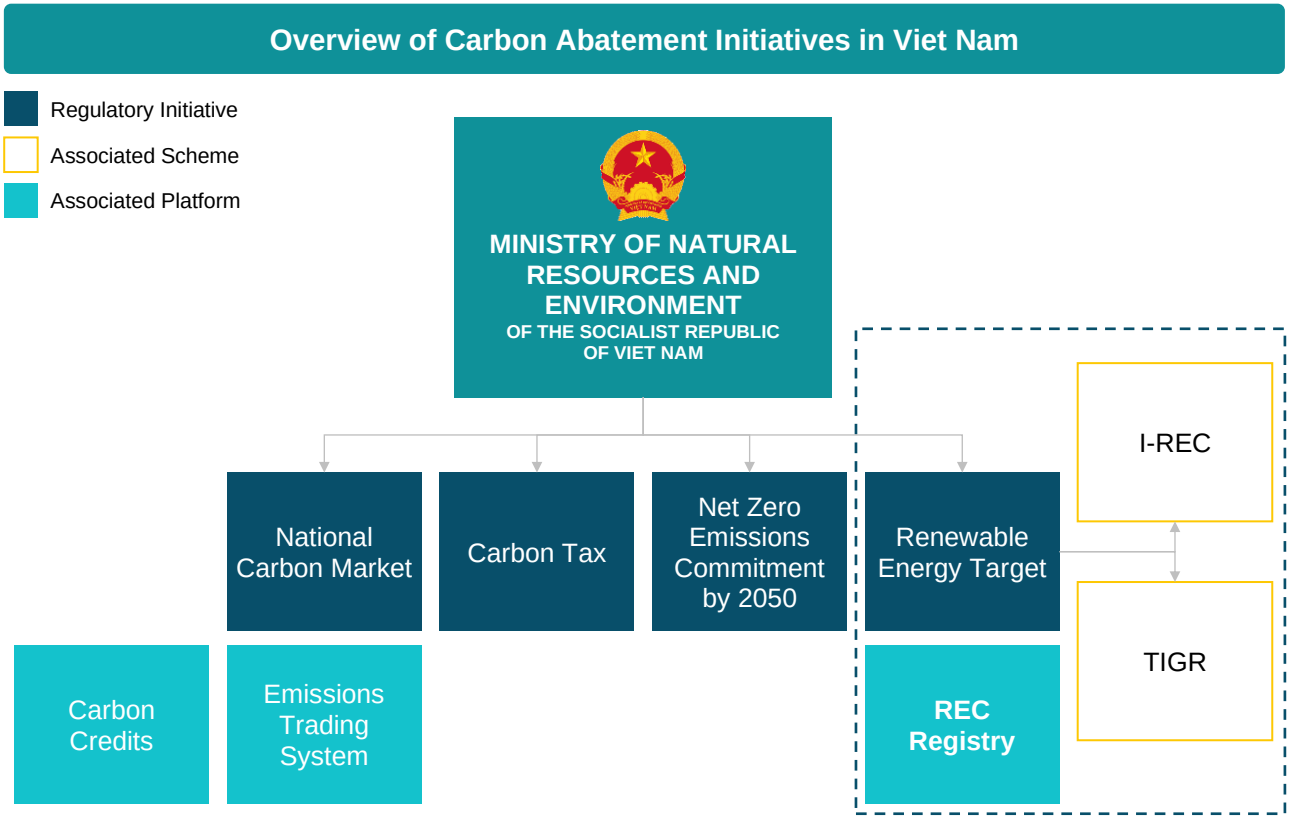

Figure 6 | Viet Nam's Carbon Abatement Initiatives

Source: Ministry of Natural Resources and Environment

3.1.3 Development of Viet Nam's REC Market

Viet Nam's renewable energy sector and its REC market can be divided into three key phases: **Foundation and Awareness** (2010 – 2014), **Market Establishment** (2015 – 2021) and **Market Growth** (2022 – Present). The Foundation and Awareness phase marked the introduction of Viet Nam's initial renewable energy targets, raising awareness and fostering early adoption of renewable energy technologies. In the Market Establishment stage, Viet Nam issued its first REC through the I-REC system, with support from the government and industry leaders. The first REC under the TIGR system was issued in 2018, further expanding market participation. In 2021, the Prime Minister approved the National Green Growth Strategy for 2021–2030, reinforcing the country's commitment to sustainability initiatives. Lastly, the Market Growth stage reflects increased government support for renewable energy, alongside the accelerated expansion of renewable capacity nationwide, strengthening Viet Nam's REC market and sustainability efforts.

3.1.4 Trends in Viet Nam's REC Market

Figure 7 illustrates the capacity growth in Viet Nam's renewable energy sector, highlighting the increase in the number of listed projects and total listed capacity in both I-REC and TIGR from 2022 to 2024, alongside the rising volume of RECs issued in Viet Nam from 2015 to 2024. This rapid expansion aligns with Viet Nam's ambitious goal of achieving nearly 50% renewable energy generation by 2030.

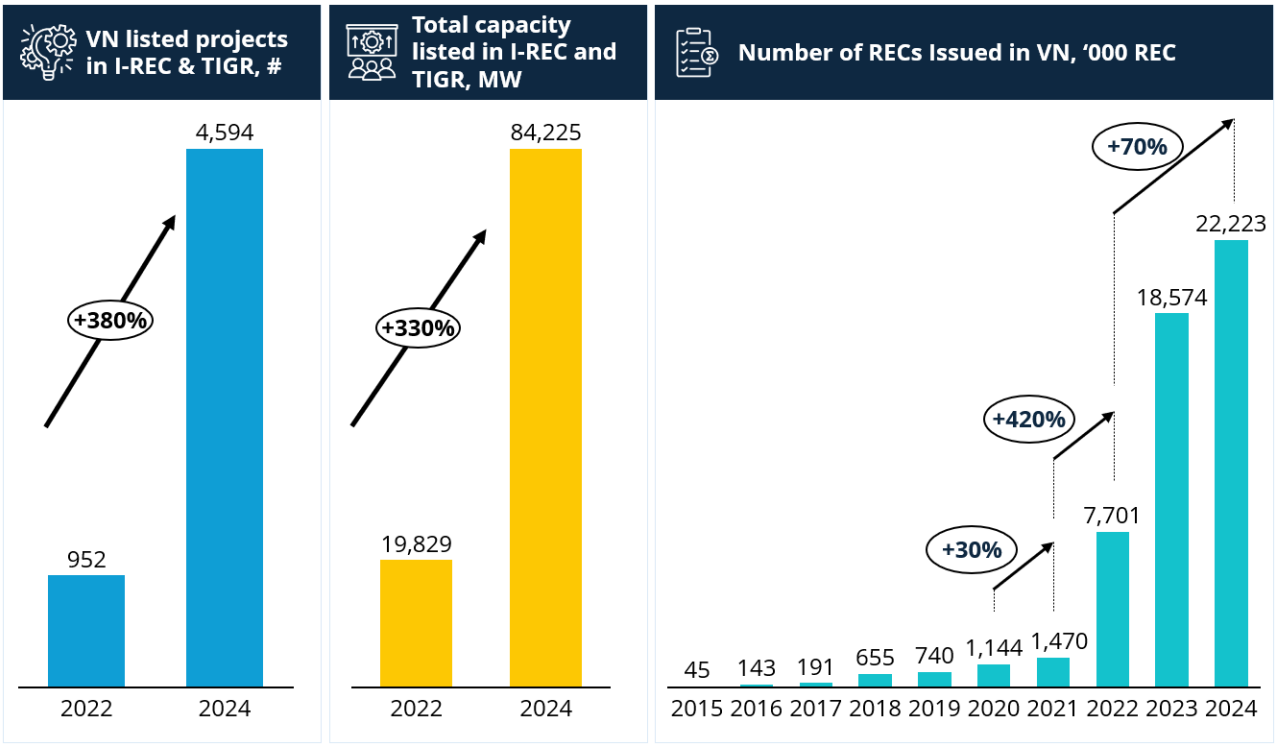

Figure 7 | Overview of Projects, Capacity and REC Issuance in Viet Nam

Source: I-REC, TIGR

3.2 Analysis on Operational Framework

3.2.1 Overall Market Phases

With over 14 years of development, Viet Nam's REC market has progressed through distinct phases. The Foundation and Awareness phase (2010–2014) saw minimal market activity and awareness. The subsequent phases—Market Establishment (2017–2021) and Market Growth (2022–Present)—witnessed increased adoption and market expansion. Further details on each phase are outlined below. Figure 8 illustrates REC issuance trends in relation to market maturity, which will be analyzed in greater depth from Section 3.1.1.

Foundation and Awareness (2010 – 2014): Viet Nam issued general law and decrees on broad environmental energy efficiency goals, clean energy development and climate change response without specific market tools/ mechanisms. The direct impact of regulations on REC market is low.

Moderate (2015 – 2021): Regulations laying the foundation for renewable energy expansion through investment incentives, national energy development strategy and sustainability transition plans were established. These regulations incentivized investment and established market confidence, impacting the REC market moderately.

Market Growth (2022 – Present): This phase includes targeted and action-driven regulations and decisions, such as reducing green gas emission, power purchase agreements and power development planning, accelerating the REC market's development through providing clarity and reducing barriers.

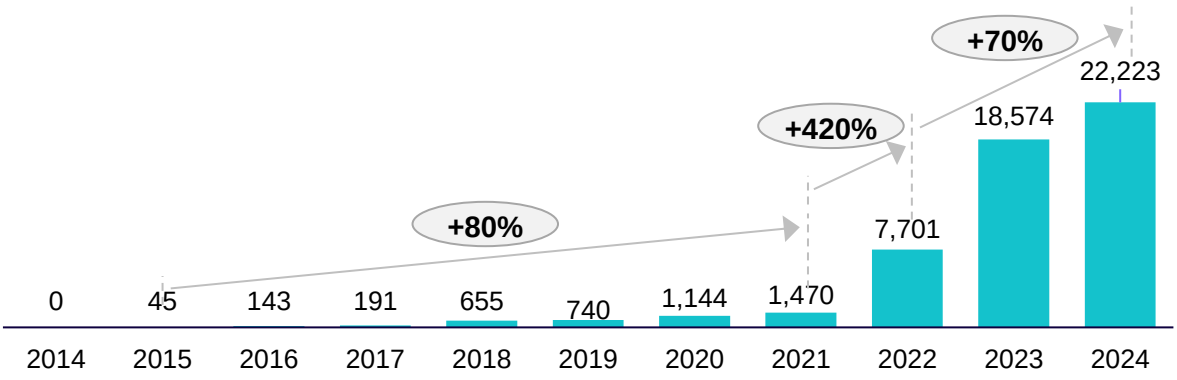

Figure 8 | Number of RECs Issued in Viet Nam, thousand RECs
Source: I-REC, TIGR

3.2.1.1 Foundation and Awareness Phase (2010 – 2014)

The Foundation and Awareness stage laid the groundwork for integrating RECs into Viet Nam's renewable energy sector by establishing broad regulatory frameworks rather than market-driven mechanisms. This phase focused on promoting clean energy development, creating a legal foundation for REC implementation and addressing climate change, without directly facilitating REC trading or monetization. Table 1 outlines the key regulations introduced between 2010 and 2014 that contributed to the early foundation and awareness of Viet Nam's REC market.

Regulation	Date Issued	Areas of Focus	Content	Impact on REC Market
Law No. 50/2010/QH12	October 17, 2010	Energy efficiency and Clean Energy Development	• **Aim:** Promote efficient and economical use of energy • **Requirements:** Prioritize the development of clean energy technologies, on-site energy production and create legal foundations	**Establishing legal basis** for REC development in Viet Nam, further encourage **investment in RE technologies.**
Resolution No. 24-NQ/TW	June 3, 2013	Climate Change Response	• **Aim:** Proactively address climate change, strengthen the management of natural resources, and enhance environmental protection measures. • **Requirements:** Promote policies and initiatives to adapt to climate change and mitigate its impacts, improve the management and sustainable use of natural resources.	Creating opportunities for the expansion of the REC market by encouraging RE adaptation as a key solution to combat climate change.

Table 1 | Regulations contributing to Viet Nam's Foundation and Awareness Phase (2010 - 2014)

3.2.1.2 Market Establishment Phase (2015 – 2021)

During the Market Establishment Phase, regulatory frameworks set national sustainability targets, including renewable energy objectives, alongside initiatives to support the transition toward a greener economy. Key policies introduced during this period include Resolution No. 55-NQ/TW, which aimed to increase the share of renewable energy in Viet Nam's total energy supply through the development of breakthrough mechanisms and policies that enhance market stability and investment attractiveness. Additionally, Decision No. 1658/QĐ-TTg approved the National Strategy

on Green Growth, outlining Viet Nam's sustainability roadmap for 2021–2030 with a long-term vision for 2050. These regulations positioned RECs as a strategic tool to support green growth objectives and facilitated their wider adoption within the energy market. Table 2 lists the key regulations that contributed to the establishment of Viet Nam's REC market during this phase.

Regulation	Date Issued	Areas of Focus	Content	Impact on REC Market
Decree No. 32/2017/ND-CP	March 31, 2017	Renewable Energy Investment Incentives	• **Aim:** Prioritize investment for power plants using RE project sources such as wind, solar, geothermal, and biomass. • **Requirements:** Classify these projects as preferential investment categories.	Prioritizing investments in RE projects, encourages the development and certification of RE, enhancing market growth and stability.
Resolution No. 55-NQ/TW	February 11, 2020	National Energy Development Strategy	• **Aim:** Increase the share of RE sources in the total primary energy supply to 15-20% by 2030 and 25-30% by 2045. • **Requirements:** Develop breakthrough mechanism and policies to encourage RE development and research and enact RE laws.	Encouraging investment and growth in RE projects enhancing market stability and attractiveness.
Resolution no. 140/NQ-CP	October 2, 2020	Renewable Energy Development Targets	• **Aim:** Set specific targets for the share of RE. • **Requirements:** Conduct research for RE production, growth, propose incentive policies to support RE development.	Laying the groundwork for policy development to incentivize RE generation by increasing the demand for RECs.
Law No. 72/2020/QH14	November 17, 2020	Environmental Protection and Greenhouse Gas Emission Reduction	• **Aim:** Promote measures to reduce greenhouse gas. • **Requirements:** Establish policies to incentivize	Enhancing demand for RE to meet national targets, further explore strategic

Regulation	Date Issued	Areas of Focus	Content	Impact on REC Market
			businesses and sectors to adopt low-emission practices.	framework to align REC adoption with green growth objectives.
Decision No. 1658/QD-TTg	October 1, 2021	National Strategy on Green Growth	• **Aim:** Approve the National Strategy on green Growth for period 2021-2030, vision up to 2050. • **Requirements:** Promote economic restructuring toward sustainability and green development, integrate RE initiatives as part of long-term strategy.	Enhancing demand for RE to meet national targets, further explore strategic framework to align REC adoption with green growth objectives.
Resolution No. 06/NQ-CP	January 21, 2021	Energy Production and Usage Transformation	• **Aim:** Transform energy production and usage towards a higher share of new, renewable, and clean energy. • **Requirements:** Implement Resolution No. 55-NQ/TW on the national energy development strategy.	Promoting the transition to renewable and clean energy sources, enhancing market growth and sustainability.

Table 2 | Regulations Contributing to Viet Nam's REC Market Establishment (2015 – 2021)

3.2.1.3 Market Growth Phase (2022 – Present)

The Market Growth phase has accelerated the development of Viet Nam's REC market through targeted aimed at strengthening GHG emissions monitoring and reporting, prioritizing the sustainability transition, and enhancing the integration of renewable energy into the national energy mix. This progress has been driven by Decision No. 500/QĐ-TTg and Decision No. 215/QĐ-TTg, which set ambitious renewable energy targets and promote REC ownership mechanisms to increase adoption. Table 3 outlines the key regulations that have contributed to the expansion of Viet Nam's REC market from 2022 to the present.

Regulation	Date Issued	Areas of Focus	Content	Impact on REC Market
Decree No. 06/2022/ND-CP	January 7, 2022	Green Gas Emission Reduction and Ozone Layer Protection	• **Aim:** Implement measures to reduce greenhouse gas (GHG) emissions and protect the ozone layer. • **Requirements:** Develop and roll out emission reduction plans, strengthen regulatory frameworks for monitoring and reporting GHG emissions.	Driving the adoption of RE as a key method for reducing GHG emissions. Supporting the transparency and accountability in emission tracking and clean energy use.
Decision No. 896/QD-TTg	July 26, 2022	National Strategy on Climate Change Response	• **Aim:** Increase the share of RE sources in the total primary energy supply to 15-20% by 2030 and 25-30% by 2045. • **Requirements:** Develop breakthrough mechanism and policies to encourage RE development and research and enact RE laws.	Strengthening the roles of RE in achieving net-zero target, encouraging further investment in RE projects
Decision No. 500/QD-TTg	May 5, 2023	National Power Development Planning	• **Aim:** Increase share of RE sources to nearly 50% of the energy mix by 2030. • **Requirements:** Approve and implement the national power development plan for 2021-2030, vision to 2050.	Setting ambitious targets for RE integration at national and forceful level, motivating the development and certification of RE.
Decision No. 215/QD-TTg	March 1, 2024	National Energy Strategy	• **Aim:** Approve the “National Energy Development Strategy of Viet Nam” up to 2030, with a vision to 2045. • **Requirements:** Outlined key tasks to promote the development of RE sources.	Strengthening integration of RE into national energy mix and encourages the implementation of REC ownership mechanism

Regulation	Date Issued	Areas of Focus	Content	Impact on REC Market
Decree No. 80/2024/ND-CP	July 3, 2024	Direct Power Purchase Agreements (DPPA) for RE	• **Aim:** Establish a mechanism for direct power purchase agreements between producers and large electricity consumers. • **Requirements:** Include provisions on REC ownership and trading to guide agreements.	Enabling direct transactions between producers and large consumers, providing guidelines on REC ownership and trading, promoting transparency, and encouraging investment in RE projects.

Table 3 | Regulations Contributing to Viet Nam's REC Market Growth (2022 – Present)

3.2.2 Key Regulators

Viet Nam's legal framework consists of normative documents with varying levels of authority, all contributing to the development of the renewable energy market. Table 4 depicts the hierarchy of documents arranged in descending order of authority and impact, while increasing in specificity regarding implementation and execution.

Level	Type	Definition	Scope
1	**Law**	A legislative act passed by the National Assembly, the highest legal authority in Viet Nam.	Laws set broad, fundamental legal frameworks and principles across all areas of governance.
2	**Resolution**	Issued by the National Assembly, the Government, or Party Congress.	Resolutions address political, strategic, or procedural goals.
3	**Decree**	Issued by the Government to guide the implementation of laws or provide regulations on administrative and procedural matters.	Decrees are subordinate to laws and specify detailed regulations for implementation.
4	**Decision**	Issued by the Prime Minister or heads of ministries to implement laws, policies, or projects at the national level.	Decisions are operational and focus on executing policies, projects, and government programs.

Table 4 | Summary of Regulation Hierarchies in Viet Nam

These regulations are governed by a well-coordinated team of government agencies, including key ministries, key government departments and supporting institutions as seen below.

Key Ministries

Ministry of Industry and Trade (MOIT)

- Mainly responsible for market and system development, drawing on global best practices and experience to meet international standards
- Assesses and proposes policies, legal frameworks, and institutional standards
- Develop supporting mechanisms and policies to control and reduce greenhouse gas emissions, aligned with NDC commitments and the Paris Agreement

Ministry of Natural Resources and Environment (MONRE)

- Provides guidelines for renewable energy certificates and their integration into the market
- Oversees environmental protection policies and responsible for implementing the Proposed National Inventory System

Key Government Department

Department of Energy Conservation and Sustainable Development

– An organization under the Ministry of Industry and Trade

– Responsible for developing REC regulation

Electricity Regulatory Authority of Viet Nam

– Regulates energy standards, including the issuance and tracking of RECs

Supporting Institutions

Viet Nam Energy Efficiency and Conservation Centre (VEECC)

- Promotes energy efficiency and renewable energy initiatives

3.2.3 REC Certification System

Within the I-REC system, any entity with a registry account is classified as a “participant” and may assume specific roles such as “Registrant” or “Beneficiary.” The Green Certificate Company (GCC), as the authorized local issuer, oversees key processes, including REC issuance, tracking, and redemption. These activities operate within the regulatory framework established by the Vietnamese government. A comprehensive overview of the entities involved and their roles in Viet Nam’s REC lifecycle is provided in Table 5.

Entities	Roles	Representative Organizations
Issuer	An independent entity recognized by government authorities, manages facility registration, verifies generation data, and issues RECs based on reported output	The Green Certificate Company
REC Suppliers/ Registrant	Power Generation Corporations (GENCOs) must register with the REC tracking system to issue RECs by creating accounts, registering production stations, and requesting REC issuance. This role is termed the "Registrant“ in I-REC and "Asset Owner“ in TIGR.	LYS Energy Group Solar Power Utility Company
Beneficiary/ Companies and Corporations	End-users who redeem RECs are typically public or private entities with global renewable energy commitments, including those in manufacturing, services, education, healthcare, NGOs, and RE100 multinational corporations.	Google Samsung Vin Group
Third Party Auditor	Accredited bodies will review data and certify for REC issuance and tracking to ensure compliance with international standards. Global firms like Deloitte and PwC may audit RE projects in Viet Nam, though not explicitly as REC verifiers.	PWC KPMG
Participants	An Entity who manages one or more trade or Redemption Accounts within a Registry. Participants are the specified owners of Product Certificates held within their Accounts.	Beetify GreenYellow

Entities	Roles	Representative Organizations
Platform Operator	A Platform Operator manages a platform that extends Registry functions, enabling remote actions without being the primary custodian of certificates. Its role varies by platform purpose and business model.	Bravowhale SCSK Asia Pacific Pte. Ltd.
Authorized Service Provider	Authorized service providers bridge the gap between RE producers and corporate buyers, enabling seamless transactions and fostering market growth, addressing both operational and market access challenges for stakeholders.	Vuphong Energy Group Alena Energy

Table 5 | Entities and their Roles in Viet Nam's REC Lifecycle

Figure 9 illustrates the relationships between different participants and their roles within the REC lifecycle, while Figure 10 and Figure 11 provide a detailed breakdown of key participants' involvement.

Although authorized service providers are not registered participants in the REC registry, they play a crucial role in facilitating trade by advising and connecting REC sellers with potential buyers. They support transactions from issuance to redemption, enhancing market efficiency.

While the government oversees regulatory frameworks and ensures compliance, third-party auditors conduct independent audits of the registry's operations. Their role is to verify transaction authenticity, ensure adherence to established regulations, and uphold the credibility and legitimacy of Viet Nam-issued RECs.

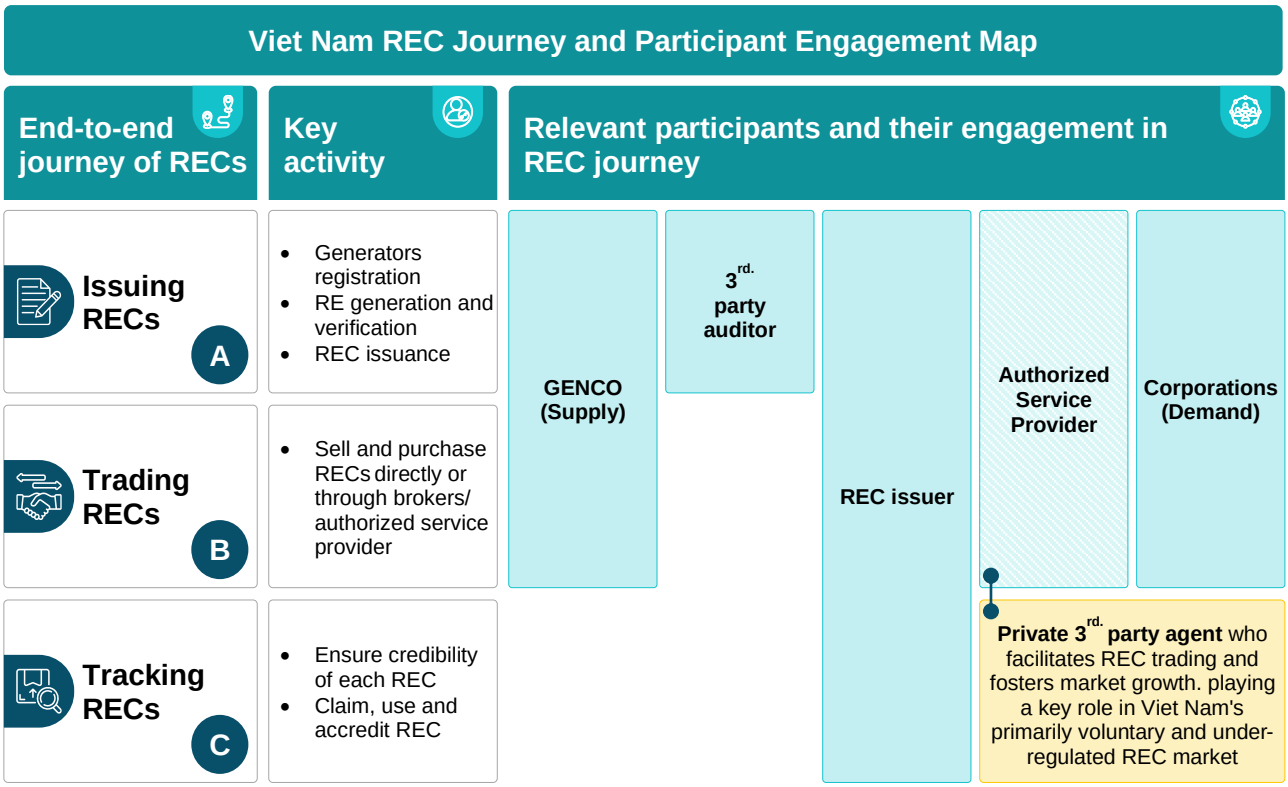

Figure 9 | Viet Nam REC Journey and Participant Engagement Map

Source: Arthur D. Little Analysis

Figure 10 illustrates the REC issuance process, detailing the roles of each participant from issuance to trading and tracking of RECs. This process adheres to I-REC and TIGR standards to ensure credibility, transparency, and compliance in all REC-related transactions.

The process begins with renewable energy suppliers, who must register their installations and provide documented evidence of electricity generation. RECs are issued only after suppliers submit the required documentation, including metering data and compliance reports, which are then verified by an accredited third-party verifier. To streamline participation and reduce barriers for new suppliers, authorized service providers offer guidance and support throughout the process.

Once verified, producers receive RECs through their issuance accounts. These RECs then move to the trading and redemption phase, where traders, corporate buyers, and utilities use their trading and redemption accounts to buy, sell, or retire RECs. These transactions help participants meet corporate sustainability goals and regulatory obligations. Additionally, authorized service providers play a crucial role in enhancing transparency and simplifying REC trading for market participants.

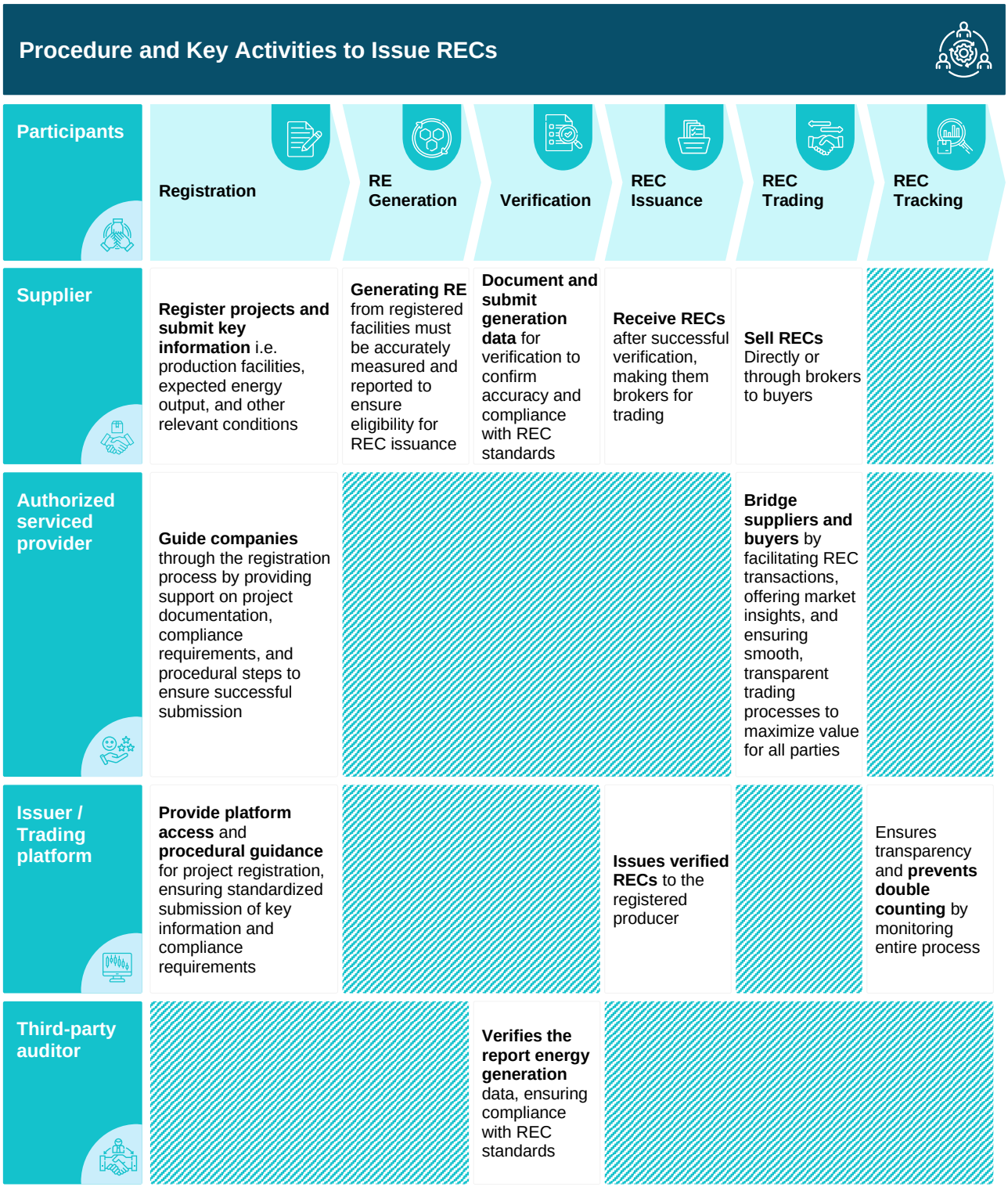

Figure 10 | REC Issuance Process Flow

Source: Arthur D. Little Analysis

Figure 11 outlines the REC trading and certification process, detailing the key steps and participants involved in ensuring secure, transparent, and compliant transactions.

The process begins with buyers evaluating their sustainability goals to determine whether RECs align with their reporting frameworks, such as the Greenhouse Gas (GHG) Protocol, RE100, or CDP (formerly the Carbon Disclosure Project). Buyers also assess how RECs compare to other sustainability instruments, such as carbon credits. To participate in the market, buyers must register and create a trading account, enabling them to purchase RECs through various trading channels, including direct transactions, registry platforms, and third-party trading platforms.

To uphold market integrity and transaction security, registry and external trading platforms implement strict verification measures, including REC authenticity checks, anti-double counting mechanisms, and regulatory compliance assessments. These safeguards ensure alignment with both national and international reporting standards. Once buyers claim RECs for sustainability reporting, they must cancel (retire) them in the registry to prevent re-use or resale. This step ensures compliance with reporting obligations, safeguards against double counting, and reinforces the credibility of the REC market.

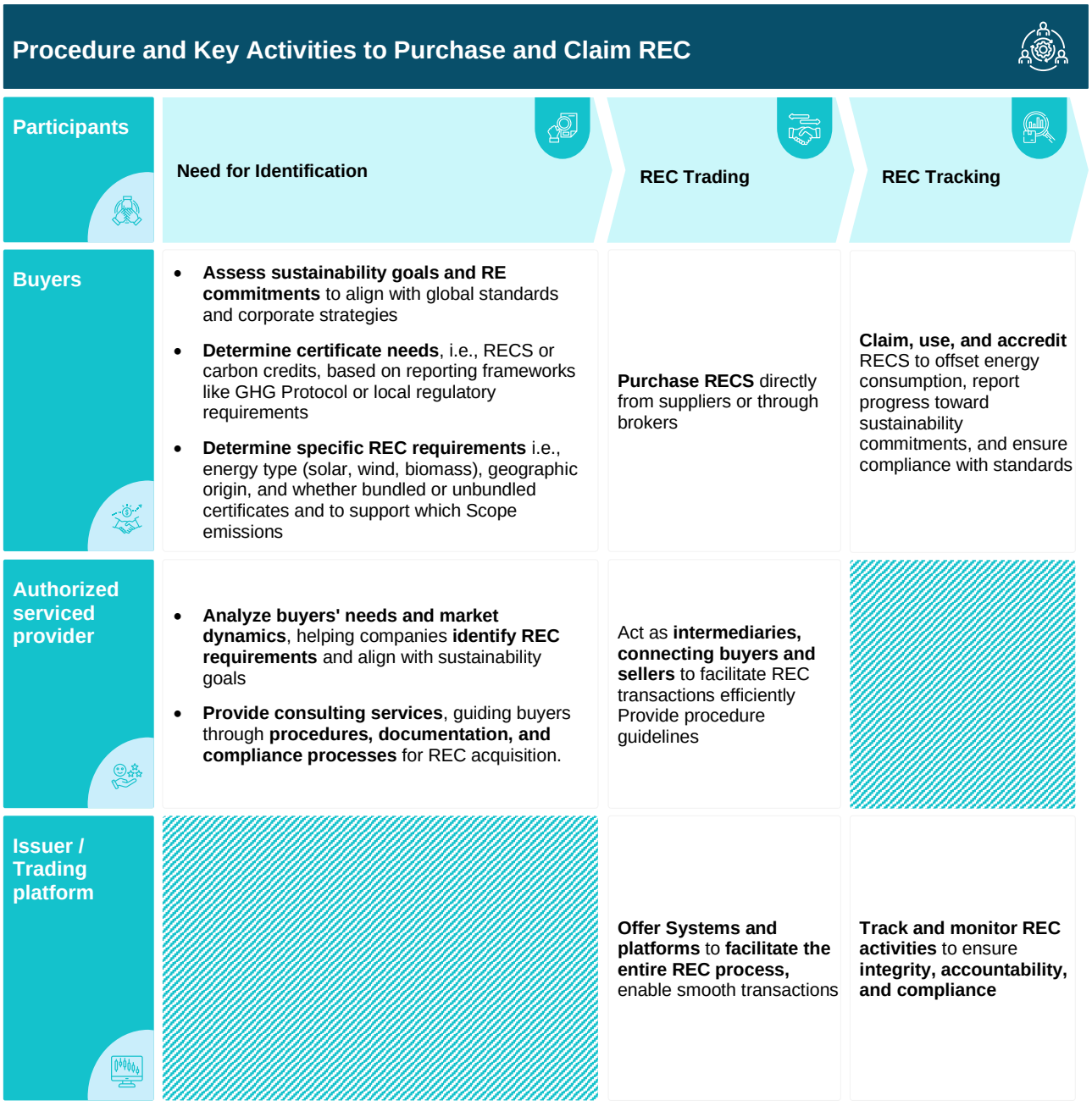

Figure 11 | REC Trading and Redemption Process Flow

Source: Arthur D. Little Analysis

3.2.4 Digital Infrastructure

Viet Nam's technological infrastructure for RECs is still developing but continues to evolve through ongoing efforts to enhance system robustness. The country's REC tracking system adheres to I-REC and TIGR standards, ensuring secure, transparent, and verifiable transactions.

A digital registry system is in place to track RECs throughout their lifecycle, utilizing advanced infrastructure such as digital registries and unique identification numbers. Further technological enhancements, including reporting and analytics tools and blockchain integration, are being developed to support businesses, streamline REC adoption, and enhance market transparency and efficiency.

Digital Registry: RECs are recorded in a digital registry, such as those provided by the I-REC foundation, which provides detailed information, such as production date, location and energy type

Unique Identification: Each REC is assigned a unique identification number to track it from issuance to cancellation

Reporting and Analytics Tools: Businesses are able to report and analyze I-REC certificate usage, enabling them to manage issued certificates, monitor usage areas and evaluate investment performance. This supports commitments to transaprency and efficiency, contributing to carbon emission reducitons in production activities.

Blockchain Usage: Potential of blockchain in the tokenization and transparent management of renewable e senergy certificate.

However, upgrading Viet Nam's digital infrastructure presents significant challenges. The rapid evolution of renewable energy and digital policies creates hurdles in developing and implementing technological solutions, as existing frameworks often lack the flexibility to adapt to changing requirements. Additionally, inconsistencies in data collection and the absence of standardized reporting mechanisms further complicate efforts to enhance the system. Addressing these issues will be crucial to enabling more efficient technological integration and ensuring the long-term scalability of Viet Nam's REC infrastructure.

3.3 Assessment of REC Demand Drivers and Market Dynamics

Viet Nam's REC demand is primarily driven by corporate sustainability commitments, influenced by growing consumer demand for green energy and pressure from the government through the Corporate Sustainability Index (CSI) program. However, despite increasing interest, demand has yet to match the rapid growth in renewable energy production, leading to a surplus of RECs and suppressed prices.

The CSI program is a cross-sector initiative led by the following departments:

Role	Entity	Key Tasks
Main Organizer	**Viet Nam Chamber of Commerce and Industry (VCCI)**: Responsible for overall coordination, execution, and communication	Close collaboration among key stakeholders for program continuous success
Key Partners (Co-Organizers)	**Central Economic Commission:** Provides strategic oversight and alignment with national economic policies **Ministry of Labor - People with Disabilities and Social Affairs:** Focuses on labor standards, employment policies, and social responsibility aspects	**Steering Committee and Evaluation Council:** Aligns strategies, evaluate companies, and ensure compliance with national policies
	Ministry of Natural Resources and Environment (MONRE): Ensures integration of environmental sustainability and resource management into program objectives **Viet Nam General Confederation of Labor (VGCL):** Represents the workforce perspective, emphasizing fair labor practices and workers' rights	**Meetings and Workshops:** Held regularly to update stakeholders, share insights, and coordinate activities i.e., CSI 2023 Evaluation Council, took place to finalize work plans and assessment methods
Technical Consultant	**Deloitte Viet Nam:** Offers technical expertise, methodologies, and support for evaluating and certifying sustainable enterprises	**Training Sessions:** Provide businesses with tools to implement the Corporate Sustainability Index (CSI)

Table 6 | Key Organizations in Viet Nam's CSI Program

As of 2024, the CSI program has been successfully running for 9 years, with 2,000 additional enterprises across various sectors participating. Annually, 1,000 enterprises are recognized for their sustainability efforts, and since 2023, 22 new criteria have been introduced to refine the index further. The program has been instrumental in promoting sustainability and advancing Viet Nam's REC market by driving REC demand and adoption, helping businesses achieve their green growth goals.

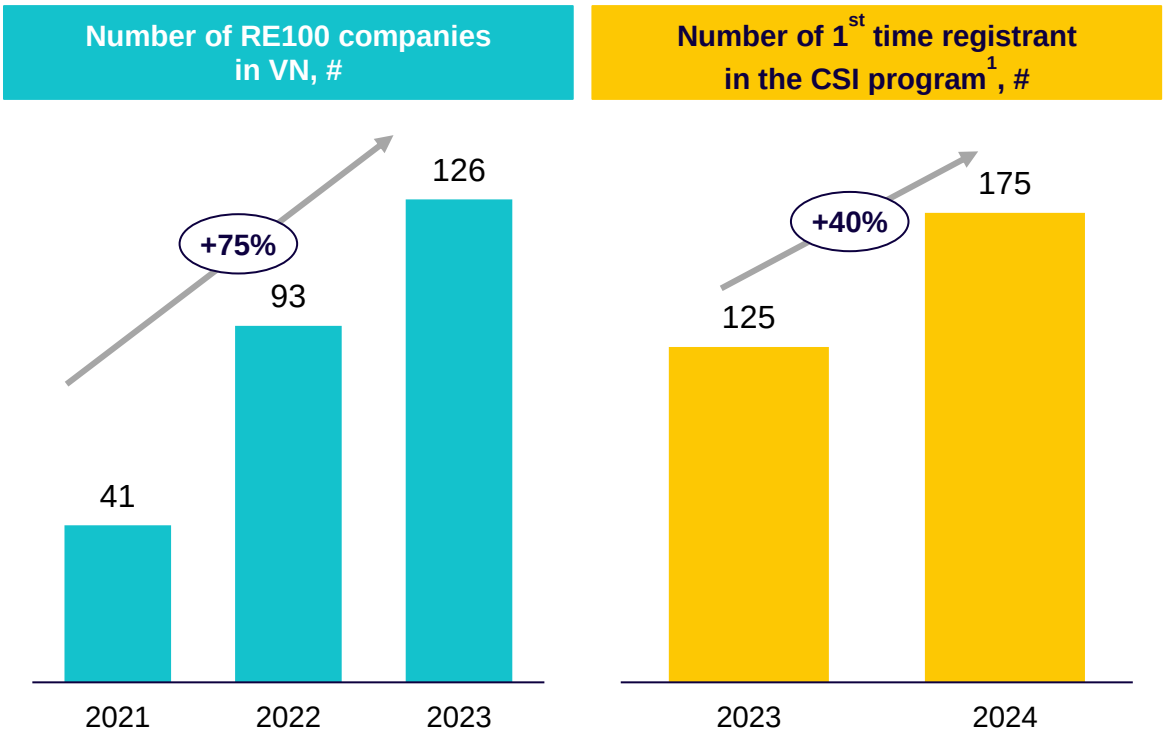

Figure 12 | RE100 Adoption and CSI Registration Trend in Viet Nam

Source: RE100 Report

The success of the CSI program is highlighted in Figure , which illustrates a significant rise in RE100 companies in Viet Nam—from 41 in 2021 to 126 in 2023—representing a 65% compound annual growth rate (CAGR). Additionally, first-time registrants for the program increased from 125 in 2023 to 175 in 2024, marking a 40% growth.

Beyond these metrics, corporations have actively advanced sustainability efforts through 4 approaches.

Participate in Sustainability Competitions and Awards: Corporations join environmental programs beyond the CSI Program, such as ESG 2024, which are recognized for sustainability commitments

Release Sustainability Report: Leading corporations in energy, manufacturing, banking and FMCG sectors regularly publish sustainability reports to highlight progress

Integrate Green Initiatives: Corporations incorporate green policies and operations such as reducing plastic usage, adopting renewable energy, and setting new-zero targets

Provide Green Products: Corporations offer eco-friendly solutions to encourage environmentally responsible consumer behavior

Additionally, multiple organizations have stepped up as advocates for sustainability, raising sustainable awareness and education in Viet Nam. These advocates can be split into 3 main groups – government institutions, authorized service providers, and educational institutions.

Advocate	Beneficiary	Content
Government Institutions	**Public**	**Training course** on "Investment, Development of Renewable Energy and DPPA Mechanism"
	Public	**PAR3E Project:** Awareness raising for RE and energy efficiency among stakeholders to boost REC understanding
	RE projects stakeholders	**Prime Minister-led conference** addressing challenges and actionable solutions for RE projects, promoting REC adaptation
Authorized Service Providers	**Genco Supplier and corporations**	**Webinar** on I-REC, carbon certificate, and collaboration opportunities, covering: • Definition, registration, and issuance process for I-REC • RE sources eligible for I-REC registration • Scale and supply/demand status of I-REC in Viet Nam
Educational Institutions (i.e., University)	**Students and Public**	**Develop RE-focused university curricula** and practical collaboration projects with energy companies to enhance relevance and industry placement
	Students	**Conduct training** sessions to raise awareness of RECs and their role in clean energy transition

Table 7 | Sustainability Advocates in Viet Nam

These efforts have yielded tangible results, with rising eco-consciousness driving greater demand for sustainable products and incentivizing corporations to accelerate their sustainability transitions. Figure 14 presents survey findings that reflect shifting consumer trends—60% of consumers trust products labeled as green, and 55% have adjusted their consumption habits for environmental reasons. Additionally, the proportion of green consumers in Viet Nam—those willing to pay a premium for environmentally friendly products—has grown at a CAGR of 15%, increasing from 54% in 2021 to 72% in 2023.

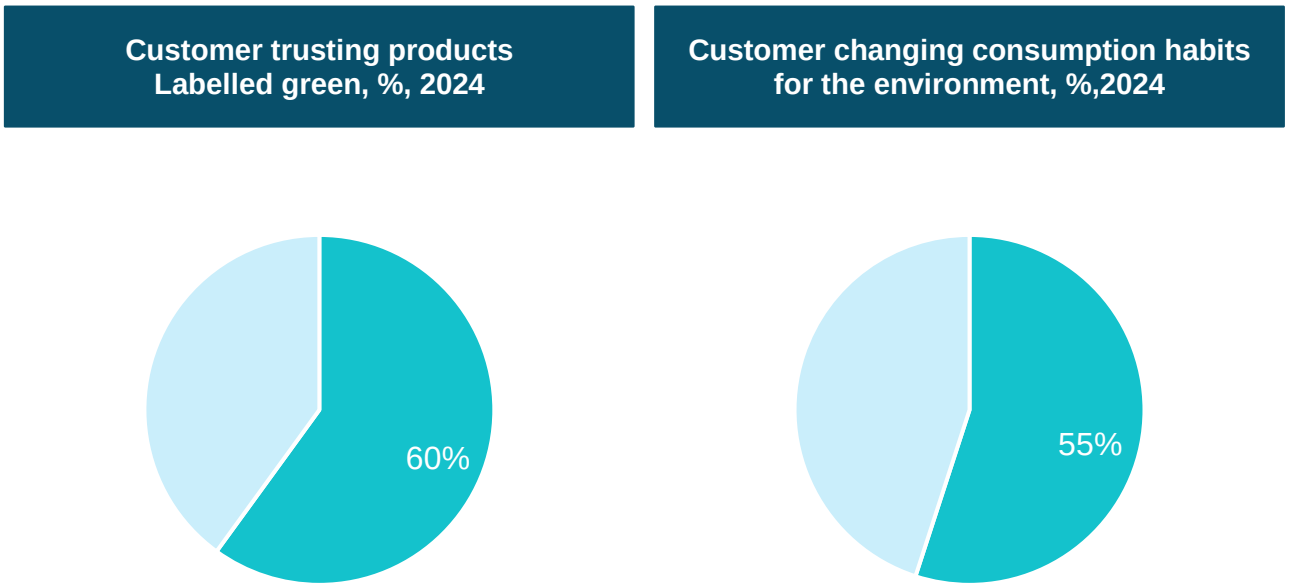

Figure 13 | Consumer Trends in Viet Nam Towards Sustainability

Source: Ministry of Industry and Trade

Beyond shifting consumption habits, Viet Nam has shown growing engagement with green initiatives, including music events, fairs, and awareness campaigns. These efforts have attracted over 5 million participants across more than 20 provinces, with support from 150 celebrities and Key Opinion Leaders (KOLs).

This increasing consumer focus on sustainability is pushing companies to adopt greener practices, with RECs becoming a key tool for demonstrating sustainability commitments. As a result, REC adoption is rising among RE100 firms and other sustainability-driven businesses.

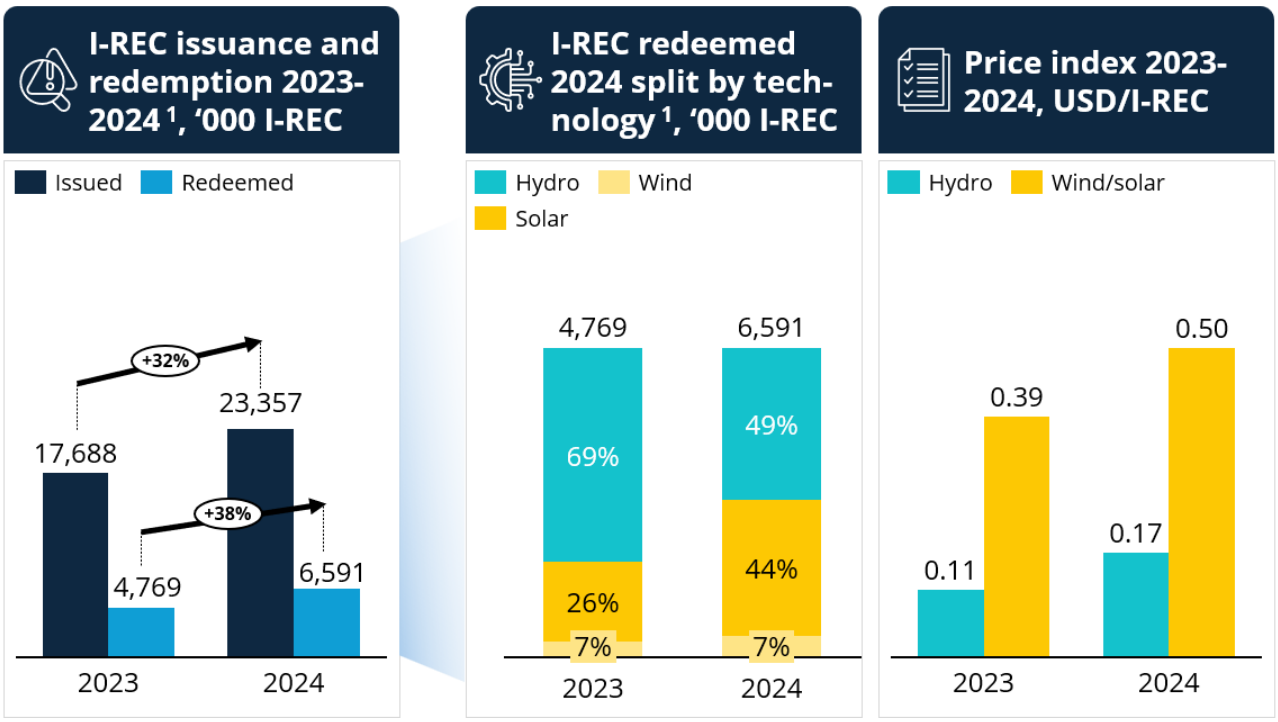

Figure 14 | I-REC Market Trends from 2023 to 2024

Source: I-REC

Despite significant efforts to drive REC demand, reflected in a 38% increase in I-REC redemptions from 2023 to 2024 (Figure 16), growth has not kept pace with the accelerating I-REC supply. Over the same period, REC issuances grew by 32%, reaching approximately 3.5 times the volume of redemptions as of 2024.

This oversupply is primarily driven by the rapid expansion of renewable energy capacity, which has outpaced domestic demand, constrained by limited awareness and weak enforcement mechanisms. Additionally, some renewable energy projects were developed for international REC sales but have faced challenges integrating into global markets.

Viet Nam's REC market continues to struggle with low buyer engagement and insufficient market infrastructure. Introducing a mandatory Renewable Portfolio Standard (RPS) mechanism could help bridge this gap by aligning REC demand with supply, fostering a more balanced and sustainable market.

3.4 Claiming, Verification and Surrendering of RECs

The claiming, verification, and surrendering of RECs are primarily managed by the local issuer, GCC, while the international registries I-REC and TIGR establishes certification framework for market participants, ensuring a structured process where:

RECs are **issued** to producers' accounts.

Trading is initiated by the initial account holders to other trading accounts.

Redemptions are exclusively done on redemption accounts.

Figure 15 illustrates the complete REC transaction process, detailing participant involvement and the types of accounts each entity is permitted to manage. When a REC is designated for sustainability disclosures, it must be transferred from a trade account to the holder's redemption account and subsequently retired from the system. This step ensures compliance with certification standards and prevents double counting, allowing only one claim to the REC's environmental attributes. Following redemption, a redemption statement can be generated from the registry, serving as a disclosure statement that verifies the end-user (or beneficiary) assigned to the REC.

While the government's role in REC transactions is largely indirect, it plays a critical role in developing Viet Nam's REC market. Its key responsibilities include regulatory oversight, policy development, and initiatives to promote market awareness and growth. Additionally, the government facilitates the integration of Viet Nam's Renewable Energy Market into broader renewable energy and emissions offset strategies.

Beyond market facilitation, the government also oversees the accreditation of international registries and monitors auditing and compliance activities. These efforts help safeguard the integrity of REC trading and verify the eligibility of RECs for sustainability disclosures.

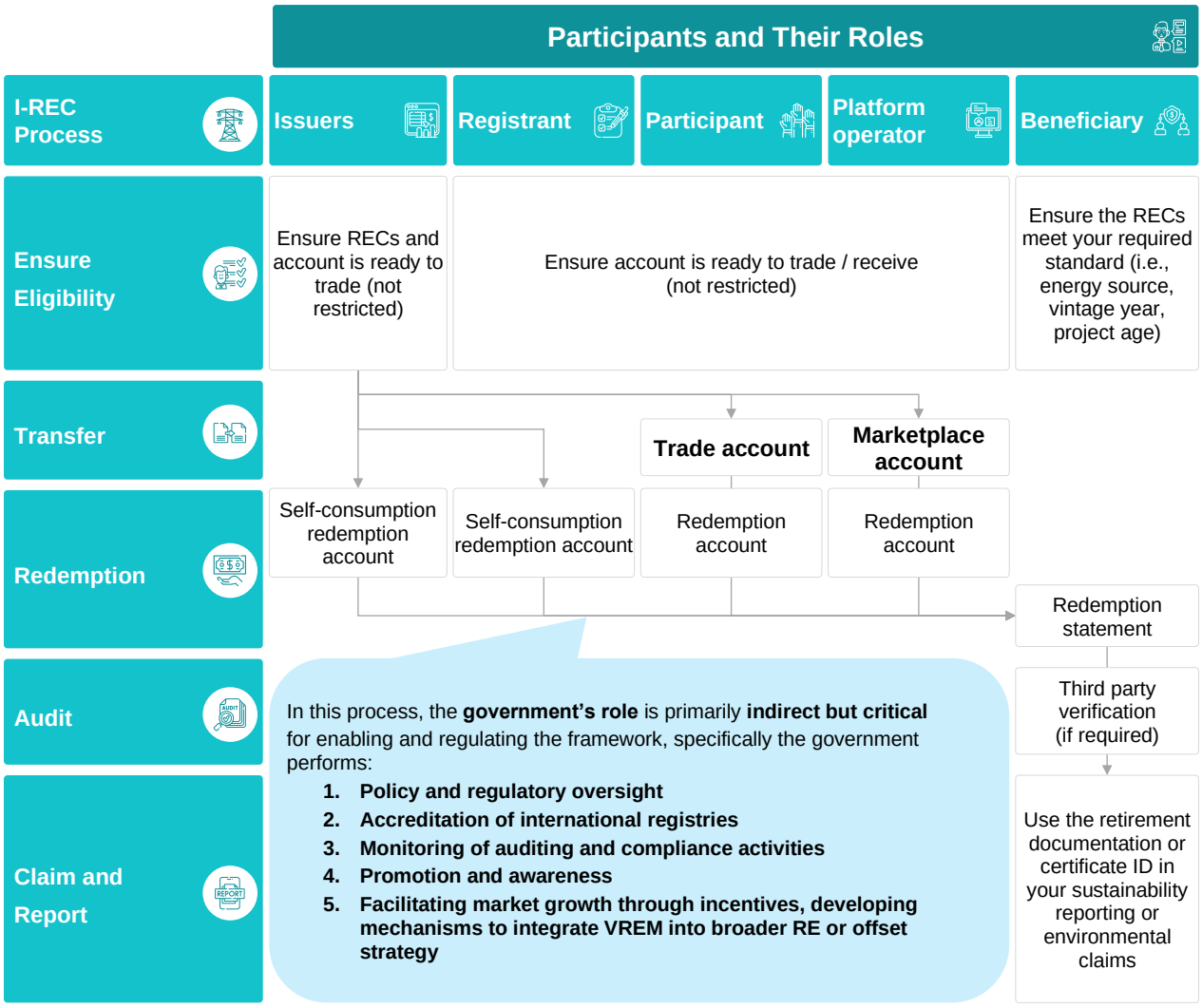

Figure 15 | Claiming, Verification and Surrendering Process of RECs in Viet Nam

Source: I-REC, Arthur D. Little Analysis

Figure 18 provides definitions and explanations of key REC terminologies referenced in Figure 17, ensuring clarity and consistency in understanding the concepts.

Term	Terminology Definition & Process Explanation for I-REC
Trade Account	An Account operated by a Participant and capable of receiving and sending I-REC from or to another Account
Market Place Account	An Account operated by a Platform Operator and capable of receiving and sending I-REC from or to another Account
Redemption Account	An Account operated by a Participant or Platform Operator end capable only of receiving I-REC from another Account
Self Consumption	An Account operated by a Registrant, Issuer (on behalf of a Registrant), or Platform Operator and capable only of receiving I-REC from another Account
Issue Account	An Account operated by an Issuer and capable only of sending I-REC to another Account

Figure 16 | Terminology Used Within I-REC Certification System

Source: Arthur D. Little Analysis

3.5 Impact Assessment on REC Capacities

Alongside the expansion of the REC market, Viet Nam's renewable energy capacity has seen significant growth. During the transition from market establishment to market growth, the share of renewable energy in total energy production surged from 4.7% in 2020 to 12.7% in 2021, before stabilizing at approximately 13% in recent years.

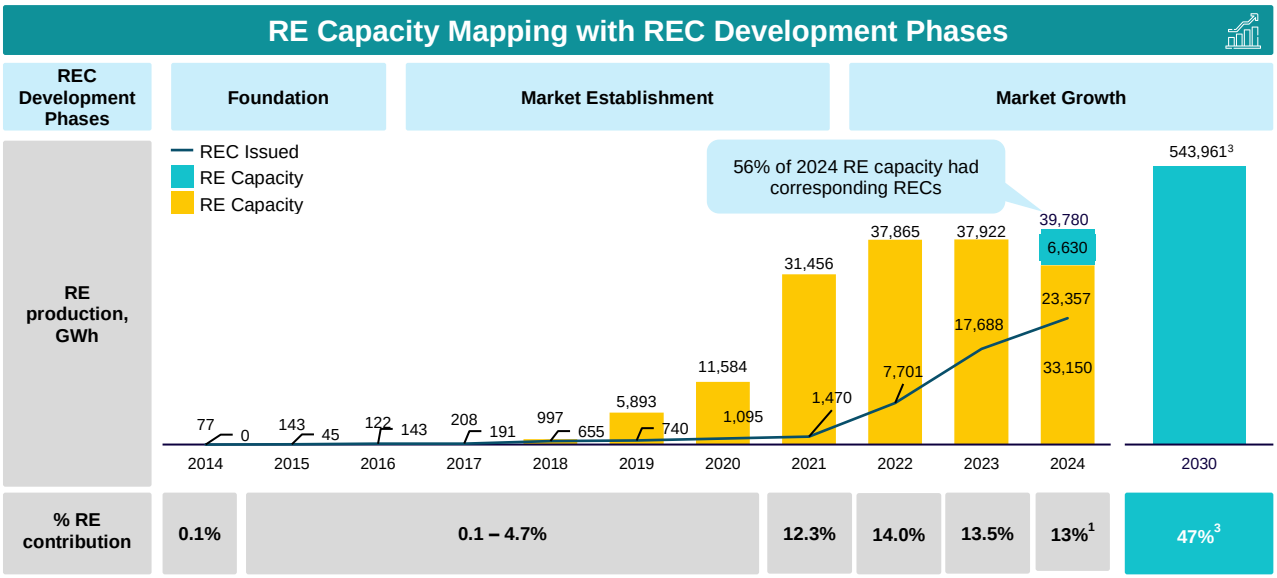

Figure 17 | Renewable Energy Production Mapping with REC Development Phases

Source: I-REC, TIGR

Figure 17 depicts the growth in REC issuance and renewable energy capacity. Based on current projections, renewable energy capacity is expected to reach 47% of total energy generation by 2030, aligning with the national targets set in Government Decision No. 262/QĐ-TTg. This growth has been driven by supportive policies that reinforce Viet Nam's commitment to sustainable energy, further accelerating REC issuance.

Additionally, the introduction of RECs, alongside favorable policies and incentives, has positioned Viet Nam as a highly attractive investment destination. The country ranked 2nd among the top 10 developing economies for foreign direct investment (FDI) in renewable energy, with an estimated value of $106.8 billion. It also placed 3rd globally for new renewable energy capacity added in 2020 (11.6 GW) and 11th among the best emerging markets for clean energy investment in 2024. These achievements have been enabled by government policies that promote renewable energy targets and increase investments in the sector, as outlined below.

Expanding Solar and Wind Energy: Significant increase in investments in solar and wind projects, spurred by incentives and attractive feed-in tariffs (FiTs)

Developing Offshore Wind Projects: Growing in number of offshore wind projects, i.e., Germany's PNE AG seeking approval for a $4.6 billion offshore wind farm in Binh Dinh province

Increasing Private Equity Interest: Renewable energy sector is becoming one of the most preferred sectors for private equity investment in VN, ranking third in 2019.

Attracting Foreign Direct Investment: Second-largest recipient of FDI in renewable energy within the ASEAN region, significant investments with $106.8 bn directed towards renewable energy projects

These policies have successfully attracted investment in Viet Nam's renewable energy sector and accelerated production. However, they have also contributed to an oversupply of RECs. To create a more balanced market, additional policies and incentives are needed to stimulate and align REC demand with the growing supply.

3.6 Lesson Learned and Applicability to the Philippines

Vietnam's VREM success is driven by clear regulations, multi-agency coordination, third-party brokers, corporate incentives, consumer awareness, and strong RE investments. The government's enabling role, supported by key ministries and private institutions, has ensured effective oversight and market development. Third-party brokers help educate and connect RE producers with buyers, driving market activity. Corporate sustainability commitments, backed by government incentives, fuel REC demand, while rising consumer awareness further pushes businesses to adopt green practices. Investment-friendly policies, tax incentives, and FiTs have accelerated Vietnam's renewable energy growth, strengthening REC supply.

To develop a successful VREM, the Philippines should gradually implement regulatory measures, encourage government-private sector cooperation, establish third-party service providers, incentivize corporate sustainability, raise consumer awareness, and introduce investment-friendly policies to drive both REC demand and renewable energy expansion.

Aspect	Key Success Factors	Solutions and Best Practices	Implications for the PH
Operational Framework - Regulation	VN approached the voluntary market with a target-based approach with diverse supporting policies and regulations to foster market development	Numerous legal normative documents varying in levels of authority including laws, resolution, decree and decisions	Start with small, actionable decisions to drive early REC demand, gradually implement higher-level laws
Operational Framework –	VN's VREM is governed by a well-coordinated team of gov.	Key ministries (including MOIT), government	Leverage cooperation among government agencies, private

Aspect	Key Success Factors	Solutions and Best Practices	Implications for the PH
Regulatory Bodies	agencies, ensuring effective oversight and implementation Government's role is primarily indirect but critical for enabling and regulating the framework	department, semi-government institution and supporting institution participate in the development of VREM	institutions, and international stakeholders to establish a robust REC framework & drive market growth
Market Participant and Role	VN has 3rd party entities acting as brokers to educate the market, connect RE producers with corporate buyers, facilitate transactions, and drive growth	Increased both the number, quality and relevance of authorized service providers, such as Vu Phong and Alena Energy	Potentially support development of authorized service providers to advise interested REC traders and allow for seamless integration of VREM
Demand Driver – Corporate Initiative	Viet Nam's REC market growth is driven by strong government initiative promoting adoption of corporate sustainability commitment	Design program to incentivize and reward corporations for sustainable practices, ultimately driving RE and REC demand	Develop programs like CSI and ESG:2024 to offer green recognition and incentivize corporate sustainability, driving corporate adoption of initiatives like RECs
Demand Driver – Consumer Perception	Growing sustainability awareness among Vietnamese consumers drives eco-friendly demand, pushing corporations to adopt green practices and boost REC purchases	Organize nationwide green awareness campaigns, engage influencers, and promote eco-friendly practices to boost consumer trust and drive sustainability efforts	Evaluate level of sustainability awareness among PH citizens and implement initiatives to boost eco-conscious consumption as these drive corporate activity as well
Renewable Energy Investment	Viet Nam successfully attracted significant investments in RE, supported by favourable policies and	Leveraged REC frameworks and supportive policies like FiTs and tax incentives to attract significant	Adopt supportive policies and incentives with measures to attract investments and drive energy growth, as seen

Aspect	Key Success Factors	Solutions and Best Practices	Implications for the PH
	incentives, which spurred the growth of RECs	investments in solar, wind, and offshore projects	in VN's supply-driven strategy

Table 8 | Key Success Factors of Viet Nam's REC Market

Vietnam's REC market challenges stem from the absence of a mandatory market, underdeveloped technological infrastructure, and suppressed REC pricing due to low demand. The lack of mandatory REC obligations has resulted in weak corporate adoption, while reliance on international registries (I-REC, TIGR) highlights the need for a domestic platform. Additionally, oversupply and limited buyer engagement have led to low REC prices, particularly for hydropower RECs.

The Philippines' mandatory REC market (RPS) ensures stable baseline demand, but introducing VREM with targeted incentives can further boost corporate adoption. Aligning with international standards (I-REC, TIGR) will enhance global market access, while strengthening awareness, regulatory enforcement, and market education can help balance supply and demand, improving overall REC pricing and market stability.

Aspect	Challenges	Key Takeaways
Legal Framework	**Lack of Mandatory Market**: VN is facing low demand in RECs due to the absence of mandatory market	• The Philippines' mandatory market ensures a consistent baseline demand for RECs • Introducing the VREM, supported by targeted policies and incentives, can further boost REC corporate adoption
Technological Infrastructure	**Underdeveloped Tech Infrastructure:** VN depends on international registries like I-REC and TIGR for REC issuance and trading due to the absence of domestic platforms	• Adopting international standards like I-REC and TIGR ensures global compliance and access to wider international markets

Pricing and Market Dynamic	**Suppressed REC pricing:** Low demand has led to suppressed prices, esp. for Hydro RECs, due to oversupply and limited buyer engagement in the market	• Increasing awareness and strengthening regulatory enforcement are crucial to balancing REC supply and demand • Enhancing market knowledge can help boost REC adoption and improve pricing

Table 9 | Key Challenges in Viet Nam's REC Market

4. Jurisdiction 2: Singapore

4.1 Summary and Market Overview

4.1.1 Singapore REC Market Summary

Over the past 12 years, Singapore's REC market has matured rapidly, solidifying its role as a key enabler of renewable energy adoption in Southeast Asia. However, rather than directly producing renewable energy, Singapore primarily facilitates REC trading and cross-border renewable energy integration.

Operationally, Singapore adheres to internationally recognized I-REC and TIGR standards while also establishing its own voluntary framework, Singapore Standard 673 (SS 673), to enhance credibility and transparency in REC transactions. The SP Group, as Singapore's appointed I-REC issuer, oversees the issuance, verification, and surrendering of RECs while managing a blockchain-supported REC marketplace to ensure traceability and prevent double-counting.

Singapore's renewable energy market faces structural limitations due to its classification as an Alternative-Energy Disadvantaged State (AEDS)—characterized by scarce land, weak wind resources, and the absence of large rivers for hydropower. As a result, domestic REC supply remains insufficient. However, as a global financial hub with a high concentration of corporate headquarters and RE100 companies, Singapore sees strong demand for RECs from businesses committed to sustainability targets. To address this supply-demand gap, Singapore imports RECs from neighboring countries and plays a pivotal role in developing cross-border renewable energy trade agreements, enhancing regional energy interconnectivity, and enabling more scalable, cost-effective, and diversified low-carbon imports.

Beyond renewable energy production and procurement, RECs serve as a key enabler of Singapore's broader energy transition and climate goals. They help aggregate demand for solar energy, encourage corporate participation in green energy sourcing, and support community-driven sustainability initiatives. While RECs alone do not directly increase renewable energy production, they create financial incentives that stimulate further investment in clean energy solutions.

Overview	Maturity & Compre-hensiveness	Tracking System & Standard	Voluntary Corporate Participant	Regulatory Framework	Relevance to PH
	12 years Growing & Maturing	**I-REC & TIGER** International standards	**RE100** Mainly among MNCs & RE100 companies	**Voluntary** Fully voluntary market	**High** High international demand

Objectives	Findings			
1 **Operational Framework**	**Policy & Regulations**	**Governance**	**Operational Framework**	**Platform & Technology**
	12 Regulations, Policies, and Acts to accelerate REM	**National Climate Change Secretariat** Main governing body	**Carbon abatement** **Carbon abatement** RECS and Carbon Credits	**I-REC & TIGR** Platform and protocols
2 **Demand Drivers & Market Dynamics**	**Corporate**	**Government**	**Public**	**Market Impact**
	RE100, CSR RE100 operations and CSR initiatives	**SG Green Plan & Net Zero 2050** **RE targets for Singapore**	**Awareness Campaigns** Growing awareness of RE technologies and impact	**Import reliant** **SG lacks land space for local RE generation**
3 **Claiming, Verification & Surrendering of RECS**	**REC Verification**		**REC Claiming**	
	I-REC Verification and trading done through I-REC, local issuers, SP Group, appointed for I-REC issuance		**Certificate Retirement System** Used to avoid double counting	
4 **Impact on Increasing RE Capabilities**	**Impact**			
	Increasing demand for RE generation Singapore continues to actively pursue strategic partnerships to enhance capacity for low-carbon and renewable energy			
5 **Impact on Increasing RE Capabilities**	**Key Best Practices**		**Key Challenges**	
	• **I-REC & TIGR** adoption allows for **REC imports into SG** • **Regulatory backing, funding, and support** for RE development		• **High demand, low local supply** • High reliance on **imports and partnerships**	

Figure 18 | Summary of Singapore's REC Market

4.1.2 Overview of Singapore's Carbon Abatement Initiatives

Singapore's carbon reduction efforts are spearheaded by the National Climate Change Secretariat (NCCS) under the Prime Minister's Office, aligning with the Singapore Green Plan 2030 and the nation's Net Zero Emissions target by 2050. These initiatives focus on two key areas: Carbon Pricing and Renewable Energy. An overview of Singapore's carbon abatement initiatives and their interconnections can be found in Figure .

Carbon pricing:

- Singapore implemented its carbon tax in 2019 (S$5 per ton) and will gradually increase it to S$50–80 per ton by 2030.
- The country allows international carbon credits as offsets from 2024, which can be traded on Climate Impact X (CIX), a Singapore-based voluntary carbon market.

Renewable Energy:

- Singapore promotes renewables through incentives, solar adoption, and cross-border energy imports.
- The country facilitates Renewable Energy Certificates (RECs), issued, and traded on platforms aligned with international standards like I-REC (International REC) and TIGR

Overview of Carbon Abatement Initiatives in Singapore

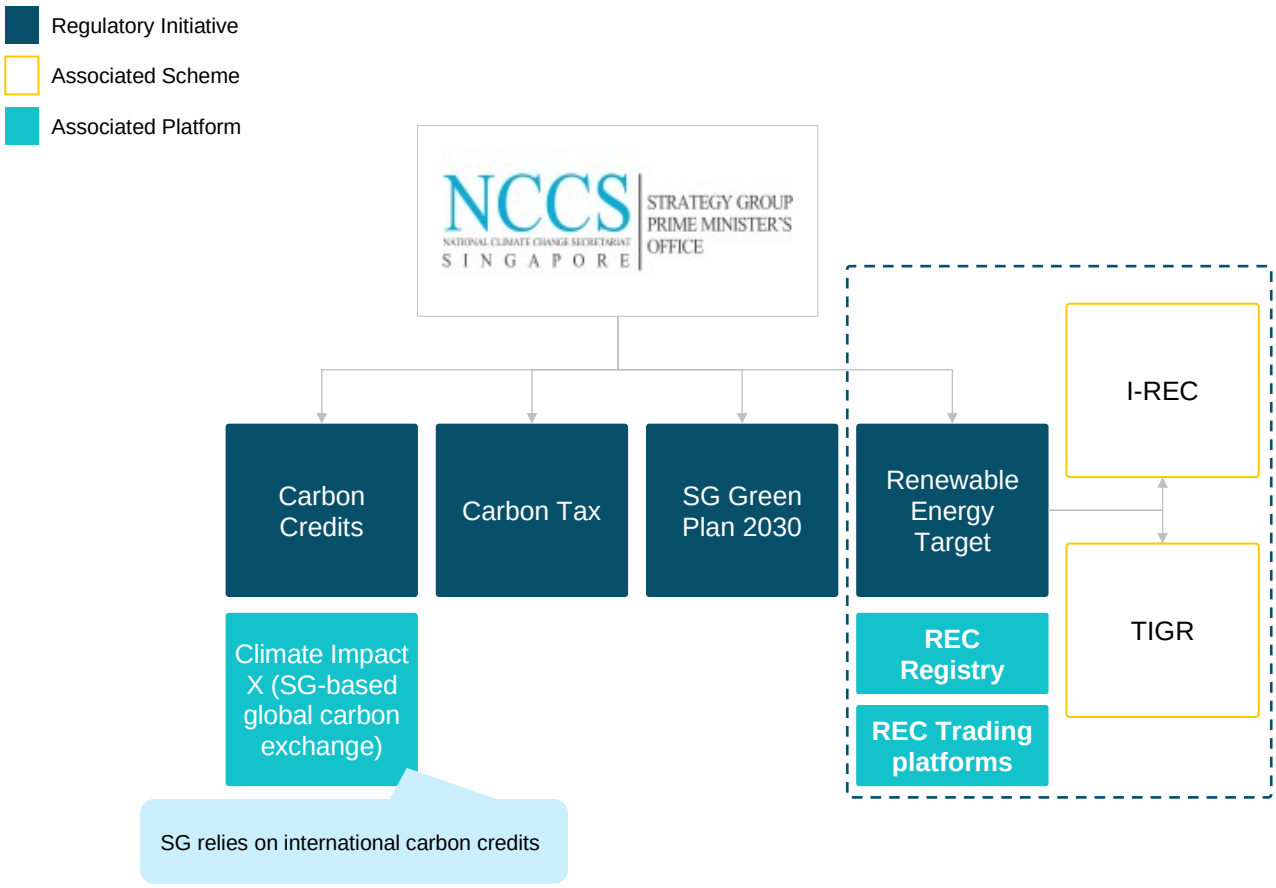

Figure 19 | Singapore's Carbon Abatement Initiatives

Source: National Climate Change Secretariat, Singapore Green Plan 2030

4.1.3 Development of Singapore's REC Market

Singapore's Renewable Energy Certificate (REC) market development can be divided into two key phases: **Market Establishmen**t (2013–2021) and **Market Growth** (2022–Present). The Market Establishment phase focused on introducing RECs into Singapore's renewable energy ecosystem by laying the groundwork for REC trading to incentivize renewable energy adoption. The Market Growth phase has been driven by policies aimed at accelerating Singapore's renewable energy transition, leading to rapid growth in REC demand while continuing efforts to expand renewable energy production despite land and resource constraints.

Singapore's experience offers three key lessons for the Philippines in developing its own REC market:

Strong REC Demand: Singapore's ambitious National Sustainability Targets, combined with market-driven policies, corporate incentives, and public sustainability programs, have created a high demand for RECs as businesses and individuals seek to meet sustainability commitments.

Emerging Technology: Singapore has strategically adopted advanced technologies to enhance both renewable energy production and REC trading infrastructure. Innovations such as floating solar farms and blockchain-supported REC platforms have helped overcome geographical constraints while ensuring greater transparency, efficiency, and accessibility in REC transactions.

International Collaborations: Singapore actively engages in cross-border REC trading by leveraging global certification standards (e.g., I-REC, TIGR) and participating in regional energy integration projects. This strengthens REC authenticity and facilitates scalable low-carbon imports, positioning Singapore as a hub for renewable energy trade in Southeast Asia.

4.1.4 Trends in Singapore's REC Market

Figure 20 illustrates the trends in total REC issuance (2015–2024) and I-REC redemption (2018–2024). Despite Singapore's constraints on renewable energy production, government investments, financial incentives, and green financing initiatives have driven notable growth in REC issuance, particularly from solar energy sources. Over the past nine years, REC issuance has expanded at a compound annual growth rate (CAGR) of 75%, reflecting Singapore's efforts to scale its renewable energy capacity within its geographic limitations.

Similarly, corporate sustainability commitments—driven by regulatory incentives, commercial pressure, and voluntary green targets—have fueled widespread REC adoption. The introduction of digital trading platforms has further enhanced market accessibility, facilitating widespread participation in REC transactions. As a result, I-REC redemptions have surged at a CAGR of 169% since 2018, highlighting the accelerating demand for verified renewable energy claims among businesses.

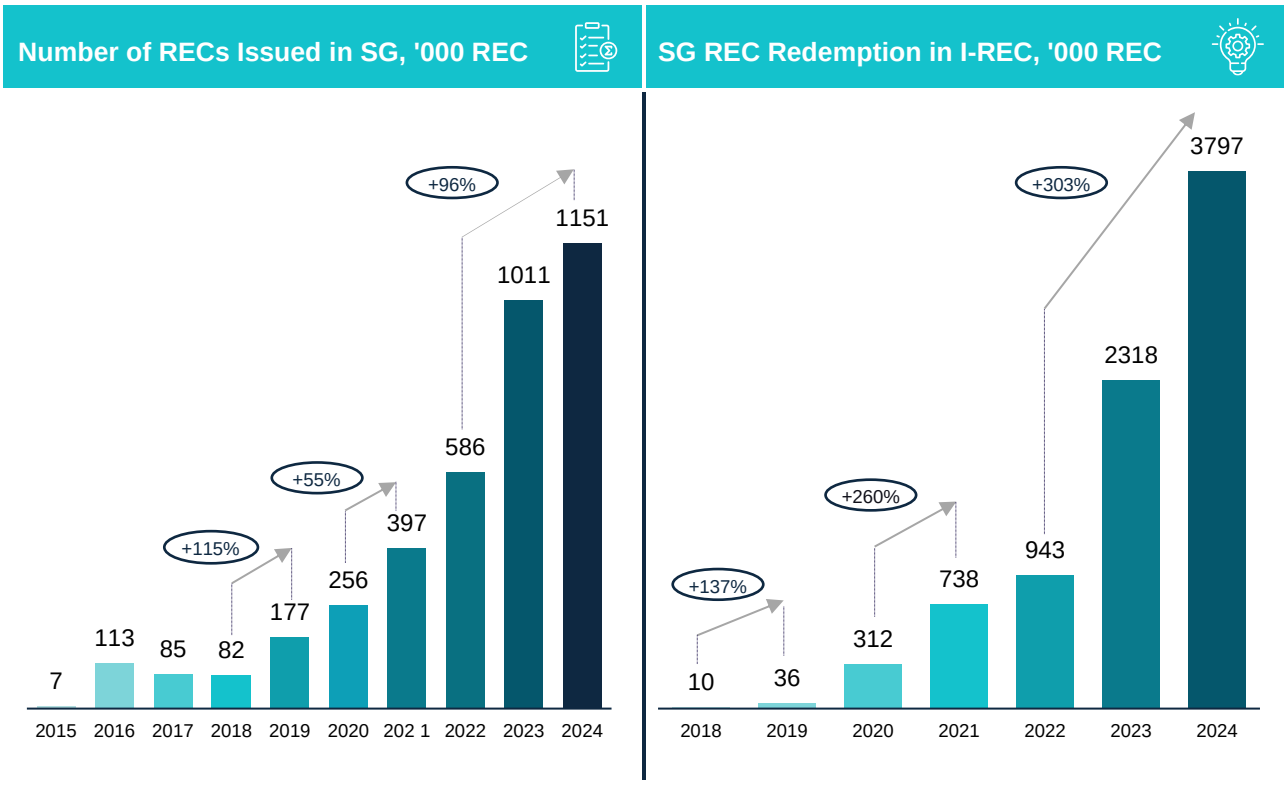

Figure 20 | Trends in REC issuance and I-REC Redemption in Singapore

Source: I-REC, TIGR

4.2 Analysis on Operational Framework

4.2.1 Overall Market Phases

Over the past 12 years, Singapore's REC market has evolved through two key phases of development: **Market Establishment** (2013–2021) and **Market Growth** (2021–Present). The impact of regulations on the REC market progressively increased as Singapore establish its REC ecosystem.

During the Market Establishment phase, several key policies were introduced to shape Singapore's REC market. Between 2013 and 2017, regulatory influence remained low but significant as it played a crucial role in laying the foundation for the market. As the framework developed, the impact of regulations increased to a moderate level from 2018 to 2020, driven by the establishment of trading platforms and structured market mechanisms that facilitated REC transactions.

In the ongoing Market Growth phase, the impact of policies has accelerated, characterized by more aggressive measures aimed at scaling REC adoption. These policies have significantly influenced the issuance of RECs and trading activities, as illustrated in Figure .

Market Establishment

2013 – 2017: Set the groundwork for its REC market by introducing RECs into its renewable energy sector through the adoption of I-REC and TIGR standards and ensuring international credibility in REC transactions while ramping up investments and initiatives to enhance the renewable energy capabilities, building the infrastructure necessary for REC trading.

2018 – 2020: Technological development of the REC market, such as the launch of blockchain-powered platforms, enhanced market participation and improved transaction efficiency and reliability. Additionally, new incentives and regulatory measures such as the Carbon Tax, were introduced to accelerate the sustainability transition for both consumers and corporations, further driving REC adoption.

Market Growth

2021 – Present: National Climate Targets and Plans, including the Singapore Green Plan 2030 and the 2050 Net Zero target, were introduced in this phase. This signaled a decisive push from the Singaporean government toward decarbonization. These commitments were reinforced by stronger policies that combine incentives and regulatory mandates to accelerate sustainability transitions. As a result, both REC demand and supply have surged, with companies increasingly integrating RECs into their sustainability strategies to meet corporate and regulatory sustainability goals.

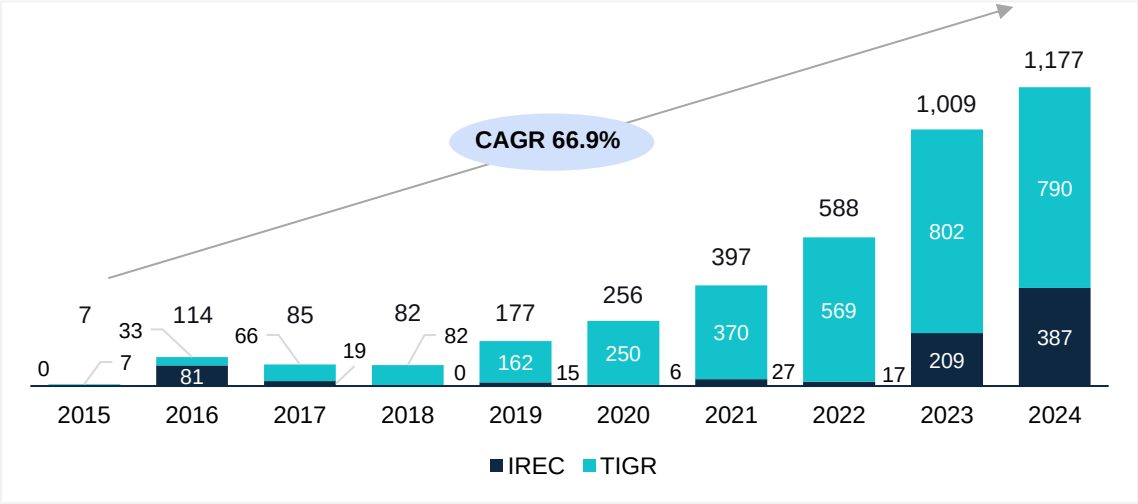

Figure 21 | Number of RECs issued in Singapore, k RECs

Source: I-REC, TIGR

4.2.1.1 Market Establishment Phase (2013 – 2020)

The Market Establishment Phase was shaped by a **three-pronged approach** by the Singapore government as seen below. Overall, REC issuance increased over this period, growing at a CAGR of 103% with volatility due to adoption of new regulations and integration of platforms.

Build Renewable Energy Production Capabilities: Renewable energy investments during this phase were primarily focused on solar power as the most viable renewable energy source constraints. Recognizing the high barriers to entry for solar energy producers, Singapore moved beyond traditional subsidies and grants by introducing innovative demand aggregation strategies. The SolarNova Program (2014) played a key role in consolidating solar demand from multiple public agencies and facilitating government rooftops as sites for solar panel deployment, thereby kickstarting the commercial viability of Singapore's renewable energy sector.

Enhance REC Accessibility: To improve market access and liquidity for REC transactions, Singapore adopted internationally recognized I-REC and TIGR standards and appointed SP Group as the local I-REC issuer, ensuring structured governance and verification of RECs. Additionally, the introduction of blockchain-powered trading platforms improved transaction transparency, security, and efficiency, making REC trading more accessible to businesses. A deeper analysis of blockchain's potential in REC markets will be covered in Section **4.2.4**.

Foster Decarbonization Sentiment among Consumers and Corporations: Alongside expanding renewable energy capabilities and REC accessibility, Singapore actively worked to shift corporate and consumer attitudes toward sustainability. Key policies such as the Carbon Pricing Act (2018) introduced Southeast Asia's first carbon tax, which created financial incentives for companies to lower their emissions or offset them through REC purchases. The Zero Waste Masterplan (2019) further reinforced sustainability sentiment by incentivizing circular economy practices and corporate sustainability commitments, increasing demand for RECs as a recognized tool for demonstrating environmental responsibility. Table 10 lists the relevant policies and events that contributed to the establishment of Singapore's REC market from 2013 to 2020.

Regulation	Date Issued	Focus Area	Content	Impact on REC Market
SolarNova Program	2014	Renewable Energy Investment	• **Aim:** Accelerate investments in Solar Power • **Tools:** Promote the growth of solar energy by utilizing rooftops of public housing and government buildings, enabling producers to achieve economies of scale.	**Increased generation** of solar power, leading to greater supply of RECs

Regulation	Date Issued	Focus Area	Content	Impact on REC Market
SP Group REC Marketplace	November 1, 2018	Accessibility of RECs	• **Aim:** Improve security and accessibility of RECs • **Tools**: Blockchain technology guarantee security, reliability, and transparency of every REC transaction.	**Enhance connectivity** between buyers and sellers with a trustworthy trading platform
Carbon Tax Introduction	January 1, 2019	Reduced Carbon Emissions	• **Aim:** Incentivize companies to reduce carbon emissions • **Tools:** Market forces of tax implementation	**Incentivize greater investment** in renewable energy technologies, creating opportunity in REC Market
Sembcorp REC Aggregator Platform	April 14, 2020	Accessibility of RECs	• **Aim**: Improve security and accessibility of RECs • **Requirements:** Promote policies and initiatives to adapt to climate change and mitigate its impacts, improve the management and sustainable use of natural resources	Provides sellers with a reliable platform to **ensure guaranteed sales**, while offering buyers confidence in the **authenticity of RECs** and the **integrity of transactions**
SG Eco Fund	November 2020	Emerging Technology for Sustainability	• **Aim:** Accelerate development in green technology • **Tools:** Funding provided to encourage co-creating technology and solutions to hit sustainability targets	**Improved technology** of RE generation led to greater supply of RECs

Table 10 | Policies and Events contributing to Singapore's REC Market Establishment (2013 – 2020)

4.2.1.2 Market Growth Phase (2021 – Present)

The transition from market establishment to market growth was marked by the launch of **Singapore's national sustainability targets**, including the Singapore Green Plan 2030 and the Net Zero 2050 commitment. With a firm foundation for the REC market established—such as standardized REC frameworks and well-developed trading channels—the market growth phase is characterized by **more aggressive government policies** aimed at accelerating both renewable energy supply and demand.

The introduction of national climate targets, along with supporting initiatives and programs, significantly shifted consumer sentiment toward sustainability, increasing demand for eco-friendly products and renewable energy solutions. Concurrently, corporate mandates—such as higher sustainability incentives, increased carbon tax rates, and mandatory sustainability reporting requirements—further incentivized companies to demonstrate environmental responsibility. As a result, RECs have become a key tool for corporations to meet their sustainability commitments, driving greater REC adoption.

Renewable energy supply in this phase has been driven by two key factors: local renewable energy production and regional low-carbon imports. Domestically, successive iterations of the SolarNova Program, alongside new incentives, grants, and programs to develop green solutions, have continued to expand Singapore's renewable energy capacity, particularly in solar power. However, due to land and resource constraints, Singapore has placed a greater emphasis on regional energy connectivity to facilitate low-carbon imports.

As an active participant in initiatives such as the ASEAN Power Grid (APG) and the Australia-Asia Power Link (AAPowerLink), Singapore is playing a pivotal role in strengthening cross-border electricity trade. These efforts are enhancing Singapore's ability to import renewable energy while simultaneously leveraging REC imports to complement growing domestic REC demand.

Table 11 outlines the key policies and events that have contributed to the growth of Singapore's REC market from 2021 to the present.

Regulation	Date Issued	Focus Area	Content	Impact on REC Market
Singapore Green Plan 2030	February 2021	Climate Change Response	• **Aim:** Align Singapore with wider global environmental targets • **Tools:** Expand solar energy generation, mandate sustainability disclosures for listed companies, provide incentives to enhance energy efficiency in buildings and businesses, and promote green financing options	**Raise corporate adoption** of RECs and **improve supply** of RECs through solar power facilities
SS 673	October 26, 2021	Standards for RECs	• **Aim:** Provide standardized framework for REC issuance and management requirements • **Tools:** Guidelines across the entire lifecycle of RECs (Production, Tracking, Management & Usage of certificates)	Provides sellers with a reliable platform to **ensure guaranteed sales and lower cost**, while offering buyers confidence in the **authenticity of RECs** and the **integrity of transactions**

Regulation	Date Issued	Focus Area	Content	Impact on REC Market
Lao PDR-Thailand-Malaysia-Singapore Power Integration Project	June 2022	Rec Supply	• **Aim:** Increased supply of RE through imports • **Tools:** Imports of renewable hydropower and increased regional power integration.	**Increase supply of RE outside of domestic producers** and expand REC market into the region
Singapore Net Zero 2050	25 October 2022	Climate Change Response	• **Aim:** Align Singapore with wider global environmental targets • **Tools:** Supporting solar energy development, Incentives to improve energy efficiency in buildings and companies, Green Financing Options	**Raise corporate adoption** of RECs and **improve supply** of RECs through solar power facilities
Enhanced Energy Efficiency Fund	2 March 2023	Energy Efficient Technologies	• **Aim:** Improve energy efficiency in Singapore • **Tools:** Enhance support for approved energy efficient technologies to increase adoption by corporations	RECs provided **synergistic effects with energy efficient technology** to hit sustainability goals, **boosting REC demand**
Carbon Tax Hike	2024	Climate Change Response	• **Aim:** Incentivize companies to reduce carbon emissions • **Tools:** Market forces of tax implementation	**Incentivize greater investment** in renewable energy technologies, creating opportunity in REC Market
Mandatory Sustainability Reporting	FY2025	Corporate Sustainability Targets	• **Aim:** Incentivize companies to align to national sustainability targets • **Tools:** Publicly listed companies mandated to release sustainability reports, Increased pressure from stock prices	**Incentivize corporations** to reduce carbon footprint through REC, **increasing REC demand**
Cross-Border REC Framework	TBC	Cross-Border REC Trade	• **Aim:** Drive demand for cross-border electricity trade • **Tools:** Provide assurance on high-integrity REC imports	**Increase supply of REC market** through recognizing imports of cross-border RECs

Table 11 | Policies and Events contributing to Singapore's REC Market Growth (2021 – Present)

4.2.2 Key Regulators

Within Singapore, there are 5 key organizations involved in implementing policies for the REC market and renewable energy sector:

Key Government Departments

Energy Market Authority (EMA)

- Key energy regulatory agency under the Ministry of Trade and Industry (MTI)
- Develop policies to support renewable energy deployment and oversees initiatives (e.g., SS 673 and clean energy imports)

Enterprise Singapore

- Oversees development of national standards (e.g. SS 673)
- Ensure integrity and credibility of RECs issued in Singapore

Government-Owned Private Corporations

- Private corporations under Temasek Holdings, Singaporean state-owned multinational investment firm
- Built REC marketplaces with support from government.

Singapore Power Group (SP Group)

- Blockchain-based REC trading platform
- Authorized local issuer of I-RECs

Sembcorp Industries

- REC Aggregator Platform for RECs from multiple sources
- Directed at corporations looking to purchase RECs in large volumes

International Organization

I-REC Standard Foundations & APX Inc.

- Oversee respective REC systems, including assessing, tracking and managing RECs
- Ensure international compatibilityof RECs for cross border trading

4.2.3 REC Certification Systems

SP Group is the locally appointed issuer of I-RECs in Singapore and along with the Green Certificate Company and APX, are the local issuers in charge of registry transactions, from issuance to redemption. With SP Group as a state-owned company with commercial independence, the Singapore government has some regulatory oversight over REC issuance but is not involved with regular operations. Additionally, on the registry, anyone can be a participant from suppliers to traders and corporations.

A complete list of the entities involved and roles in Singapore's REC lifecycle can be found below in Table 12.

Entities	Roles	Representative Organizations
Issuer	An independent entity recognized by government authorities, manages facility registration, verifies generation data, and issues RECs based on reported output	APX SP Group Green Certificate Company
REC Suppliers / Registrant	Power Generation Corporations (GENCOs) must register with the REC tracking system to issue RECs by creating accounts, registering production stations, and requesting REC issuance. This role is termed the "Registrant" in I-REC and "Asset Owner" in TIGR.	Cleantech Solar LYS Energy Group
Participants	An entity that manages one or more trade or Redemption Accounts within a Registry. Participants are the specified owners of Product Certificates held within their Accounts.	GreenYellow
Third Party Auditor	Accredited bodies will review data and certify for REC issuance and tracking to ensure compliance with international standards. Global firms like Deloitte and PwC may audit RE projects in Singapore, though not explicitly as REC verifiers.	PWC KPMG

Entities	Roles	Representative Organizations
Beneficiary / Companies and Corporations	End-users who redeem RECs are typically public or private entities with global renewable energy commitments, including those in manufacturing, services, education, healthcare, NGOs, and RE100 multinational corporations.	DBS UBS CapitaLand
Platform Operator	A Platform Operator manages a platform that extends Registry functions, enabling remote actions without being the primary custodian of certificates, such as facilities to transfer or redeem I-RECs. Its role varies by platform purpose and business model.	SP Group Sembcorp

Table 12 | Entities and Their Roles in Singapore's REC Lifecycle

The involvement of key participants in the REC lifecycle is outlined in Figure 22 to Figure 24. Figure 22 specifically highlights Singapore's REC issuance and certification process, which relies heavily on REC issuers - operating with varying degrees of independence from the government - while also showcasing the primary demand and supply sources that drive the Singapore REC market.

Unlike Viet Nam, where authorized service providers and platform operators play a significant role in facilitating REC trading, Singapore's REC transactions take place on online platforms. These include registry platforms and locally developed trading platforms, which help streamline market operations by aggregating demand and supply, reducing costs, and increasing market transparency.

Third-party auditors play a similar role to other jurisdictions in conducting independent audits of the REC registry's processes. The auditors ensure transparency, regulatory compliance, and accountability across the entire of the REC lifecycle, thereby maintaining the credibility and authenticity of Singapore's RECs for both local and international markets.

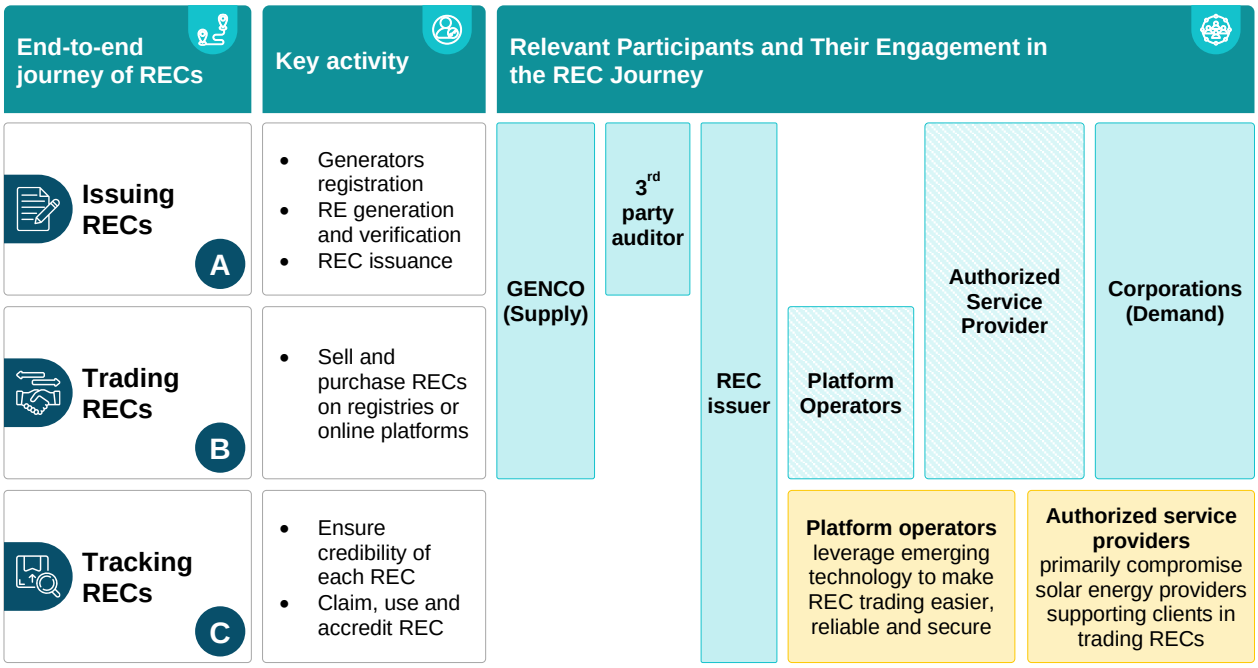

Figure 22 | Singapore REC Journey and Participants Engagement Map

Source: Arthur D. Little Analysis

Figure 10 illustrates the **REC issuance process flow**, outlining the roles of each participant from issuance to trading and tracking of RECs. This process adheres strictly to I-REC and TIGR standards, ensuring credibility, transparency, and compliance.

The process begins with renewable energy producers, who must register their installations and provide documented evidence of electricity generation. Only after submitting the required documentation, including metering data and compliance reports, and passing verification checks by an accredited third-party verifier are RECs issued.

Producers hold issuance accounts, which allow them to receive RECs upon verification. Once issued, RECs enter the trading and redemption phase, where other participants—such as traders, corporate buyers, and utilities—utilize their trading and redemption accounts to buy, sell, or retire RECs in line with corporate sustainability commitments or regulatory compliance.

Procedure and Key Activities to Issue REC

Participants	Registration	RE Generation	Verification	REC Issuance	REC Trading	REC Tracking
Supplier	Register RE asset/solar system by submitting key information i.e., address, geographical coordinates, installed capacity, date of commissioning, project photos, metering evidence and electrical diagram	Generating RE from renewable energy facilities, such as wind farms & solar panels, which is fed into general power grid	Document and submit generation data for verification to confirm accuracy and compliance with REC standards	Receive RECs after successful verification through registry system.	Sell RECs directly, on registry trading system or on online platforms	
Online Platform Operators	Guide companies through the registration process by providing support on project documentation, compliance requirements, and procedural steps to ensure successful submission			REC undergoes verification by tracking system to ensure authenticity and traceability	Bridge suppliers and buyers by facilitating REC transactions, offering market information and reliable transactions	
Issuer (I-REC/ TIGR)	Provide platform access and procedural guidance for project registration, ensuring standardized submission of key information and compliance requirements		Conduct audits to inspect PV system and authenticate electricity generation data	Issues verified RECs to the registered producer	RECs transferred into buyer's redemption account	Ensures transparency and prevents double counting by monitoring entire process
Third-party Auditor			Verifies the report energy generation data, ensuring compliance with REC standards			

Figure 23 | REC Issuance Process Flow

Source: Arthur D. Little Analysis

Figure 24 illustrates the **process flow for REC trading and certification**, detailing the key steps and participants involved in ensuring secure, transparent, and compliant transactions. The process begins with buyers assessing their sustainability goals to determine whether RECs align with their reporting frameworks such as GHG Protocol, RE100, or CDP, and how they compare to other sustainability instruments, such as carbon credits. Buyers must register and create a trading account to participate in the market, allowing them to purchase RECs through various trading channels, including direct transactions, registry platforms and third-party trading platforms.

Meanwhile, to ensure transaction security and market integrity, registry and external platforms implement security and tracking measures, including verification of REC authenticity, anti-double counting mechanisms and regulatory compliance checks to ensure that RECs meet national and international reporting standards. Once buyers claim RECs for sustainability reporting, they must cancel (retire) them in the registry to prevent re-use or resale, ensuring compliance with reporting requirements and preventing double counting.

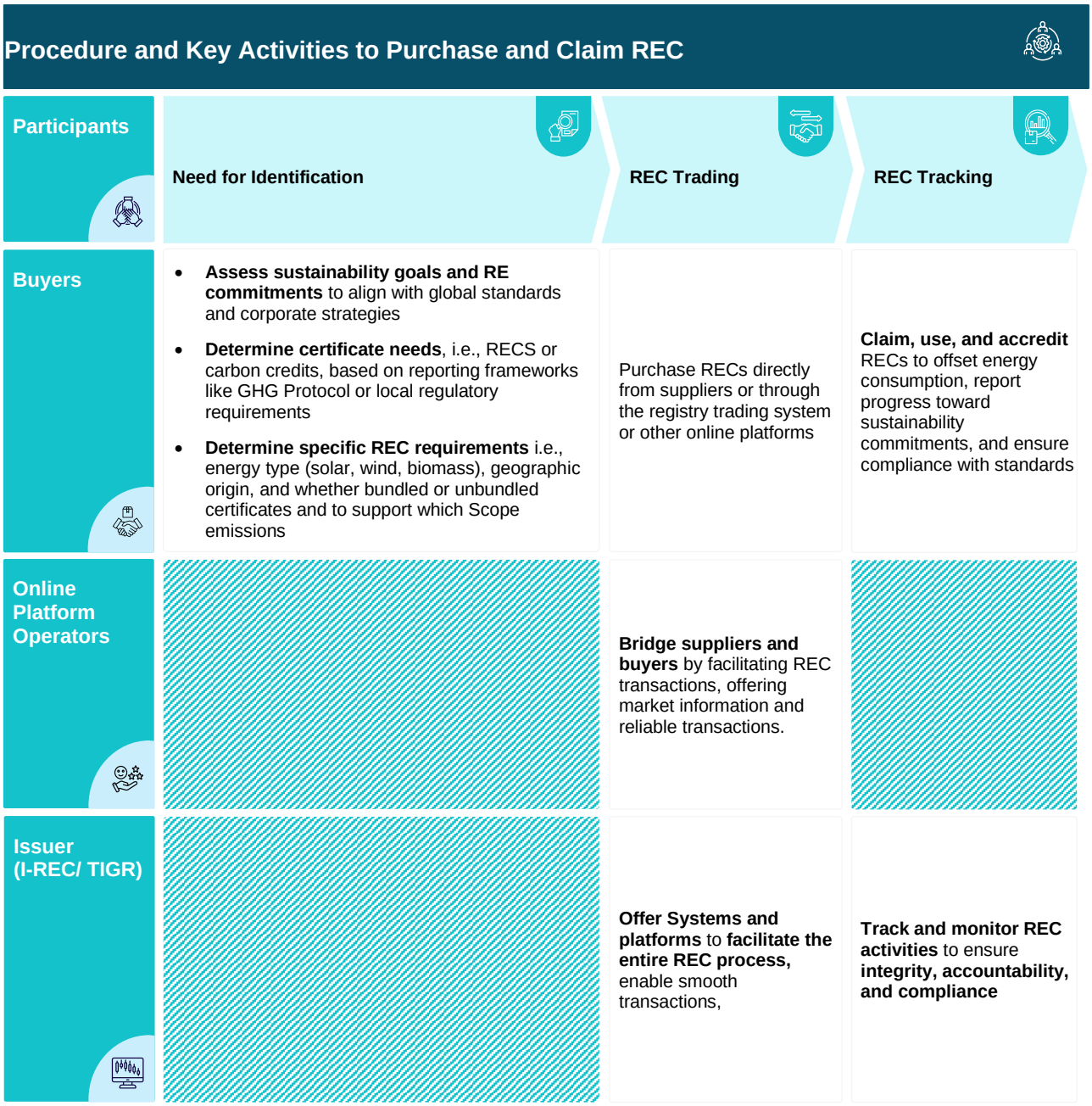

Figure 24 | REC Trading and Redemption Process Flow

Source: Arthur D. Little Analysis

4.2.4 Digital Infrastructure

Singapore's REC tracking system adheres to I-REC and TIGR standards, ensuring secure, transparent, and verifiable transactions. The country operates a digital registry system designed to track RECs throughout their lifecycle, using advanced digital infrastructure such as digital registries and unique identification numbers.

Digital Registry: RECs are recorded in a digital registry, such as those provided by the I-REC foundation, which provides detailed information, such as production date, location and energy type

Unique Identification: Each REC is assigned a unique identification number to track it from issuance to cancellation

Singapore actively integrates blockchain technology into its REC market to enhance the trading process. Blockchain supports online trading platforms by aggregating supply and demand, as well as automating compliance checks against the Singapore Standard 673, Singapore's regulation on REC issuance. Additionally, it strengthens international integration, allowing Singapore's REC market to align with global standards.

Cost: Decentralized public ledgers and smart contracts automate transactions, eliminating third-party intermediaries and manual verification processes. This significantly reduces transaction costs, improves efficiency, and lowers barriers to entry for REC adoption.

Security: Immutable transaction records and advanced cryptographic security prevent tampering and fraudulent activities. Public ledger visibility ensures real-time transaction transparency without requiring third-party verification.

International Integration: Standardized blockchain infrastructure ensures compatibility across different REC trading systems, facilitating cross-border REC transactions. This allows for greater interoperability between markets and promotes global sustainability commitments.

Despite its advantages, blockchain introduces complexities in requirements from international trading partners, such as high technological maturity from trading partners to ensure system interoperability. Additionally, cybersecurity risks must be addressed through standardized data protection and certification frameworks to ensure the credibility and eligibility of internationally traded RECs.

4.3 Assessment of REC Demand Drivers and Market Dynamics

Singapore's Renewable Energy Certificate (REC) market is characterized by strong corporate demand, driven by increasing investor and consumer valuation of sustainability efforts, as well as regulatory mandates and incentives promoting corporate environmental responsibility. However, this demand is constrained by a limited domestic REC supply, necessitating imports from neighboring countries to bridge the gap. While Singapore has made significant progress in enhancing renewable energy production despite its land constraints, the current supply remains insufficient to meet the growing demand, resulting in a persistent price premium of SGD 30 to 50 per REC. To address this

challenge, Singapore is actively exploring regional partnerships and initiatives to facilitate low-carbon energy imports.

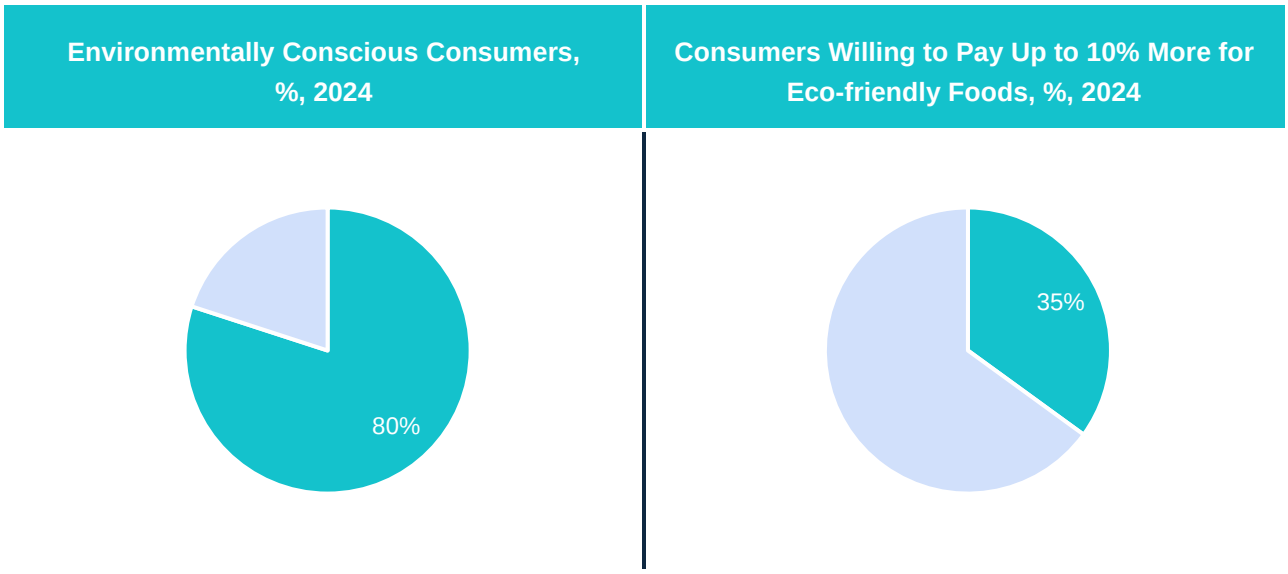

Figure 25 | Consumer Trends in Singapore Towards Sustainability

Source: Nielsen, Ministry of Industry and Trade

A key factor driving REC adoption is Singapore's increasingly eco-conscious population. A 2024 study by Singapore Business Review found that 80% of consumers express environmental concerns, and 35% are willing to pay up to 10% more for sustainable products as seen in Figure 25. However, barriers such as a lack of information and trust, low availability, and higher costs remain significant obstacles to widespread adoption. This indicates a growing market for sustainable products, one that corporations can tap into by utilizing RECs to demonstrate their commitment to sustainability.

Beyond consumer demand, investors are also playing a crucial role in shaping corporate sustainability strategies. With S$130.7 billion in retail investor capital allocated to ESG investments in Singapore, and 61% of investors incorporating sustainable thematic investments into their portfolios, businesses face increasing pressure to integrate sustainability into their operations. Furthermore, 37% of investors intend to allocate more than 15% of their portfolios to sustainable assets, reinforcing the financial significance of corporate sustainability efforts. As a result, companies are increasingly adopting RECs as part of their broader ESG strategies to remain competitive and attractive to investors.

On the regulatory front, Singapore has implemented various mandates and initiatives to accelerate the transition to a sustainable economy. The introduction of a carbon tax in 2019, with scheduled

increases between 2024 and 2030, is designed to incentivize emissions reductions. Additionally, Singapore Exchange (SGX)-listed companies are required to provide sustainability disclosures, enhancing transparency and accountability in corporate sustainability efforts. The Green Mark certification program further encourages sustainable development by offering incentives such as co-funding and tax deductions, alongside mandatory sustainability requirements for public-sector buildings and large-scale private developments.

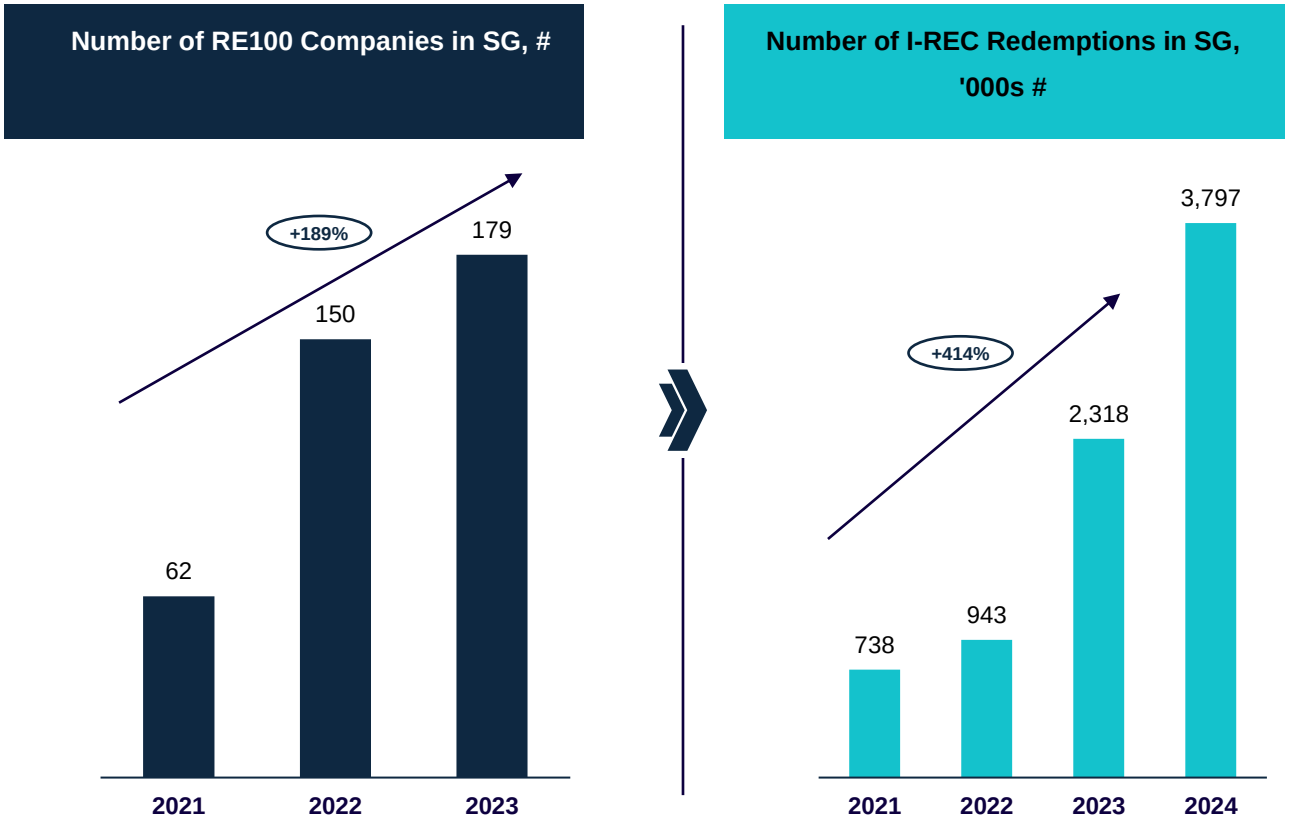

Figure 26 | RE100 Adoption and REC Demand Trend in Singapore

Source: RE100 Report, I-REC

To support businesses, particularly SMEs and startups, the government has introduced various sustainability programs, funds, and grants aimed at fostering innovation and co-developing sustainable solutions. These measures, combined with evolving consumer and investor sentiment, have led to a sharp increase in corporate sustainability commitments. The number of companies participating in the RE100 initiative more than doubled from 62 in 2021 to 179 in 2023, while REC redemptions have surged with a compound annual growth rate of 172% between 2021 and 2024 as seen in Figure 26.

While REC supply is growing at a compound annual growth rate (CAGR) of 180%, significantly outpacing REC demand at 87% CAGR, projections suggesting that supply will overtake demand within six years are unlikely to materialize due to land constraints in Singapore. To address this limitation, Singapore is turning to cross-border electricity imports to supplement its renewable energy supply. However, this approach presents challenges, including transaction security, REC authenticity, and the prevention of double counting. To mitigate these risks, Singapore is actively engaging in international collaborations aimed at enhancing inter-regional connectivity and establishing robust verification mechanisms.

4.4 Claiming, Verification and Surrendering of RECs

The claiming, verification, and surrendering of Renewable Energy Certificates (RECs) are primarily managed by the local issuers while I-REC, TIGR and SS673 establishes certification framework for market participants, ensuring a structured process where:

RECs are **issued** to producers' accounts.

Trading is initiated by the initial account holders to other trading accounts.

Redemptions are exclusively done on redemption accounts.

Figure 27 illustrates the full process flow of REC transactions, detailing participant involvement and the types of accounts each entity is permitted to create and hold. Platform operators manage a unique marketplace account, which temporarily holds RECs listed for trading. They are also responsible for maintaining auditable records of all transactions on their platforms, a task that can be made more efficient and cost-effective through blockchain technology, which enhances security, traceability, and automation.

Once a REC is designated for sustainability disclosures, it must be transferred to the account holder's redemption account and retired from the system to prevent double counting and ensure compliance with certification standards. The government's role in this system is primarily regulatory oversight, which includes establishing compliance frameworks, supporting third-party auditing, and fostering REC market growth through policies, regulations, and strategic initiatives that enhance market integrity and participation.

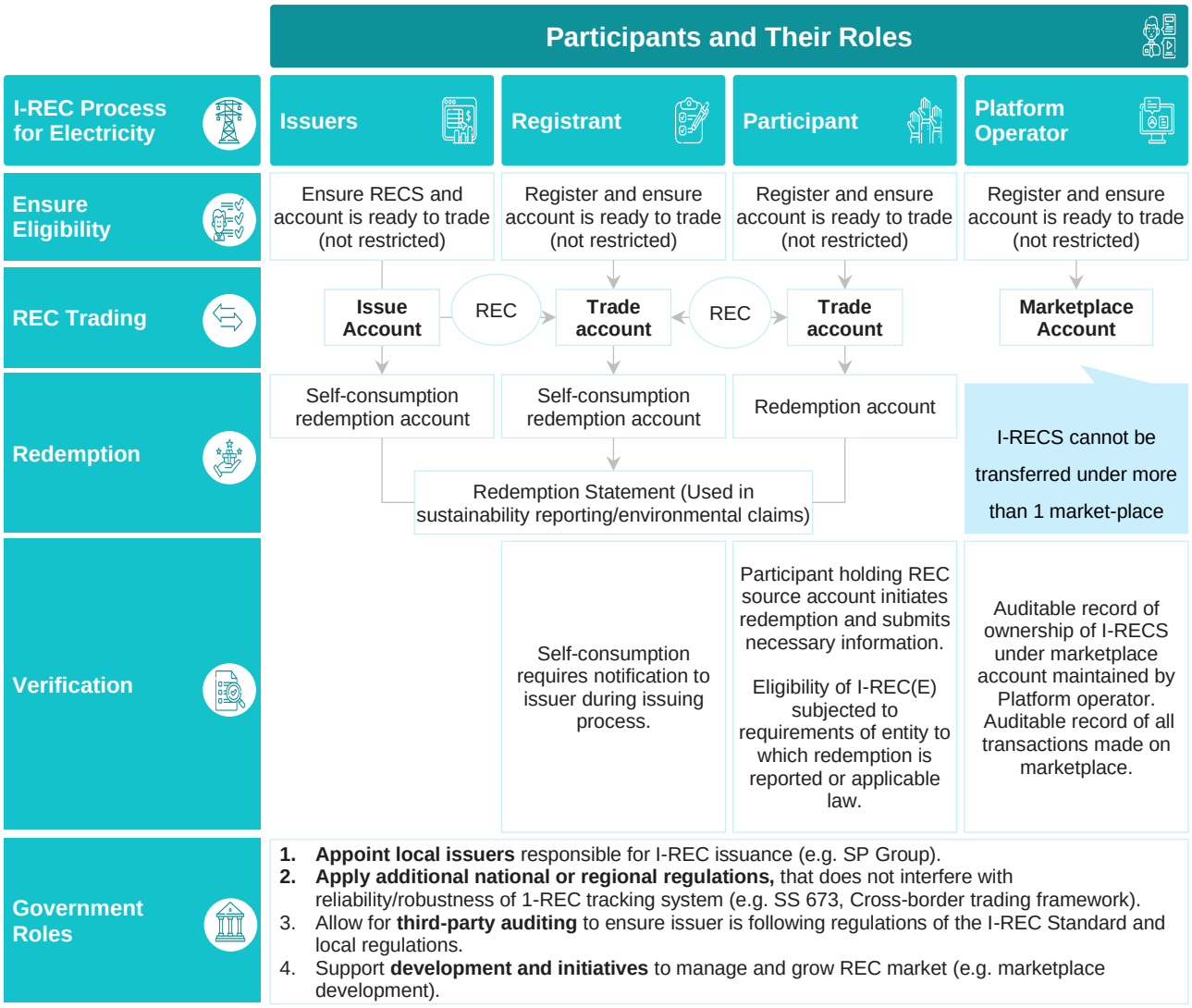

Figure 27 | Claiming, Verification and Surrendering Process of RECs in Singapore

Source: Arthur D. Little Analysis

Figure 30 defines and explains key REC terminologies referenced in Figure 29 for clearer understanding and context.

Term	Terminology Definition & Process Explanation for I-REC
Issue account	An Account operated by an Issuer and capable only of sending I-REC(E) to another Account
Trade Account	An Account operated by a Participant and capable of receiving and sending I-REC(E) from or to another Account
Marketplace Account	An Account operated by a Platform Operator and holds I-RECs placed on the marketplace.
Redemption Account	An Account operated by a Participant or Platform Operator and capable only of receiving I-REC(E) from another Account
Self Consump -tion Redemption Account	An Account operated by a Registrant, Issuer (on behalf of a Registrant), or Platform Operator and capable only of receiving I-REC(E) from another Account.
Redemption Statement	A uniquely verifiable report confirmed the redemption & assignment of I-REC(E)s using a QR code and verification key.
General Provision for Redemption	Before any claim can be made, the I-REC(E) **must be removed from a Trade Account and placed in a Redemption Account or a Self-Consumption Redemption Account** Once an I-REC(E) has been Redeemed, only **one claim to the underlying attributes of that I-REC(E) can be made.** Participants can generate a **Redemption Statement from the Registry,** which can be used as a **disclosure statement** The use of an I-REC(E) can only be verifiably Assigned to an End-user (or Beneficiary) upon Redemption and shall be recorded within the Registry.

Figure 28 | Terminology Used within I-REC Certification System

Source: Arthur D. Little Analysis

4.5 Impact Assessment on REC Capacities

Supported by substantial investments in solar photovoltaic (PV) projects, Singapore's Renewable Energy Certificate (REC) market has closely mirrored the growth of renewable energy production, with REC issuance projected to align with the country's 2030 renewable energy targets.

As illustrated in Figure 29, Singapore's renewable energy production is expanding at a compound annual growth rate (CAGR) of 10.9%, driven largely by the deployment of 901 MW of solar PV capacity. This growth trajectory is consistent with Singapore's Green Plan 2030, which targets at least 2 gigawatt-peak (GWp) of installed solar capacity to meet approximately 3% of the country's projected electricity demand by 2030. The expansion of solar energy infrastructure has been facilitated by supportive government policies, which encourage investment in renewable energy and reduce barriers to entry for clean energy projects.

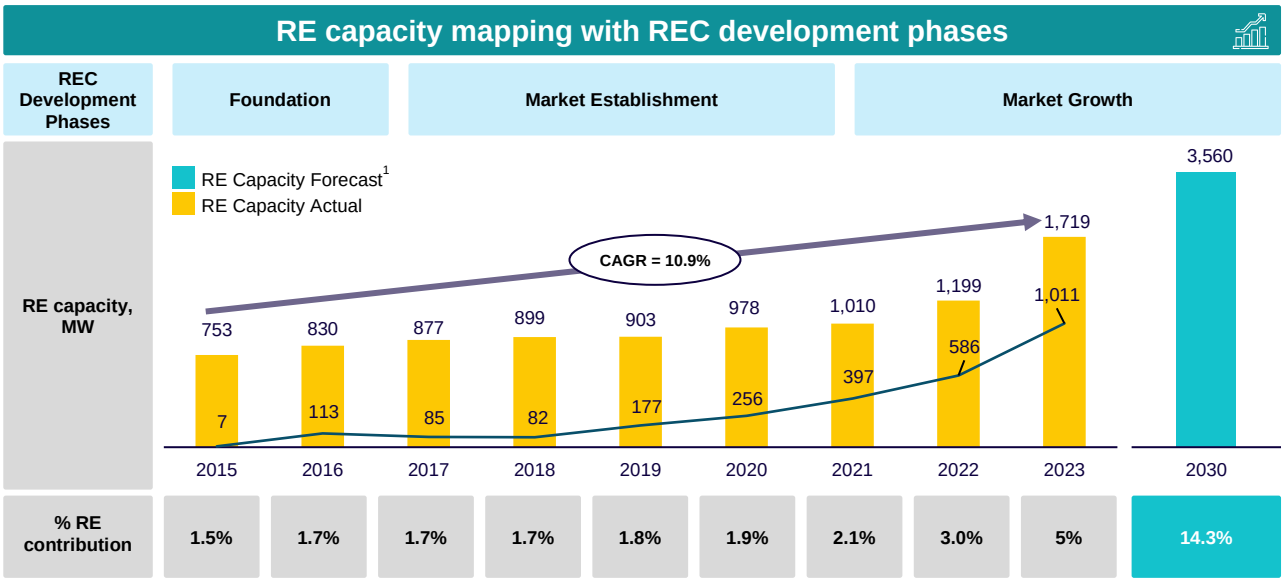

Figure 29 | Renewable Energy Production Mapping with REC Development Phases

Source: I-REC, TIGR, IRENA Report

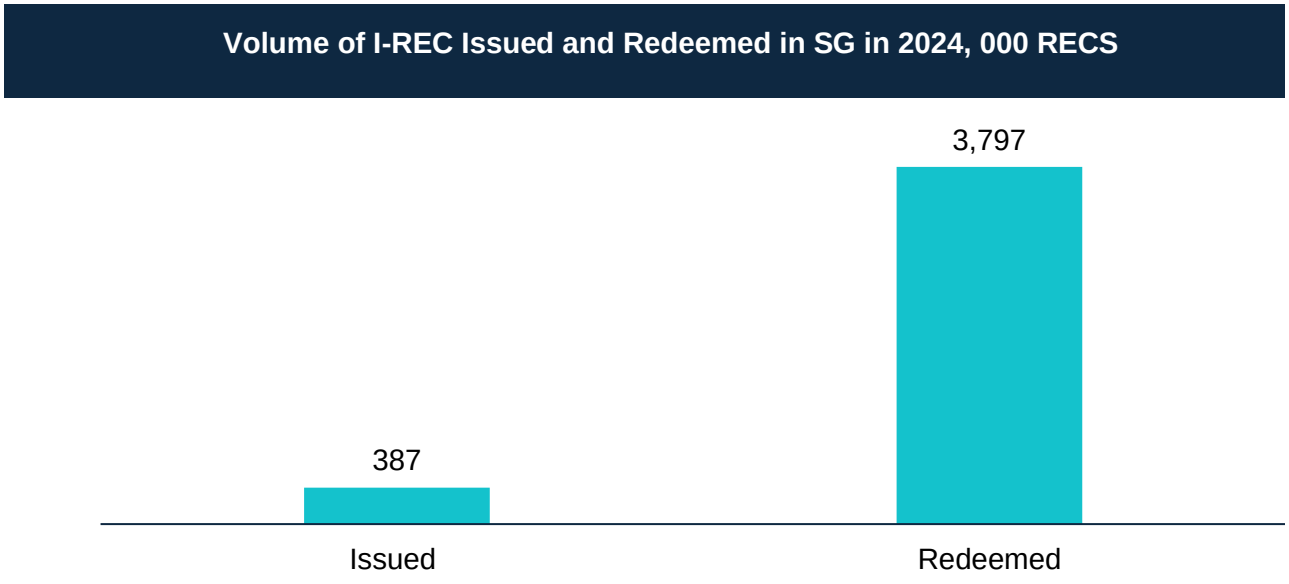

Figure 30 | Supply-Redemption Volume of I-RECs in Singapore

Source: I-REC

Despite its progress, current I-REC issuance volume remains approximately ten times lower than I-REC redemption volume in Singapore, highlighting a significant supply-demand gap as seen in Figure 30. To address this shortfall, Singapore plans to increase low-carbon electricity imports to 4 GW by 2035, which is expected to constitute around 30% of the country's projected electricity supply. This objective will be achieved through a series of international collaborations aimed at enhancing regional energy connectivity and ensuring a credible REC framework. Key initiatives include:

Cross-Border REC Framework: Singapore is working with neighboring countries, particularly Malaysia and Australia, to establish a standardized system for recognizing RECs associated with cross-border electricity trade.

ASEAN Power Grid: This initiative seeks to interconnect the power grids of ASEAN member states, creating a fully integrated regional energy system that promotes energy security and sustainability.

Lao PDR – Thailand – Malaysia – Singapore (LTMS) Power Integration Project: A multilateral effort enabling the import of renewable energy from Lao PDR through Thailand and Malaysia to Singapore.

SunCable's Australia-Asia PowerLink Project: A large-scale infrastructure project designed to transmit renewable energy from Australia to Singapore via an undersea high-voltage direct current (HVDC) cable.

These initiatives reflect Singapore's commitment to diversifying its energy sources, strengthening energy security and scaling up REC availability to meet growing corporate demand.

4.6 Lesson Learned and Applicability to the Philippines

Singapore's REC market success is driven by an incentive-based regulatory approach, strong corporate demand, international integration, and strategic partnerships. Initially, funds, grants, and programs encouraged sustainability commitments before stricter mandates were introduced. Private sector collaboration played a key role in co-developing REC trading tools and renewable energy solutions, while international REC standards (I-REC, TIGR) ensured market scalability. Corporate demand, fueled by Singapore's role as an industrial hub, was further strengthened through carbon taxes and sustainability disclosures. To address its renewable energy limitations, Singapore leveraged international partnerships and blockchain technology to enhance REC trading efficiency and security.

The Philippines can adopt a phased approach, starting with corporate sustainability incentives before introducing stricter mandates to drive REC adoption. Encouraging public-private partnerships and supporting technological advancements in REC trading will strengthen market development.

Aligning local REC standards with international frameworks (I-REC, TIGR) will enhance global integration, while leveraging blockchain and digital infrastructure can boost REC security, reduce costs, and increase international market participation.

Aspect	Key Success Factors	Solutions and Best Practices	Implications for the PH
Operational Framework - Regulation	SG approached the voluntary market with an incentive-based approach before phasing in stricter mandates to incentivize national sustainability commitment	Numerous funds, grants and programs to foster sustainability commitment and reduce barriers to entry	Begin with encouraging sustainability commitment in suppliers and corporations, leading to greater initiative in RE adoption
Operational Framework - Partnerships	SG partnered with private corporations to co-develop sustainable solutions and develop new technology in REC trading tools and renewable energy sources	Support private corporations in developing solutions for gaps in the market	Offer regulatory backing, funding and other support to private corporations in renewable energy development
Operational Framework – International Integration	SG adopted I-REC and TIGR standards which are international recognized	Allowed international supply of RECs to make up for excess corporate demand	Align current REC standards to international standards for greater international integration
Market Mechanics	SG's REC market was driven by strong corporate demand, originating from SG's role as an industrial hub	Phase in stricter mandates that utilize market mechanics, such as carbon tax and sustainability disclosures, to drive REC adoption	Strengthen corporate demand, especially MNCs, by utilizing market tools
International Partnerships	Development of infrastructure, partnerships, and frameworks with neighboring countries to make up for lacking renewable energy supply.	Utilize unique characteristics of blockchain to increase security, international integration and reduce costs of REC trading	Adopt similar technology in REC marketplaces for higher global adoption of PH RECs

Table 13 | Key Success Factors in Singapore's REC Market

Singapore's limited land capacity restricts renewable energy expansion, creating high REC demand and driving premium pricing compared to the region.

With surplus REC supply and competitive pricing, the Philippines can position itself as a key REC supplier for Singapore. Additionally, leveraging Singapore's expertise in technology and international market integration can help accelerate VREM development both domestically and globally.

Aspect	Challenges	Key Takeaways
Renewable Energy Deficit Status	Lack of land capacity restricted the growth of RE sources alongside high corporate demand for RECs leads to excess demand and a premium on REC price compared to rest of the region	• PH's regional proximity and surplus REC supply, offering competitive pricing, position it as an attractive REC supplier for SG • SG's technological expertise and strong international integration provide the Philippines with valuable opportunities to accelerate VREM growth both locally and globally

Table 14 | Key Challenges in Singapore's REC Market

5. Jurisdiction 3: Australia

5.1 Summary and Market Overview

5.1.1 Australia REC Market Summary

Australia launched its renewable energy initiatives in 2000 with the introduction of the Renewable Energy Target (RET), which aimed to generate 2% of the nation's electricity from renewable sources by 2020. To support this goal, the REC system and the REC Registry were established as tracking and compliance mechanisms.

Under the guidance of the RET, Australia's REC market is primarily driven by contributions to fulfill the RET requirements. As a result, Australia's REC generation is tailored to meet local demand, with limited supply going towards the international market.

The Australian population also have strong eco-consciousness and a widely progressive culture. This view and acceptance of renewable energy technologies drives renewable energy and REC demand in the voluntary market.

Australian RECs play a crucial role in Australia's commitment to its clean energy goals and corporate commitment to sustainable operations. Figure 31 provides a high-level overview of Australia's structured REC market, which includes both mandatory and voluntary participation. Australia's mature REC framework and comparable market development trajectory make it a valuable case study for the potential implementation of the Philippine VREM.

Overview

Maturity & Compre-hensiveness	Tracking System & Standard	Voluntary Corporate Participant	Regulatory Framework	Relevance to PH
23 years Mature & Accelerating	**REC Registry** Local Standard	**RE100** Mainly among MNCs & RE100 companies	**Mandatory & Voluntary**	**High** Similar economic profile

Objectives — Findings

1 Operational Framework

Policy & Regulations	Governance	Operational Framework	Platform & Technology
10 Regulations. Policies & acts to accelerate REM	**Clean Energy Regulator** Main governing body	**Carbon abatement** RECS and Carbon Credits	**REC Registry** Registration, trading, and surrendering platform

2 Demand Drivers & Market Dynamics

Corporate	Government	Public	Market Impact
RE100, CSR RE100 operations and CSR Initiatives	**Renewable Energy Target** Mandatory RE generation target	**Progressive Culture** Drives voluntary initiatives	**Growing LGC supply. stagnant STC supply** Oversaturation of rooftop solar

3 Claiming, Verification & Surrendering of RECS

REC Verification	REC Claiming
CER, REC Registry Verification and trading done through REC Registry, CER provides oversight and compliance	**Vintage Rule, unique serial numbers** Used to avoid double counting

4 Impact on Increasing RE Capabilities

Impact
Moderate increase in RE generation RE production grows at 11% CAGR from 2014-2022 and REC generation grows at 13% from 2019-2022

5 Impact on Increasing RE Capabilities

Key Best Practices	Key Challenges
• Development of **mandatory market prior to voluntary** • **Strong progressive culture** driving RE investment • Creation of CER as **single governing body**	• Long **bureaucratic processes** • **Expiring policies** create uncertainty in future investments

Figure 31 | Summary of Australia's REC Market

5.1.2 Overview of Australia's Carbon Abatement Initiatives

Australia's carbon abatement initiatives prioritized on reducing carbon emissions and renewable energy generation. RECs were introduced to Australia first in 2000 alongside the RET. Additionally, Australian Carbon Credit Units (ACCU) were established in 2011 under the Carbon Farming Initiative, along with the formation of the Clean Energy Regulator (CER).

Carbon Farming Initiative establishes the use of ACCUs, which are tradable financial instruments that represent verified reductions of greenhouse gas (GHG) emissions. Australia has set a target to reduce GHG emissions by 43% compared to 2005 levels by 2030. Subsequently, Australia aims to achieve net-zero emissions by 2050.

Renewable Energy Target (RET) establishes the foundation for REC usage. Initially set to target 2% renewable electricity generation by 2020, the target has been updated over time to reflect Australia's rising ambition in their renewable energy journey. Currently, Australia aims to achieve 82% renewable electricity generation by 2030.

The inception of the CER placed the RET under their jurisdiction, making it the main governing body in Australia to oversee and govern the country's sustainability initiatives. Figure 32 will outline a high-level structure of the CER's operation and jurisdiction in Australia.

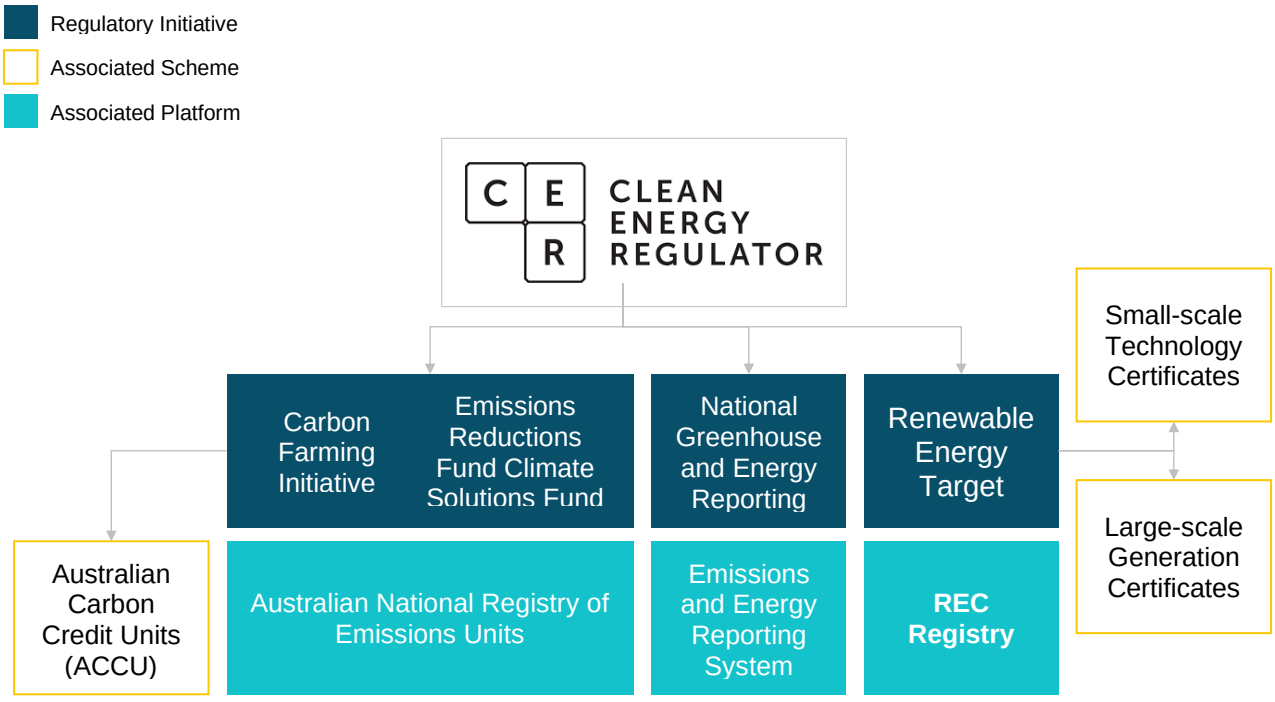

Figure 32 | Overview of CER's Carbon Abatement Initiatives

Source: Clean Energy Regulator

5.2 Analysis on Operational Framework

5.2.1 Development of Australia's REC Market

Australia's REC market development can be divided into two main phases: **Market Establishment** (2000–2010) and **Market Growth** (2011–Current). In the Market Establishment phase, Australia focused on policies supporting renewable energy development, establishing initial goals, governance, and early supporting policies. The Market Growth phase introduced policies aimed at accelerating REC adoption among producers, utilities, and corporations. It achieved acceleration of REC adoption through creating more ambitious renewable energy goals and establishing more generous incentives and supporting policy.

Australia's operational framework offers two key lessons for the Philippines to consider in developing its REC market:

Establishing Ambitious Targets: Ambitious targets, especially in a mandatory market, drives liable entities to produce more renewable energy to meet their obligations.

Create Strong Incentives and Supporting Policies: Strong incentives and supportive policies further encourage liable and voluntary entitites to grow their renewable energy adoption and participate in the REC market.

5.2.2 Trends in Australia's REC Market

Australia's REC market has seen significant growth since the establishment of its RET. Australia's support for the renewable energy market through its policy and regulation has driven its early growth in renewable energy adoption. This is reflected in Australia's REC validation prior to 2021, where the growth from 2019 – 2021 can be observed in Figure 33.

CER's REC Validation by Type, Mn RECs

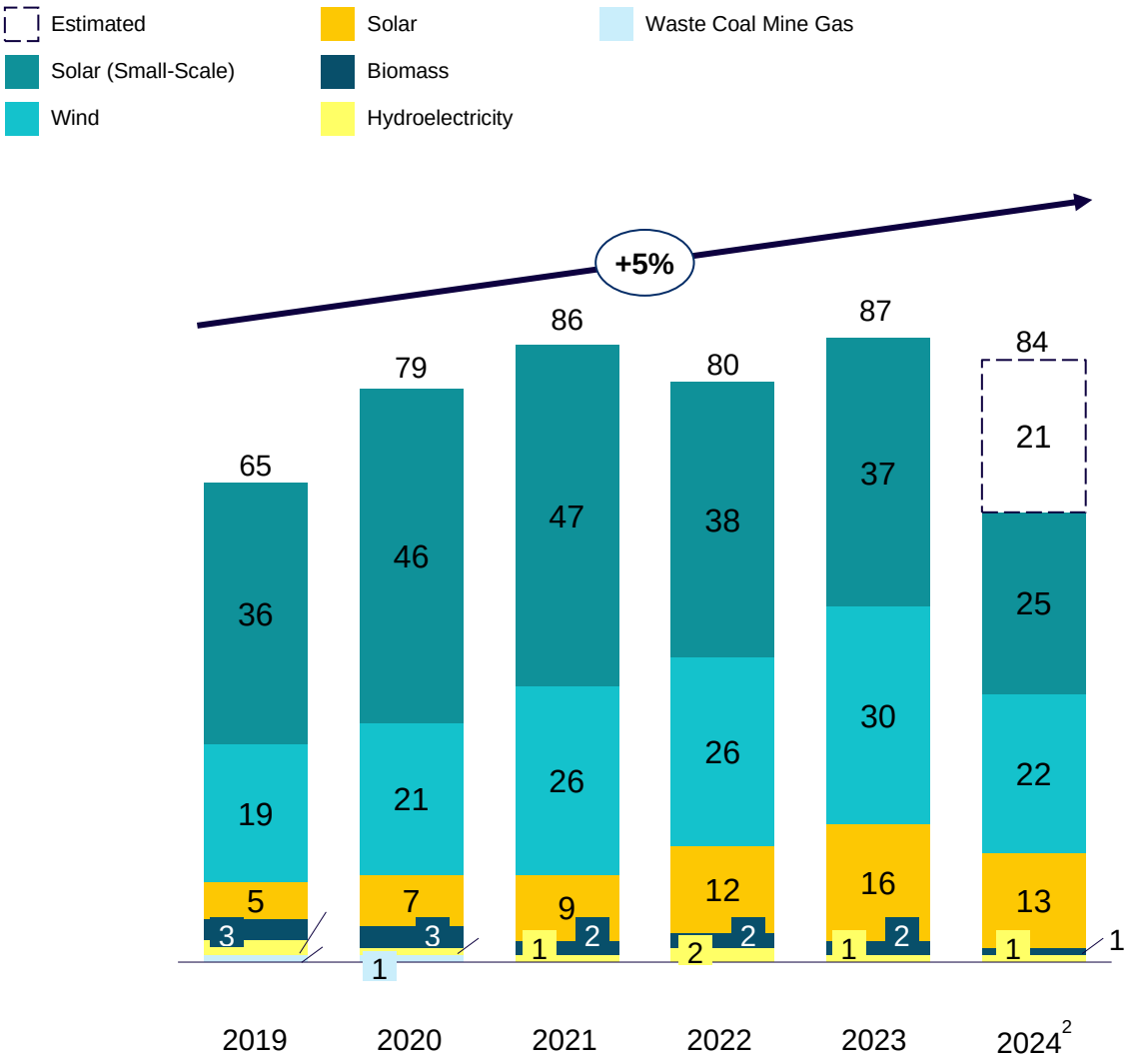

Figure 33 | REC Validation by Renewable Energy Type per Year

Source: Clean Energy Regulator

REC validation in Australia has slowed from 2021 to 2024, primarily due to a decline in the validation of Small-Scale Technology Certificates (STCs) generated from rooftop solar installations.

STCs are created at the time of installation, meaning their issuance is directly tied to the rate of new small-scale solar system deployments. The decline in STC validation suggests that the growth of new rooftop solar installations has plateaued, as Australia has already achieved high penetration of distributed solar energy across residential and commercial sectors.

Additionally, market saturation, reduced incentives, and evolving energy policies have contributed to the stagnation in small-scale solar adoption. With rooftop solar nearing its peak, future REC growth in Australia may need to rely more on large-scale renewable projects (LGCs), emerging technologies, and new policy incentives to sustain momentum in the REC market.

5.2.3 Market Establishment Phase (2000 – 2010)

d on regulations that cover broad environmental and energy efficiency goals rather than directly fostering the REC market, lacking specific market tools and mechanisms. Table 15 shows the key regulation issued in this phase.

Regulation	Date Issued	Focus Areas	Content	Impact on REC Market
Renewable Energy Act	December, 2000	Renewable energy development targets	• **Aim:** Encourage generation of electricity from renewable sources targets 2% electricity sourced by RE by 2020 • **Tools:** Prioritize the development of clean energy technologies, on-site energy production and create legal foundations	**Establishing legal basis** for REC development in Australia, further encourage **investment in RE technologies**

Table 15 | Summary of Key Regulations in the Market Establishment Phase

During this timeframe, the Renewable Energy Act remained as the regulation impacting the REC market. Australia did not develop additional policies to further expand the REC market during this period. However, the government adjusted the RET to reflect the growing adoption of renewable energy technologies. In 2009, the RET was revised to target 20% renewable electricity generation by 2020.

5.2.4 Market Growth (2011 – Present)

The market growth phase began in 2011 when the Australian government introduced regulations to further develop the REC market and support renewable energy development. These new regulations laid the foundation for growth by incentivizing investment and strengthening market confidence. Table 16 shows the key regulations that affect the REC landscape and renewable energy development.

Regulation	Date Issued	Focus Areas	Content	Impact on REC Market
National Strategy on Energy Efficiency	July, 2009	Energy Efficiency and clean energy development	• **Aim:** Develop overarching framework for energy efficiency policy and improve minimum standards for energy efficiency • **Tools:** Establish framework for tracking and compliance in relation to strategic goals	Improvement of **regulatory process** on energy efficiency to **expand REC market opportunity**
National Strategy on Energy Efficiency	July, 2009	Renewable energy development targets	• **Aim:** Establish Clean Energy Regulator to administer legislation aimed at reducing greenhouse gas emissions and promoting use of clean energy • **Tools:** Establish framework and organization structure for compliance and governance	Improvement of **regulatory processes** on energy efficiency to **expand REC market opportunity**
Clean Energy Regulator Act	November, 2011	Climate change response	• **Aim:** Governing body to conduct reviews under acts such as the Renewable Energy Act • **Tools:** Establish framework, incentives, and punishments for reviews findings	Additional legal structure and governance for REC, opening **opportunity for small-scale technology certificates (STC)**
Climate Change Authority Act	November, 2011	Renewable energy development targets	• **Aim:** To provide funding for R&D of renewable energy technologies • **Tools:** Establish budget and criteria for allocating funds	Provides additional **oversight and compliance** mechanisms for RE market

Regulation	Date Issued	Focus Areas	Content	Impact on REC Market
Clean Energy Finance Corporation Act	November, 2011	Renewable energy investment incentives	• **Aim:** Facilitate increased flows of finance into the clean energy sector • **Tools:** Establish budget and criteria for allocating funds	**Promotes development** of new RE technologies, providing **opportunity in REC market**
Clean Energy Finance Corporation Act	July, 2012	Renewable Energy investment incentives	• **Aim:** Develop overarching framework for energy efficiency policy and improve minimum standards for energy efficiency • **Tools:** Establish framework for tracking and compliance in relation to strategic goals	**Promotes development** of new RE technologies, providing **opportunity in REC market**
National Energy Productivity Plan 2015 – 2030	December, 2015	Energy efficiency and clean energy development	• **Aim:** Transform Deliver national energy productivity target of 40% improvement between 2015 - 2030 • **Tools:** Create and implement framework and economy-wide work plan	**Promoting the transition to renewable and clean energy sources**, enhancing market growth and sustainability
Electricity Network Transformation Roadmap	December, 2016	Green gas emission reduction and ozone layer protection	• **Aim:** Adapt the electricity grid to higher shares of renewables, 30-40% of total electricity by 2050 • **Tools:** Establish framework for tracking and compliance in relation to strategic goals	Promote use of renewable energy sources directly towards **electricity network**
Technology Investment Roadmap	May, 2020	National power	• **Aim:** Accelerate development and commercialization of low emissions technologies	**Setting ambitious targets for RE**

Regulation	Date Issued	Focus Areas	Content	Impact on REC Market
		development planning	through government investment • **Tools:** Develop framework and criteria for project investment and outcomes	**integration** at national and forceful level, motivating the development and certification of renewable energy
Net-zero emission 2050	October, 2021	Direct Purchase Power Agreements (DPPA) for RE	• **Aim:** Roadmap to achieve net zero greenhouse gas emissions by 2050 • **Tools:** Strategies, incentives, goals towards adopting low-carbon technologies	

Table 16 | List of Relevant Regulations and Policies in the Market Growth Stage

Newer regulations and policies provided clearer and more ambitious renewable energy targets, as well as strong incentives aligned with national goals. These policies prioritized the growth of renewable energy and strengthened REC market mechanisms.

5.2.5 Australia's Regulatory Framework

Australia's REC market is a hybrid of both mandatory and voluntary markets. The mandatory market was established in 2001 following the enactment of the Australia Renewable Energy (Electricity) Act 2000. This act set the foundation for the Renewable Energy Target (RET) and outlined the framework for renewable energy generation. Under the RET, electricity retailers are mandated to surrender a specified number of RECs annually to meet compliance obligations.

The RET is further reinforced by policies such as the Clean Energy Regulator (REC) Act 2011, which led to the formation of the CER and the restructuring of the REC framework into two distinct schemes with REC-equivalent archetypes.

Large-scale Renewable Energy Target (LRET): The LRET created large-scale generation certificates (LGC) as a type of REC equivelent, currently targeting 33MWh of electricity produced annually until 2030.

Small-scale Renewable Energy Scheme (SRES): The SRES created small-scale technology certificates (STC) as a type of REC equivalent. The scheme has an annual goal in the form of a small-scale technology percentage (STP), with a target of 21.26% in 2024 for liable entities to generatate renewable electricity from small-scale technologies.

Both the LRET and SRES serve as financial incentives to drive investment in renewable energy. LGCs and STCs function similarly to RECs in other jurisdictions, with each certificate representing 1MWh of electricity generation.

These schemes were designed to encourage renewable energy adoption across all scales, particularly by stimulating demand for small-scale renewable technologies.

Both LGC and STC trade can be considered towards Australia's RET, making their overall RET goals more attainable.

5.2.6 REC Certification System

Australia's REC framework is managed through the REC Registry, managed by the CER. The REC Registry facilitates the entire REC lifecycle, from registration to trading. Table 17 highlights the key entities involved in Australia's REC lifecycle.

Entities	Roles	Representative Organizations
Issuer	An independent entity recognized by government authorities, **manages facility registration, verifies generation data, and issues RECs** based on reported output. Oakly Greenwood is the issuer for I-REC certificates in Australia.	The Clean Energy Regulator Oakly Greenwood
REC Supplier / Registrant	Power Generation Corporations (GENCOs) **must register** within the **REC Registry** under the CER, by creating accounts, registering production stations, and requesting REC issuance. This role is termed the "Registrant" in I-REC.	AGL Origin Infigen
Beneficiary, Companies, and Corporations	End-users who redeem RECs are typically public and private entities committed to international renewable energy goals, including manufacturers, service providers, educational institutions, healthcare organizations, NGOs, and RE100 multinational corporations.	Commonwealth Bank Mars Coca-Cola

Entities	Roles	Representative Organizations
Auditors	Tracking REC issuance and trade to ensure **compliance** with **legislative standards.** 3rd party auditors can be employed for **voluntary audits**, while not mandatory, they provide confidence in accuracy of reported information.	CER PWC EY KPMG Deloitte

Table 17 | Entities and their Roles in Australia's REC Lifecycle

Australia's REC market operation relies heavily on the CER due to the mandatory regulations of the RET. Figure 34 illustrates the involvement of the CER in the end-to-end process of issuing, trading, and tracking of RECs.

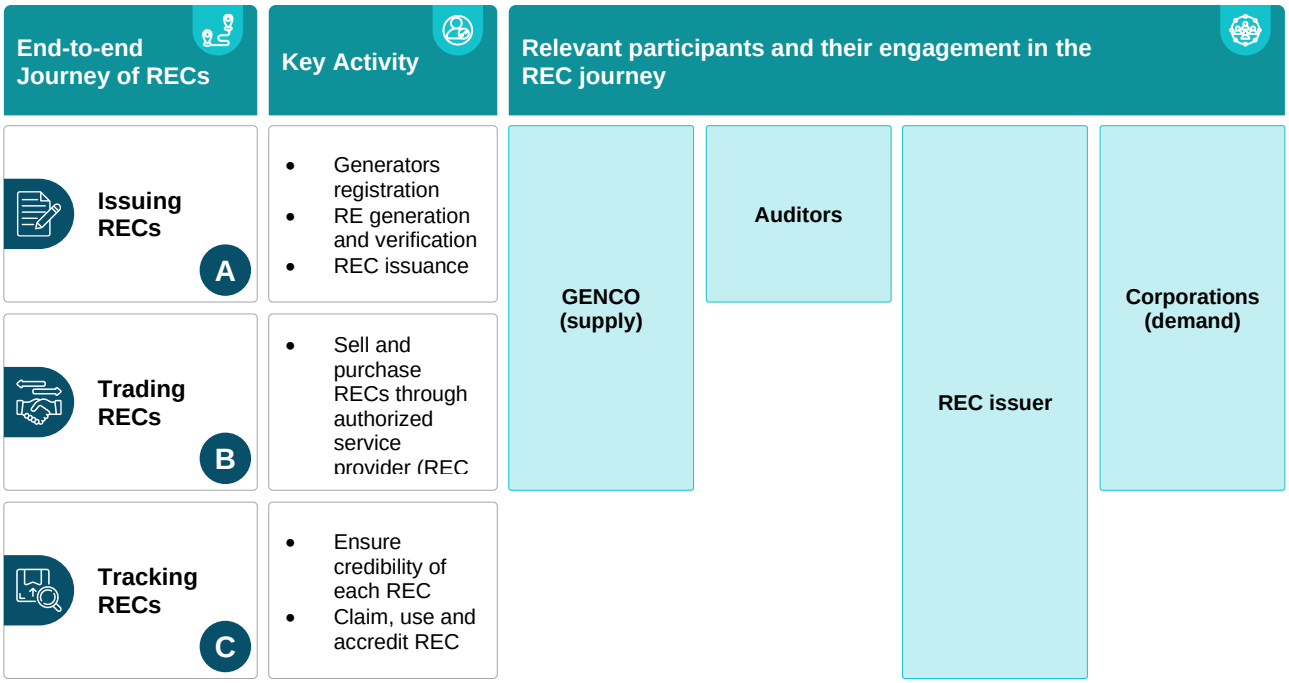

Figure 34 | Australia's REC Journey and Participants Engagement Map

Source: Arthur D. Little Analysis

While the CER is involved in the end-to-end process of the REC journey, the suppliers initiate and drive the REC issuance and trading. The CER is involved to ensure compliance and provide guidance on the market. Figure 35 illustrates how suppliers drive this journey from the accreditation of RECs, trading, and surrendering.

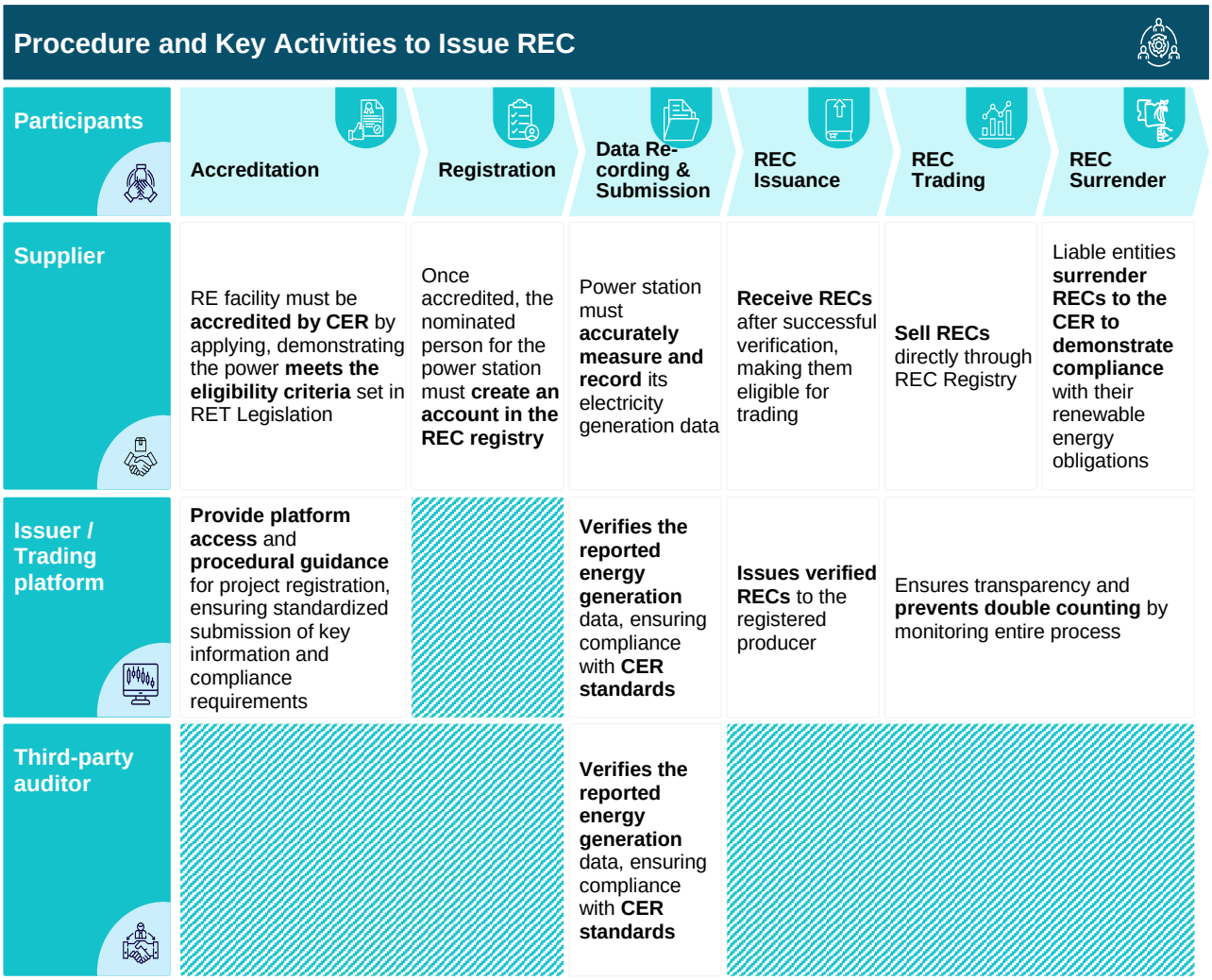

Figure 35 | Map of Supplier Driven REC Journey

Source: Arthur D. Little Analysis

Figure 36 elaborates on the involvement buyers take part in the REC journey. Highlighting the process and key considerations from the buyer's perspective.

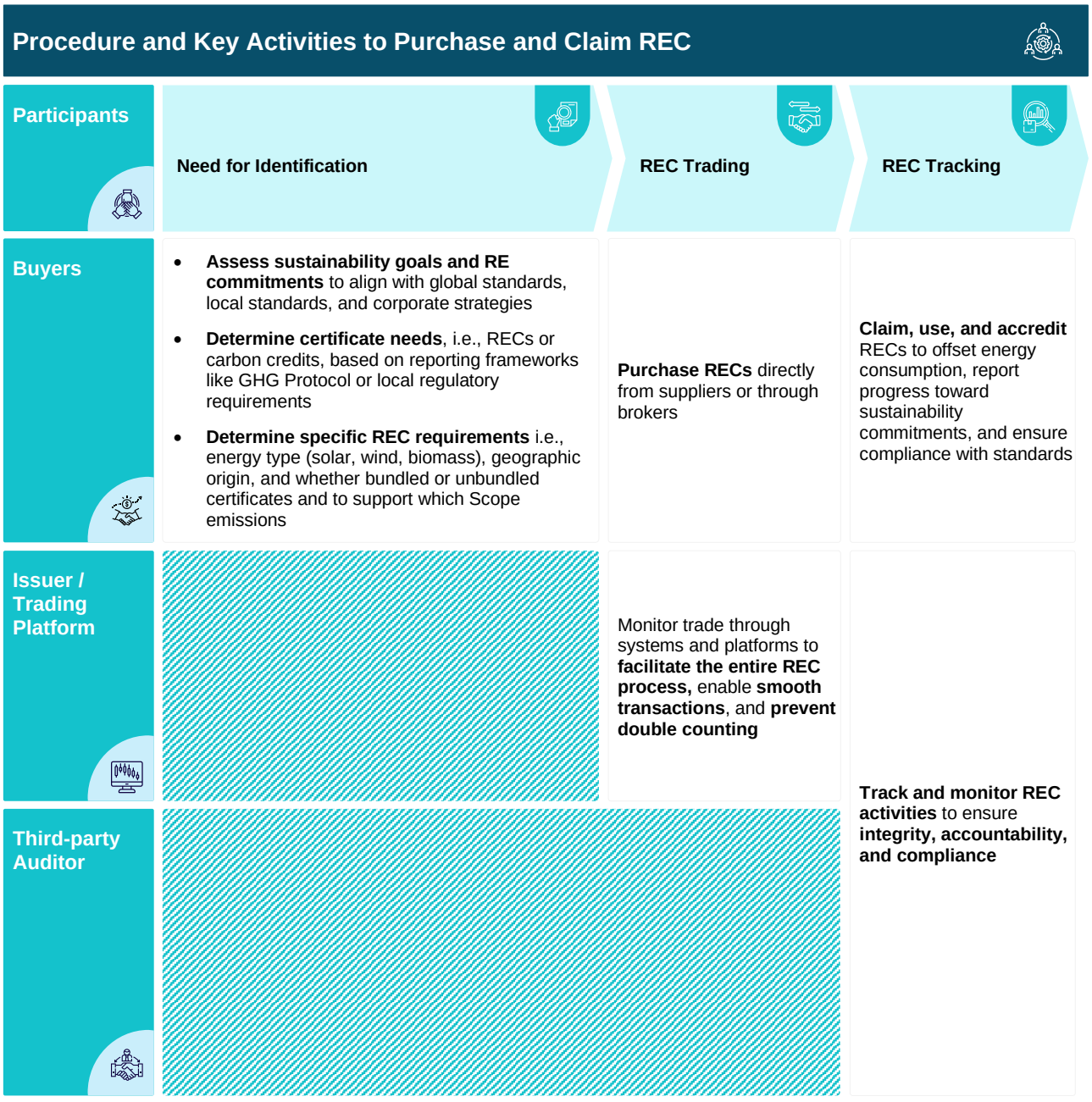

Figure 36 | Buyer Involvement in REC Journey

Source: Arthur D. Little Analysis

5.3 Assessment of REC Demand Drivers and Market Dynamics

5.3.1 Australian Corporate and Voluntary Demand

Australia is one of the more economically advanced and culturally progressive nations in the Asia Pacific region. This had led to high corporate participation in sustainability initiatives and renewable energy adoption. Corporate commitment to renewable energy is evident in the growing number of RE100 companies operating in Australia. Figure 37 illustrates the growing presence of RE100 companies in the country.

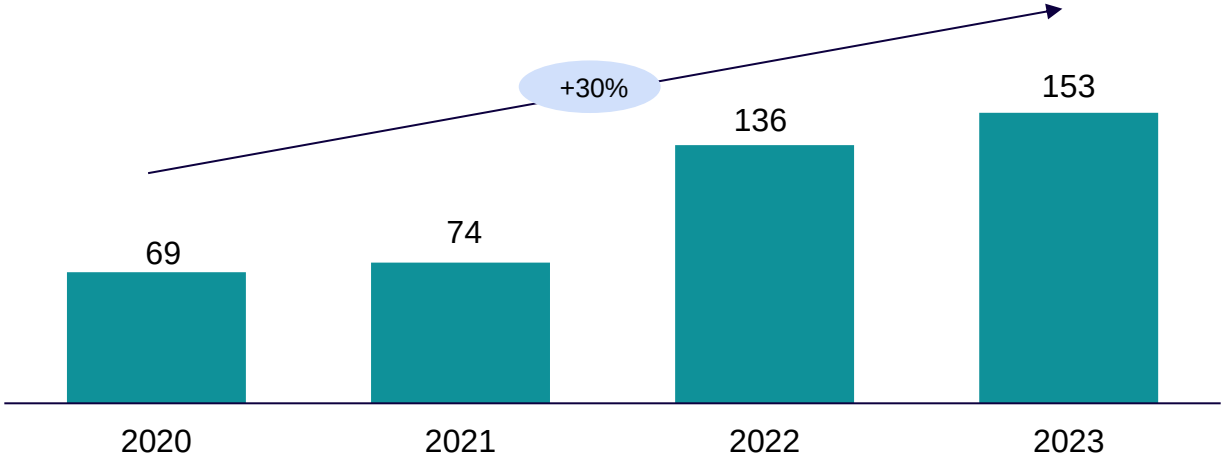

Figure 37 | Number of RE100 Companies Operating within Australia from 2020 – 2023

Source: RE100 Report

The government and groups of corporations have also launched several sustainability initiatives to support and incentivize voluntary adoption.

NABERS – National Australian Build Environment Rating System is a rating system for buildings that assess energy efficiency, water usage, waste management, and indoor environment quality.

Business Council for Sustainabile Development Australia supports development of tools, research, and business models to create sustainability business cases and deliver measurable impact on their sustainability goals/agenda.

Strive 4 Sustainability Scorecard assists tourism businesses in assessing their sustainability journey across environmental, socio-economic, cultural, and sustainability impacts.

Nature Positive Matters is a coalition of over 20 leading Australian businesses to drive investment in nature, improve its protection, and promote nature related reporting within the business sector.

Similarly, government and educational institutions launch awareness and education programs to steer renewable energy adoption and drive long-term market growth. Table 18 highlights key initiatives launched by these organizations, these initiatives were designed to align with Australia's progressive culture and further strengthen public support for renewable energy adoption.

Institution Type	Advocate	Beneficiary	Content
Government	Making Positive Energy Campaign	Public	Informative public communications campaign about national initiatives.
	Energizing Australia Campaign	Public	Showcase of renewable energy work in remote areas of Australia through series of videos.
	Solar Cities Program	Businesses and Communities	Demonstration program promoting solar power, smart meters, energy conservation, and innovative energy pricing.
Educational Institutions	University of Newcastle	Students	Clean energy programs such as master of clean energy and graduate diploma in clean energy
	University of New South Wales	Students	Specialized degrees of master's in engineering and engineering science for renewable energy
Educational Institutions	Queensland University of Technology	Students	Graduate certificates in renewable energy systems, developed in collaboration with industry leaders

Table 18 | List of Initiatives Sorted by Institution Type, Advocates, Beneficiaries, and Content

Government initiatives primarily aim to raise public awareness and foster positive sentiment toward renewable energy adoption across Australia. Meanwhile, educational institutions focus on building expertise among students, investing in talent to further develop the country's renewable energy sector.

5.3.2 LGC Supply and Demand Dynamics and Drivers

Australia's LGCs are the main driver towards the LRET and overall RET. In 2023, LGCs contributed approximately 57% of all RECs generated in Australia, producing 50 million MWh out of the country's 87 million.

The LGC market operates entirely on a supply and demand dynamics. While the mandatory market a significant share of demand, it does not get priority over the voluntary market for available LGC supply. Figure 38 shows the supply and demand of LGCs for 2023 and 2024.

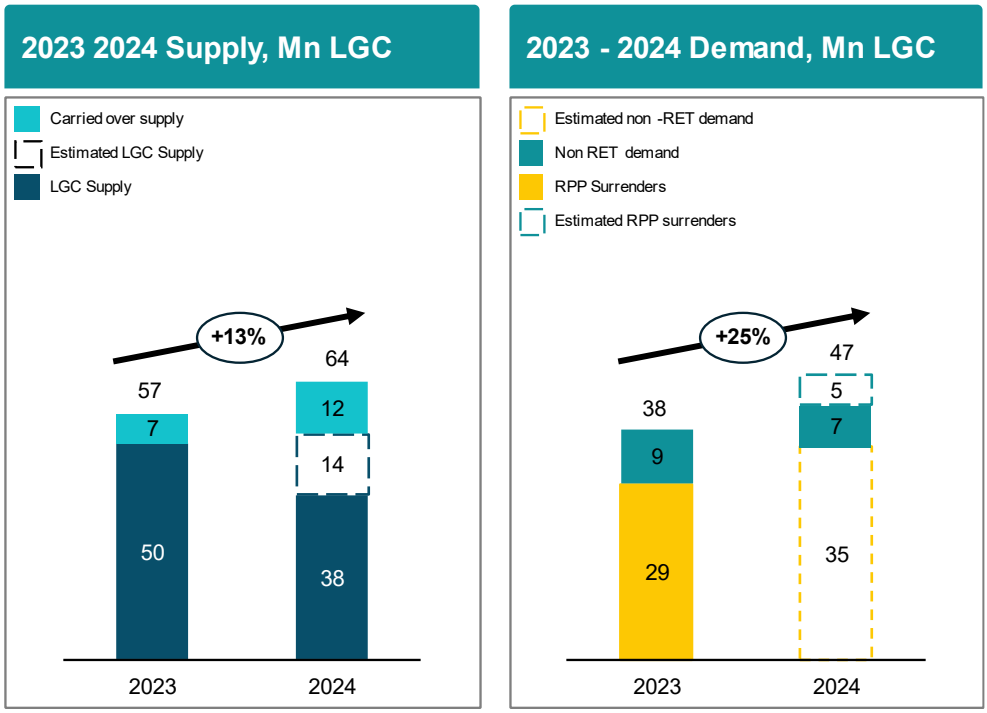

Figure 38 | Supply and Demand of LGCs in Million LGCs for 2023 and 2024 (YTD November 2024)

Source: Clean Energy Regulator

Both supply and demand figures grew from 2023 to 2024. The growth in supply was driven by the commissioning of new renewable energy projects, coinciding with the ongoing retirement of fossil fuel. On the demand side, the Renewable Power Percentage (RPP) surrenders played a key role in supporting the mandatory market and achieving the CER's ambitious LRET. Additionally, non-RET demand has surged to an all-time high alongside mandatory market demand. It is forecasted to reach another record in 2024, driven by retail, real estate, and transportation industries.

The supply and demand dynamics of the LGCs drive market-based pricing, as there is no fixed price floor or ceiling. Instead, prices are determined entirely by the market. Figure 39 illustrates the recent price of LGCs with an end-of-year forecast.

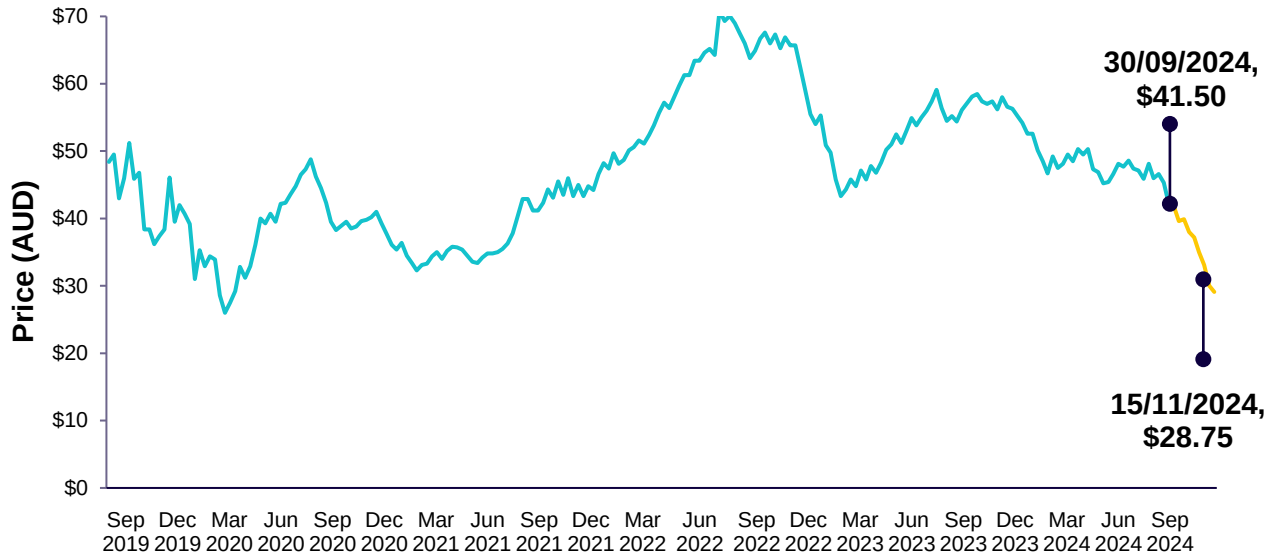

Figure 39 | Historical Price and Forecast of LGCs in AUD/MWh

Source: Clean Energy Regulator

With the rapid growth of LGC generation, LGC prices declined due to an oversupply in 2024. The forecasted price drop is primarily due to voluntary surrenders early in the year, which reduced demand for LGC purchases. Lower LGC prices present an opportunity for increased demand participation in the voluntary market.

5.3.3 STC Supply and Demand Dynamics and Drivers

Australia's STCs are another key contributor to the country's renewable energy market. Before 2020, STCs played a larger role in driving Australia's renewable energy generation than the LGCs. Similarly to the LGCs, the STC market operates on supply and demand dynamics. However, STC prices are capped, making them more consumer-friendly and accessible.

STC supply and demand are primarily influenced by rooftop solar adoption, creating a unique market dynamic. Figure 40 highlights STC supply and demand trends for 2023 and 2024.

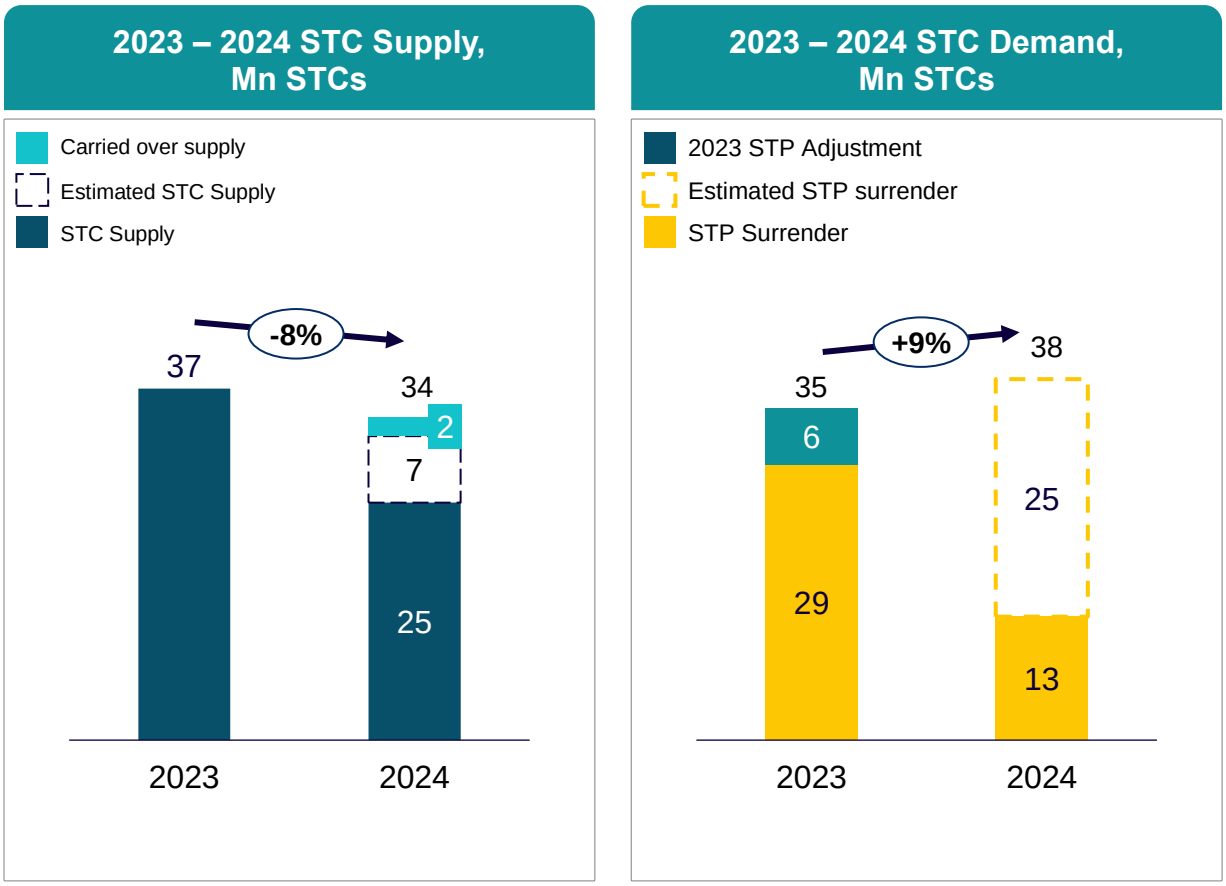

Figure 40 | Supply and Demand of STCs, in Million STCs for 2023 and 2024 (YTD November 2024)

Source: Clean Energy Regulator

s observed in Figure 41, STC supply is forecasted to decrease in 2024, primarily due to a slowdown in new roof-top solar installations. With Australia already having one of the highest rooftop solar adoption rates globally, the market appears saturated. Conversely, STC demand continues to rise with increased electricity consumption and voluntary demand from corporates and consumers.

The supply-demand imbalance has significantly impacted STC prices, with undersupply keeping prices high. However, the CER has enforced a price ceiling, known as the “Clearing House Price”, set at $40 AUD per STC. Figure 41 highlights the historical price of STCs in relation to this price cap.

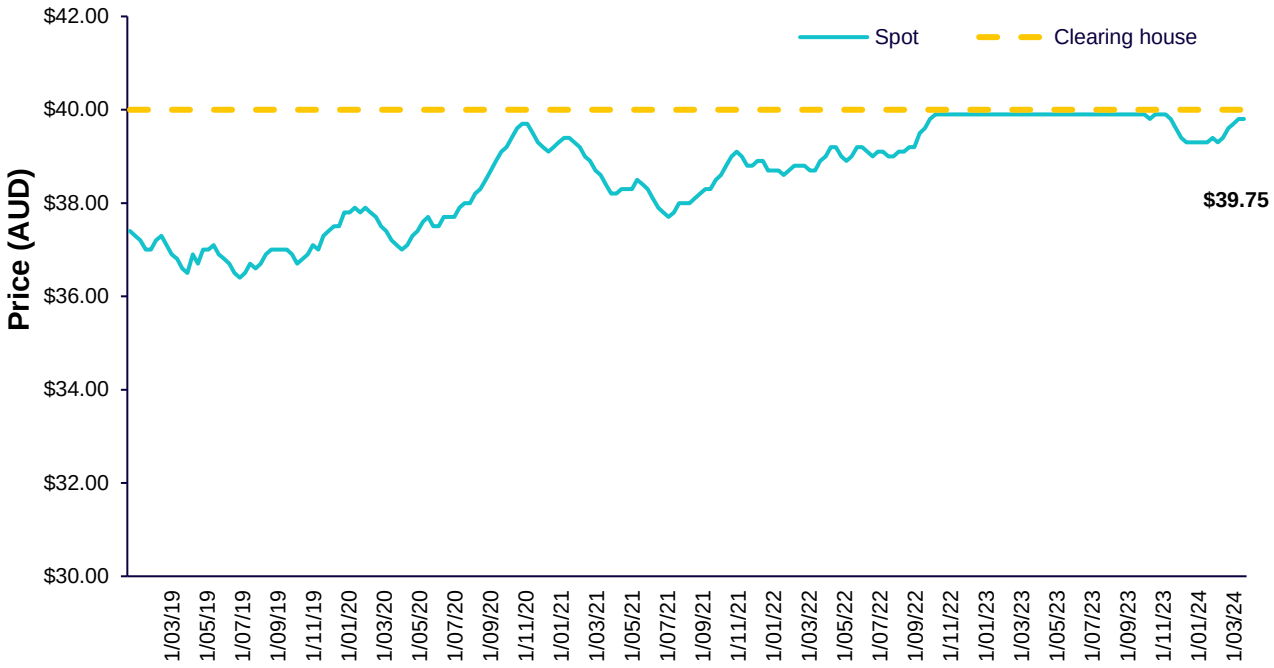

Figure 41 | Historical Price of STCs in Comparison to the Clearing House Price

Source: Clean Energy Regulator

The supply and demand imbalance, as observed in Figure 41, has kept STC prices high STC throughout 2023. The tight supply is expected to persist through 2024, leading to a continued supply deficit. As a result, the spot price is projected to remain above $39 AUD. These high STC prices are advantageous for sellers in the voluntary market.

5.4 Study Claiming, Verification and Surrendering of RECs

Australia's process for claiming, verifying, and surrendering RECs is relatively straightforward, as the entire process is managed through a single platform - the REC Registry. LGCs are exclusively traded on the REC registry, while STCs offer more flexibility in trading methods. The STCs can be traded through bi-lateral contracts between buyers and sellers outside the REC Registry. However, all transactions must be reported to the CER for verification and compliance. Figure 42 highlights the steps taken in the claiming, verifying, and surrendering process.

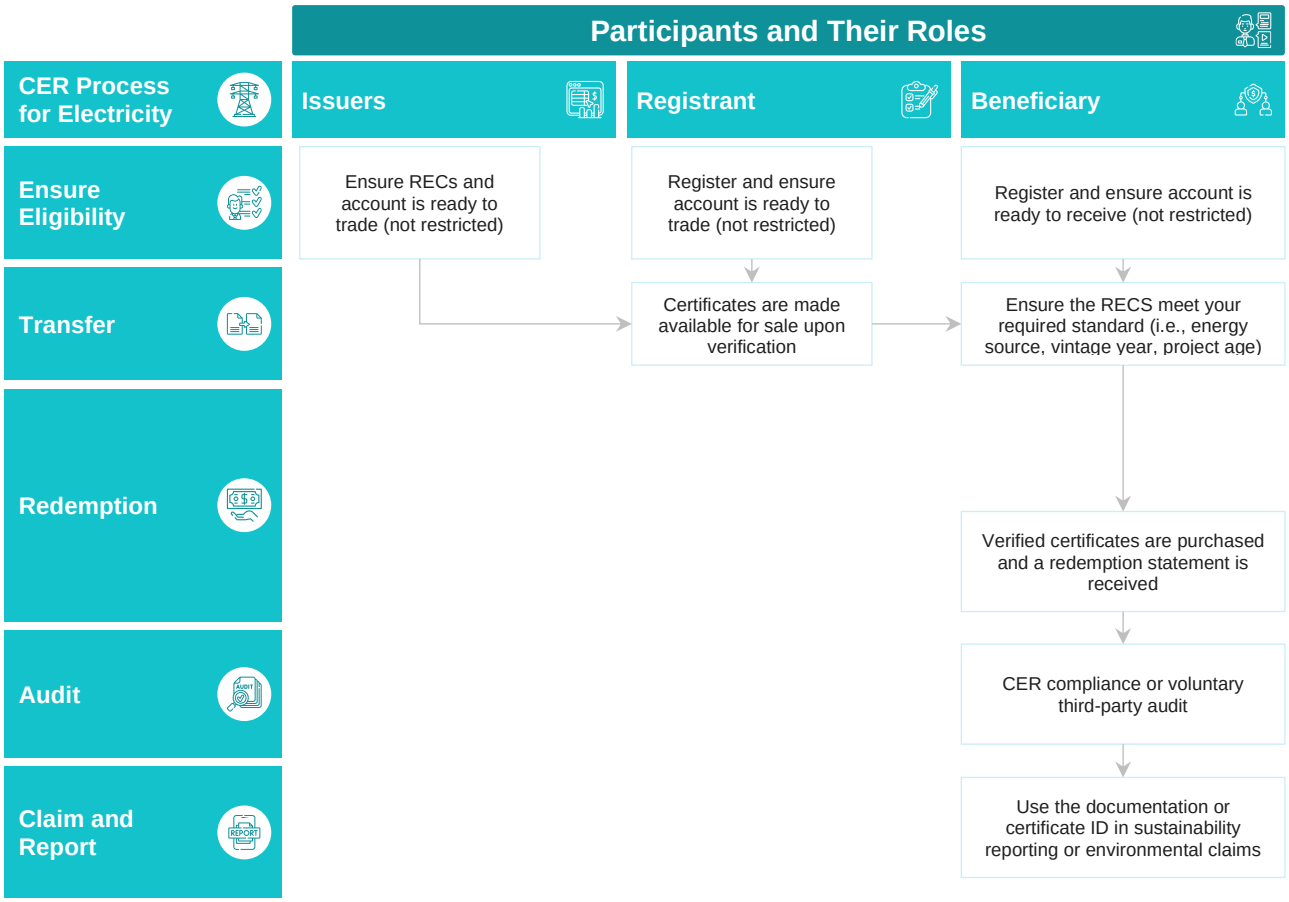

Figure 42 | End-to-End Process of Claiming, Verification, and Surrendering Process of RECs

Source: Arthur D. Little Analysis

The CER provides a clear framework built around the REC registry for claiming and verification for both the mandatory and voluntary market. The combination of CER and third-party audits ensures a strong verification process.

It is important to note that the CER has several methods to prevent double counting of certificates. For instance, Vintage Rule Enforcement ensures that certificates can only be surrendered for the assessment year in which they were created or earlier, preventing the reuse of RECs across multiple compliance years. Additionally, the REC registry assigns unique serial numbers to each certificate, providing a guarantee to authenticity of each certificate.

5.5 Impact Assessment on REC Capacities

Australia showcases one of the earliest adoptions of renewable electricity globally, with a well-established and mature market that continues to grow consistently. Figure 43 highlights this growth from 2014 to 2022, supported by strong initiatives and ambitious targets set for 2030.

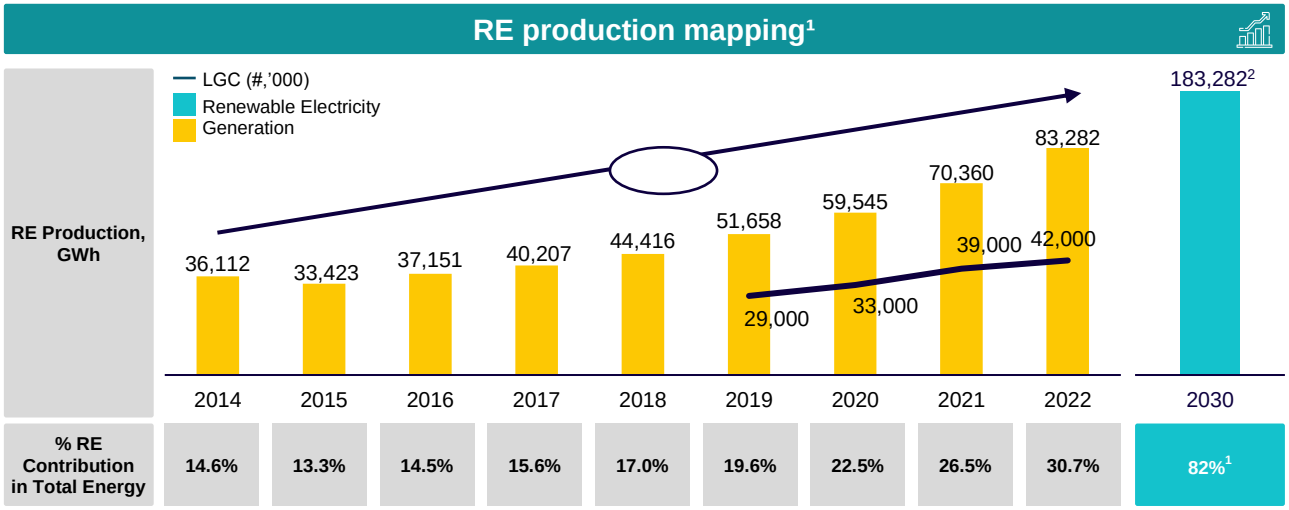

Figure 43 | Historical Renewable Electricity Generation and 2030 Forecast

Source: Clean Energy Regulator

Australia's renewable electricity contribution doubled between 2014 to 2022, with renewable electricity production at a CAGR of 11%. The Clean Energy Regulator (CER) has set a target of 82% renewable electricity by 2030, requiring an additional 100,000 GWh of production to meet this goal. This growth in Australia is driven by the continued maturation of the REC market, growing solar and wind adoption, and strong policy support through progressive incentives that encourage further renewable energy adoption.

5.6 Lesson Learned and Applicability to the Philippines

Australia's REC market success is driven by a target-based regulatory approach, strong voluntary market incentives, centralized governance, and consumer-driven sustainability awareness. Its mandatory market follows a phased strategy, starting with small, actionable goals and gradually increasing targets. The voluntary market is supported by incentives for individuals and small businesses, while a single governing body (CER) manages REC transactions through a centralized platform, ensuring efficiency. Additionally, Australia's sustainability-conscious culture has driven corporate adoption of RECs through consumer demand.

The Philippines can adopt a phased approach in its mandatory market, setting gradual REC targets while incentivizing voluntary adoption. Establishing a centralized REC platform under a single governing body can streamline tracking and governance. Additionally, raising public awareness

through nationwide campaigns can drive consumer-led sustainability efforts, encouraging businesses to adopt RECs.

Aspect	Key Success Factors	Solutions and Best Practices	Implications for the PH
Operational Framework - Regulation	Australia approached the mandatory market with a **target-based approach with diverse supporting policies** and **regulations** to foster market development	Numerous legal normative documents **varying in levels of authority** including laws, resolution, decree, and decisions	**Start with small, actionable goals** to drive early REC demand in the **mandatory market**, gradually implement more **ambitious goals** and incentivize the **voluntary market**
Operational Framework - Regulation	Australia drives the voluntary market growth through **involvement** and **incentives** to **individuals and smaller entities**	Design programs to **incentivize and reward individuals and corporations** for sustainable practices	Develop programs that **promote adoption of small-scale technologies** such as rooftop solar to incentivize PH citizens
Operational Framework – Regulatory Bodies	Australia has **one body governing the REC market**, all transactions of RECs are done through **a single platform** for a simplified and **centralized process**	A centralized platform such as the REC Registry governed by a single body like the CER to **avoid overcomplicating governance and tracking structure**	Replicate Australia's practice by developing a **single governing body** to track and maintain the REC market **through a single platform**
Demand Drivers	Australia's **progressive culture drives sustainability awareness and initiative** among Australian consumers pushing corporations to **adopt green practices and boost REC purchases**	Organize nationwide **awareness campaigns**, engage business and the public to **promote eco-friendly practices**	**Evaluate level of sustainability awareness** among PH citizens and **implement awareness programs** to boost eco-conscious consumption

Table 19 | Key Success Factors in Australia

Australia's high REC demand and STC undersupply have led to consistently high prices, driving the need for continuous investment in renewable energy development. The voluntary market thrives through incentives for individuals and small businesses, while a single governing body manages all REC transactions via a centralized platform, ensuring efficiency.

To sustain REC market growth, the Philippines should incentivize RE investments, streamline regulatory approvals, and ensure strong compliance mechanisms. Additionally, evolving incentive frameworks with planned phase-out periods can maintain long-term market stability.

Aspect	Key Success Factors	Key Takeaways
Pricing and Market Dynamics	**High demand and undersupply** of STCs have led to **consistently high prices** in the past few years	Emphasis on promoting RE development projects through **incentives and attracting investment** to keep up with continuously rising demand
Legal Framework	Australia drives the voluntary market growth through **involvement** and **incentives** to **individuals and smaller entities**	Emphasize **regulatory checks and compliance** while keeping project **approval time short**
Legal Framework	Australia has **one body governing the REC market**, all transactions of RECs are done through **a single platform** for a simplified and **centralized process**	Continue evolution of regulatory and incentive frameworks, **plan and apply phase out periods for expiring initiatives**

Table 20 | Key Challenges in Australia

6. Jurisdiction 4: USA – California

6.1 Summary and Market Overview

6.1.1 California REC Market Summary

California has over two decades of experience in renewable energy market development, having implemented its Renewable Portfolio Standard (RPS) in 2002. It is one of the oldest renewable energy markets in the United States and a national leader in renewable energy development and advocacy. While solar and wind dominate California's renewable energy portfolio, the state also supports a diverse range of technologies.

California independently governs its RPS and renewable energy market, operating separately from federal oversight. Although the federal government provides policies and incentives, it has no jurisdiction over California's RPS requirements. The state employs the Western Regional Energy Generation Information System (WREGIS), co-developed by the California Energy Commission (CEC), to track renewable energy generation.

California's advanced renewable energy market is driven by its historically eco-conscious and progressive culture. This ethos encourages both corporations and individuals to voluntarily adopt renewable energy and use Renewable Energy Certificates (RECs). The state's large tech sector, known for its high carbon emissions, plays a significant role in supporting voluntary corporate contributions. Figure 44 summarizes key aspects of California's renewable energy market, including its maturity, governance, high-level processes, best practices, and challenges.

Overview

Maturity & Compre-hensiveness	Tracking System & Standard	Voluntary Corporate Participant	Regulatory Framework	Relevance to PH
23 years Mature & Accelerating	**WREGIS** Local System	**RE100** Mainly among MNCs & RE100 companies	**Mandatory & Voluntary**	**High** Similar in climate and RE portfolio

Objectives

Findings

1 Operational Framework

Policy & Regulations	Governance	Operational Framework	Platform & Technology
13 Regulations, Policies, and Acts to accelerate REM	**California Energy Commission** State-level main governing body	**Renewable Energy Transition** RE generation targets	**WREGIS** Independent tracking platform

2 Demand Drivers & Market Dynamics

Corporate	Government	Public	Market Impact
RE100, Big Tech Companies RE100 & big tech operations	**Renewable Portfolio Standards** Mandatory RE generation target	**Progressive Culture** Drives voluntary initiatives	**Oversupply of RECS** IOUS generating surplus of RECS over RPS obligations

3 Claiming, Verification & Surrendering of RECS

REC Verification	REC Claiming
CEC, WREGIS, bi-lateral contracts Verification done by CEC, WREGIS tracks trades made through bi-lateral contracts	**Unique Serial Numbers** Used to avoid double counting

4 Impact on Increasing RE Capabilities

Impact
Consistent growth in RE generation California RE generation grows at 5% CAGR from 2014-2022, ranks 2nd in contributing to the U.S.'s RE generation

5 Impact on Increasing RE Capabilities

Key Best Practices	Key Challenges
• Strong **financial support** from **federal government** • REC **compatibility across states** • Strong **progressive culture** driving voluntary demand	• **Political inconsistency on federal level** policy/incentive • **Strong reliance on self-reporting** • **High production costs** in California

Figure 44 | High-Level Summary of California Renewable Energy and REC Market

6.1.2 Development of California's REC Market

California's REC market development can be divided into two main phases: **Market Establishment** (2000–2011) and **Market Acceleration** (2012–Present). The establishment phase focused on laying the foundation through policies that promoted renewable energy development and set initial targets. The acceleration phase introduced measures to drive faster adoption of renewables and RECs, expanding incentives and adjusting targets to match the state's growing ambitions.

California offers two key lessons for the Philippines in developing its REC market:

Strong Renewable Energy Demand: A highly eco-conscious and progressive population drives suppliers, corporations, and citizens to commit to sustainability targets.

Regional Integration: California inter-region REC trade allowance offers insight to applicability of international trading channels.

6.1.3 Trends in California's REC Market

California's renewable energy market has experienced steady growth in both capability and capacity. Since the implementation of its Renewable Portfolio Standard (RPS) in 2002, the state has significantly expanded its renewablefirst energy infrastructure. As shown in Figure 45, California saw rapid initial growth, followed by sustained expansion in recent years, solidifying its position as one of the top U.S. states in renewable energy production capacity.

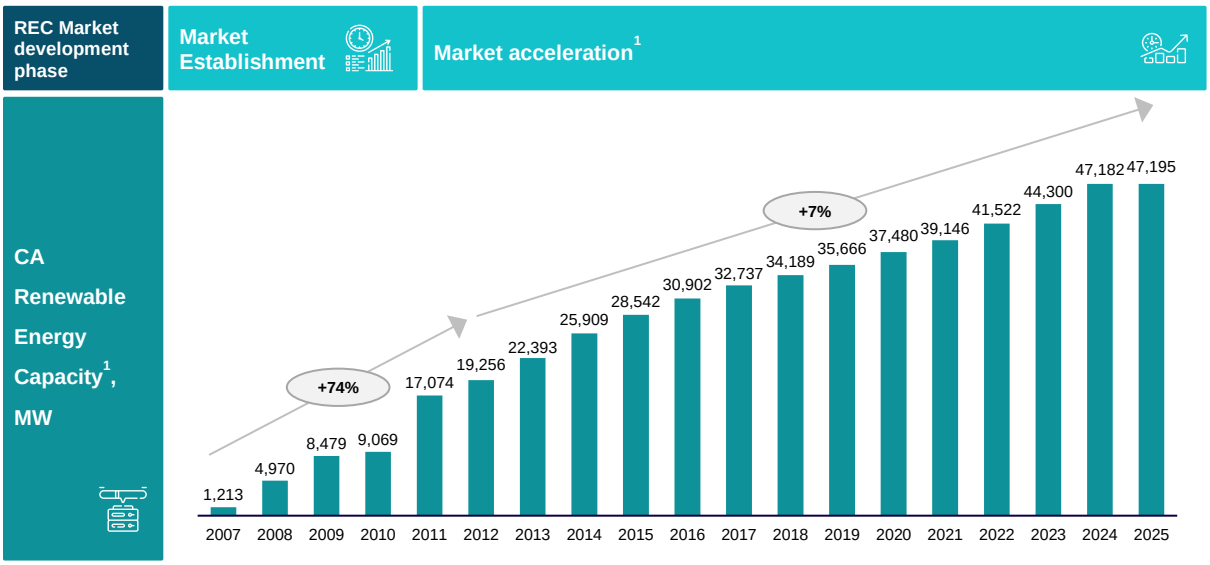

Figure 45 | California Renewable Energy Cumulative Capacity in MW from 2007 – 2025 (YTD Jan 2025)

Source: WREGIS

While the growth of renewable energy capacity has slowed compared to its early years, it remains steady, driven by government support and corporate investment. A wide range of policies and incentives has made renewable energy more accessible to entities of all sizes. Figure 46 illustrates the breakdown of technologies contributing to California's renewable energy growth from 2020 to 2025, highlighting solar energy as the primary driver of the state's renewable portfolio.

CA Total Capacity Listed in WREGIS, MW (Cumulative)

Figure 46 | Renewable Energy Breakdown from 2020 – 2025

Source: California Energy Commission, California Public Utilities Commission

6.2 Analysis on Operational Framework

6.2.1 United States Legal Framework Summary

The U.S. legal framework operates at two levels: federal and state governments. Each governs policies and regulations within its jurisdiction, both influencing a state's renewable energy landscape, including California's. Table 21 summarizes the key differences and roles of these two government levels.

Jurisdiction Level	Key Information
Federal Government	• Federal laws and policy are enacted by the U.S. Congress and apply uniformly across 50 states • Congressional seats and policy are influenced by the presidential policy, elections, and political agenda • Federal laws take precedence over conflicting state laws
State Government	• State laws are created by state legislatures and apply only within the state's respective borders • Elected state officials and policy are heavily influenced by the states priorities, culture, and needs, which will vary across states

Table 21 | Summary of Key Information of the Federal and State Governments

Both federal and state governments influence a state's renewable energy market. However, it is important to note that the federal government lacks jurisdiction to impose mandatory requirements on a state's renewable energy policies. In the case of California, the federal government does not determine the state's Renewable Portfolio Standard (RPS) targets or requirements, nor can it mandate RPS adoption at the state level.

Although the federal government cannot mandate state-level renewable energy regulations, it plays a crucial role in supporting states through policies and incentives. Federal agencies contribute to the renewable energy landscape by implementing programs that encourage development and adoption. While these initiatives drive growth, it is important to note that federal policies are highly susceptible to changes influenced by the U.S. political climate. Administrative shifts, such as presidential elections, can significantly impact both existing and future policies. Table 22 outlines the key federal agencies directly involved in shaping the U.S. renewable energy market.

Agency	Roles and Responsibilities
U.S. Department of Energy (DOE)	• Develops policies, conducts research, and provides funding to promote renewable energy technologies. • Offers guidance on energy management and compliance
Federal Energy Regulatory Commission (FERC)	• Oversees the integration of renewable energy sources into the grid • Establishes policies related to energy markets and transmission planning
U.S. Environmental Protection Agency (EPA)	• Develops and enforces regulations to protect the environment • Provides information on state and federal renewable energy policies and incentives

Table 22 | Summary of Key Federal Agencies and their Roles and Responsibilities

In contrast, state-level regulations, policies, and incentives are more adaptable, as they align with each state's priorities and cultural values, which tend to remain stable over time. This is especially true for California, given its historically progressive stance on renewable energy. Table 23 outlines the key state agencies shaping California's renewable energy market.

Agency	Roles and Responsibilities
California Energy Commission (CEC)	• California's primary energy policy and planning agency • Develops and administers programs to promote renewable energy, enhance energy efficiency, and ensure a reliable energy supply
California Public Utilities Commission (CPUC)	• Regulates investor-owned utilities and implements policies to encourage the adoption of renewable energy sources • It collaborates with the CEC to achieve the states renewable energy goals and ensures utilities comply with RPS requirements

Table 23 | Summary of Key State Agencies and their Roles and Responsibilities

6.2.2 Market Establishment

California's market establishment phase began with the introduction of its Renewable Portfolio Standard (RPS). During this phase, policies, regulations, and incentives prioritized broad environmental and energy efficiency goals rather than directly fostering the REC market. Table 24 outlines the key regulations from this period.

Regulation	Date Issued	Jurisdiction	Content	Impact on REC Market
Energy Policy Act	1992	Federal	• **Aim:** Introduces the Production Tax Credit (PTC), providing a kWh tax credit for electricity generated by qualified renewable energy resources • **Tools:** Framework for tax credit approvals, electricity generation tracking and compliance	Establishes incentive for investment into research, development, and adoption renewable energy technologies
Senate Bill 1078	2002	State	• **Aim:** Establishes California's Renewable Portfolio Standards (RPS) Program, mandating renewable electricity generation • **Tools:** Establish framework for tracking and compliance in relation to strategic goals	Establishes a mandatory market for renewable electricity generation, setting the foundation for the mandatory REC market
Energy Policy Act 2005 Amendment	2005	Federal	• **Aim:** Addresses various aspects of energy production and consumption in the U.S., including energy efficiency, RE, and energy tax incentives. Expands the scope of the investment tax credit to include clauses for renewable energy • **Tools:** Refinement of existing frameworks and updating incentive schemes to fit modern needs	Provides additional incentives and legal structure to support the growing RE market
Global Warming Solutions Act	2006	State	• **Aim:** Mandates California to reduce greenhouse gas emissions to 1990 levels by 2020, setting the foundation for the state's climate change initiatives	Establishing further legal basis for RE development in California, further encourages

Regulation	Date Issued	Jurisdiction	Content	Impact on REC Market
			• **Tools:** Create framework for tracking and compliance of greenhouse gas emissions	investment in RE technologies
Senate Bill 107	2006	State	• **Aim:** Further refine the RPS target and emphasis on compliance verification system, leading to the adoption of WREGIS for tracking RECs • **Tools:** Establish tracking, compliance, and enforcement methods,	Establishes legal basis for the mandatory REC market, enforcing tracking and compliance through WREGIS
Clean Energy Finance Corporation Act	2007	State	• **Aim:** Aims to install 3000MW of new solar energy by 2017, supported by $3.3Bn budget to encourage solar adoption in the state • **Tools:** Establish funds distribution network and approval processes for eligible projects	Promotes development of new solar adoption, providing opportunity in REC market
American Recovery and Reinvestment Act	2009	Federal	• **Aim**: Provided funding for RE projects, energy efficiency improvements, the development of a smart electric grid, and extends tax incentives for RE production • **Tools:** Establish funds distribution network and approval processes for eligible projects	Promoting the transition to renewable and clean energy sources, enhancing market growth and sustainability
Assembly Bill 2514	2010	State	• **Aim:** Requires utilities to evaluate and set procurement targets for viable and cost-effective energy storage	Creates additional push for RE adoption in California,

Regulation	Date Issued	Jurisdiction	Content	Impact on REC Market
			systems to enhance grid reliability and support RE integration • **Tools:** Establish framework for approval, tracking, and compliance	furthering opportunity for RECs

Table 24 | Policies and Events contributing to California's REC Market Establishment

6.2.3 Market Acceleration

Starting in 2012, the market acceleration phase saw California implement more targeted, action-driven regulations aimed at directly advancing renewable energy and REC market development. These policies provided greater clarity and reduced barriers to adoption. Similarly, the federal government introduced additional policies and incentives to further drive renewable energy adoption nationwide. Table 25 outlines key regulations, policies, and incentives from both federal and state governments contributing to this phase.

Regulation	Date Issued	Jurisdiction	Content	Impact on REC Market
Clean Energy and Pollution Reduction Act	2015	State	• **Aim:** Sets goals to increase California's RE usage to 50% and double energy efficiency in buildings by 2030 • **Tools:** Continue governance and oversight in reporting and compliance to meet energy goals	Sets more ambitious goals for the state and its liable entities to push for, further emphasizing the need for RECs and reliable tracking and compliance
100 Percent Clean Energy Act	2018	State	• **Aim:** California to achieve 100% clean energy by 2045 • **Tools:** Continue governance and oversight in reporting and compliance to meet energy goals	
Energy Act of 2020	2020	Federal	• **Aim:** Authorized programs to advance renewable energy	Provides additional incentive towards

Regulation	Date Issued	Jurisdiction	Content	Impact on REC Market
			technologies, energy storage, and grid modernization, also aimed to incentivize federal building energy efficiency • **Tools:** Funding and tracking of additional technology development	RE initiatives on a federal level, boosting REC favorability in California
The Clean Energy, Jobs, and Affordability Act	2022	State	• **Aim:** Establishes interim targets for the 100 percent clean energy goal, requiring 90% by 2035 and 95% by 2040 and accelerates the clean energy requirement for state agencies to 2035 • **Tools:** Continue governance and oversight in reporting and compliance to meet energy goals	Providing interim goals further emphasizes the need for additional REC adoption in the short-term
Inflation Reduction Act	2022	Federal	• **Aim**: Allocates substantial funding to combat climate change, including investments in RE, energy efficiency, and clean transportation, aiming to reduce GHG emissions and promote sustainable economic growth • **Tools:** Establish framework and organization structure for funding, compliance, and governance	Provides additional incentive towards RE initiatives on a federal level, boosting REC favorability in California

Table 25 | Policies and Events contributing to California's REC Market Acceleration

6.2.4 Trump Administration Energy Outlook

As mentioned previously, federal energy policy is highly influenced by presidential administrations, leading to frequent shifts in priorities. The current administration has signaled a renewed focus on fossil fuels, implementing key policies centered on deregulation and de-prioritization of clean energy initiatives. Notable actions include:

- Expanding permits for petroleum and LNG production
- Repealing previous green initiatives, including emissions standards and fossil fuel restrictions
- Strengthening support for traditional energy industries (oil, gas, and fracking) to bolster U.S. energy independence
- Revoking electric vehicle incentives, including a January 20, 2025, executive order repealing the non-binding target for 50% EV sales by 2030
- Halting remaining funds from the $5 billion EV charging station program
- Plans to repeal the Inflation Reduction Act (2022)

These policies aim to boost corporate earnings and market stability in the energy and financial sectors but come with both positive and negative impacts:

Positive impact:

- Lower compliance costs for energy companies, increasing profitability, particularly in energy and finance
- Tariff revenues indirectly support fiscal stability, enabling sustained deregulation and investment

Negative impact:

- Slower clean energy adoption due to reduced funding for EV infrastructure and weakened emission standards
- Limited renewable energy growth, restricting innovation and weakening global competitiveness

6.2.5 REC Certification System

California's REC framework is built around bilateral contracts for trades, with an independent web-based tracking system for oversight. The California Energy Commission (CEC) manages the market, monitoring conditions, overseeing activity, and ensuring compliance. Table 26 highlights the complete list of market participants and their roles in the Californian REC market.

Entities	Roles	Representative Organizations
Issuer	An independent entity recognized by government authorities, **manages facility registration, verifies generation data, and issues RECs** based on reported output	California Energy Commission
Tracking System	**Independent web-based tracking system for RECs**, **monitors trade** and serves as a **tool for compliance tracking** for the CEC, collaborating with the state and other registries to **prevent double counting**	Western Renewable Energy Generation Information System
REC Supplier / Registrant	Load Serving Entities (LSE) **must register** with the CEC and within WREGIS to ensure visibility of power and REC generation	Calphine Energy Solutions Shell Constellation
Beneficiary / Companies and Corporations	End-users who redeem RECs are typically public or private entities with global renewable energy commitments, including those in manufacturing, services, education, healthcare, NGOs, and RE100 multinational corporations.	Meta Google Apple
Auditors	**The CEC is the primary auditor for RECs**, however, 3rd party auditors can be employed for **voluntary audits**, while not mandatory, they provide confidence in accuracy of reported information	California Energy Commission Deloitte Ernst & Young

Entities	Roles	Representative Organizations
3rd Party Brokers and Exchanges	3rd party brokers and exchanges **facilitate transactions and trades outside of bilateral contracts**	SREC Trade Evolution Markets Nodal Clear Energy

Table 26 | Entities and their Roles in California's REC Lifecycle

A unique aspect of California's REC market is the presence of third-party brokers and exchanges. Since REC trades rely on bilateral contracts, some buyers and sellers seek intermediaries to facilitate transactions. Engagement with third-party brokerages is entirely optional, with brokers acting as advisors and facilitators, helping clients trade RECs or sustainable assets that align with their portfolio needs. Table 27 highlights key brokerages operating in California's market.

Broker	Description
SRECTrade	Headquartered in California, SREC Trade **specializes in facilitating transactions of Solar RECs (SRECs),** they provide an **online platform for solar energy system owners to monetize their SRECs by connecting them with buyers**
nodal	Headquartered in Virginia, Nodal Exchange **offers risk management solutions** in the North American commodities market with a **focus on electric power, natural gas, and environmental contracts**
EVOLUTION MARKETS	Headquartered in New York, Evolution Markets **facilitates transaction in RECs, emission allowances, carbon credits, and various energy commodities**. Their services include over-the-counter execution, exchange execution, and advisory support for clients
CLEAR ENERGY	Headquartered in Washington DC, Clear Energy Brokerage **specializes in energy and environmental commodities brokerage and consulting**, they assist client in navigating environmental markets by providing insights and **facilitating transactions**

Table 27 | List of 3rd party brokers and descriptions

Additionally, third-party brokers are **not required to report REC trades to tracking platforms** like WREGIS. The responsibility for self-reporting ultimately falls on the seller.

California's REC system is heavily reliant on bilateral contracts and self-reporting, with the California Energy Commission (CEC) playing only an oversight role in WREGIS. Figure 45 illustrates this, showing that while the CEC issues RECs, it is not directly involved in the trading process.

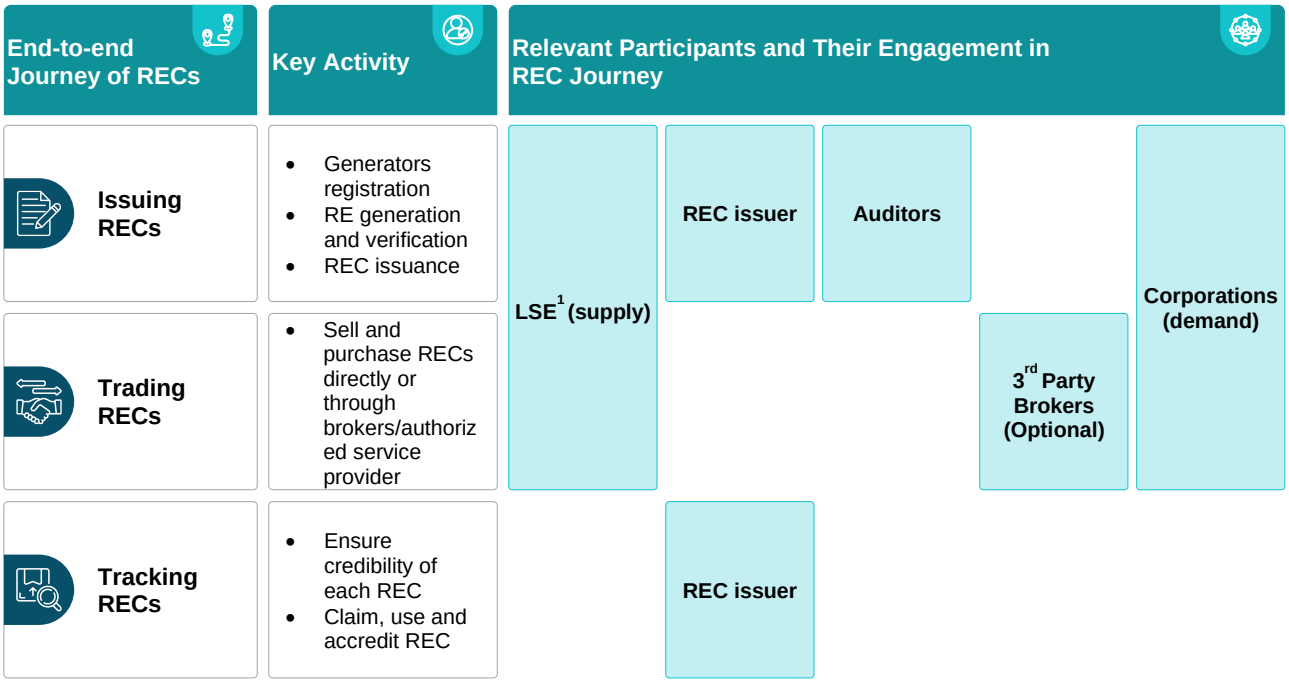

Figure 47 | California's REC Journey and Participants Engagement Map

Source: Arthur D. Little Analysis

With minimal CEC involvement in the trading process, sellers drive the end-to-end REC process and bear sole responsibility for self-reporting trades to WREGIS. The CEC's role is limited to ensuring compliance. Figure 48 illustrates this seller-driven market, outlining the step-by-step REC trading process in California.

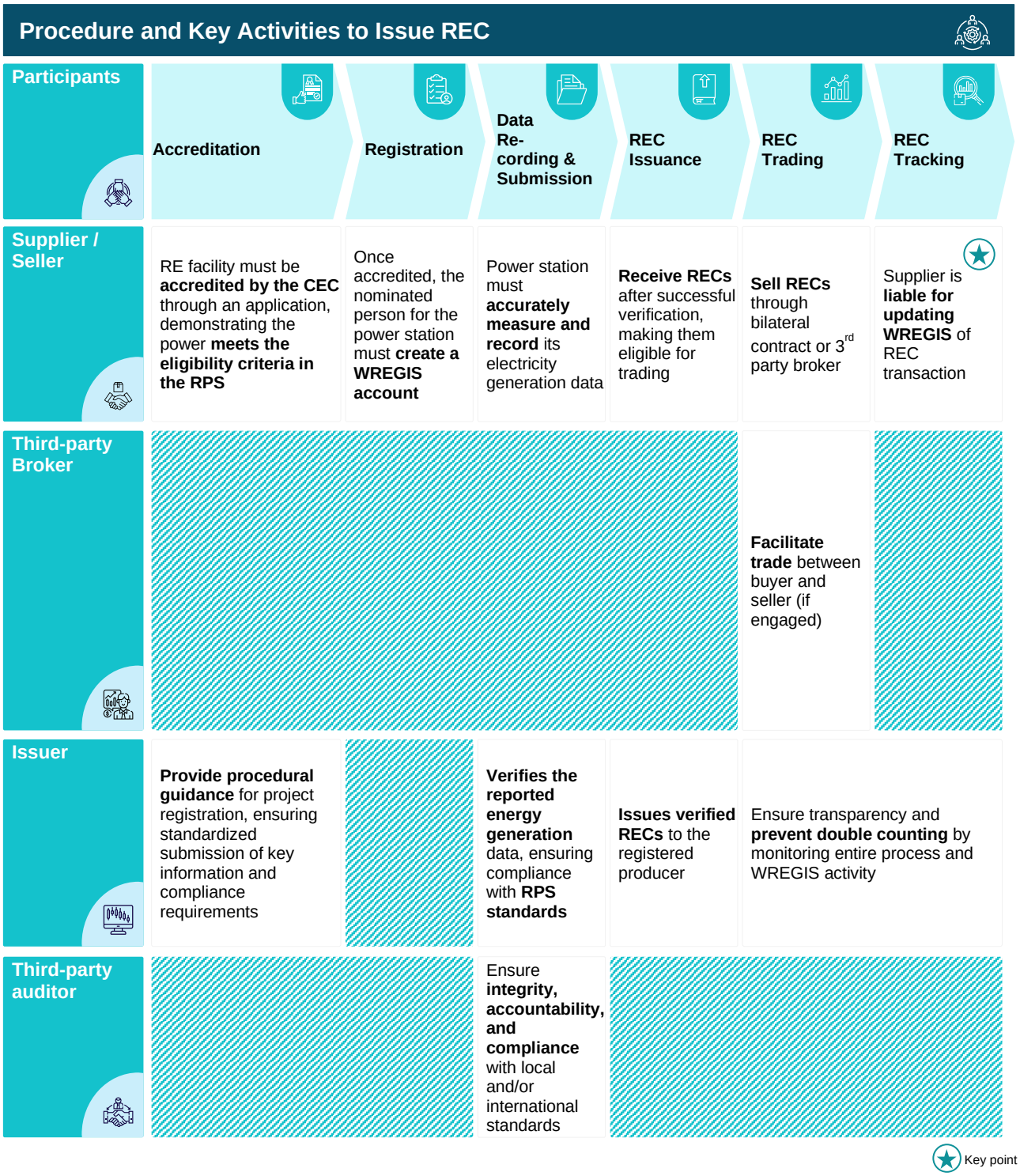

Figure 48 | Map of Seller/Supplier Driven REC Journey

Source: Arthur D. Little Analysis

Figure 49 details the buyer's role in the REC journey, outlining the process and key considerations from their perspective.

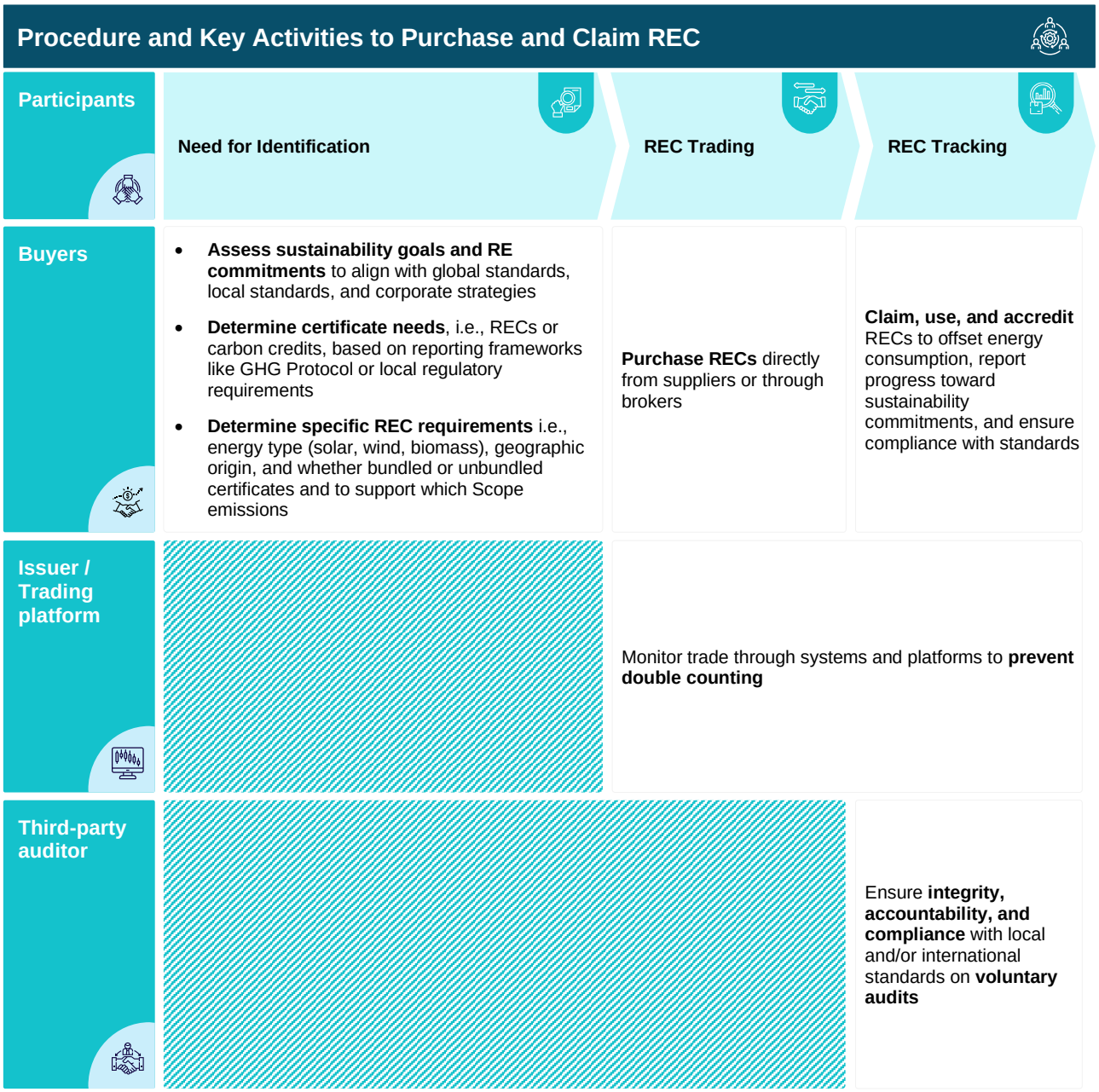

Figure 49 | Buyer Involvement in REC Journey

Source: Arthur D. Little Analysis

6.3 Assessment of REC Demand Drivers and Market Dynamics

6.3.1 Voluntary Corporate Demand

The United States, as one of the world's strongest economies, has a capitalistic structure and culture that fosters entrepreneurship and business growth, leading to the success of global companies across industries. Figure 50 highlights the substantial number of RE100 companies headquartered in the U.S., particularly in California in 2023. California embodies many of the nation's business growth opportunities, serving as home to some of the world's largest tech companies and innovators.

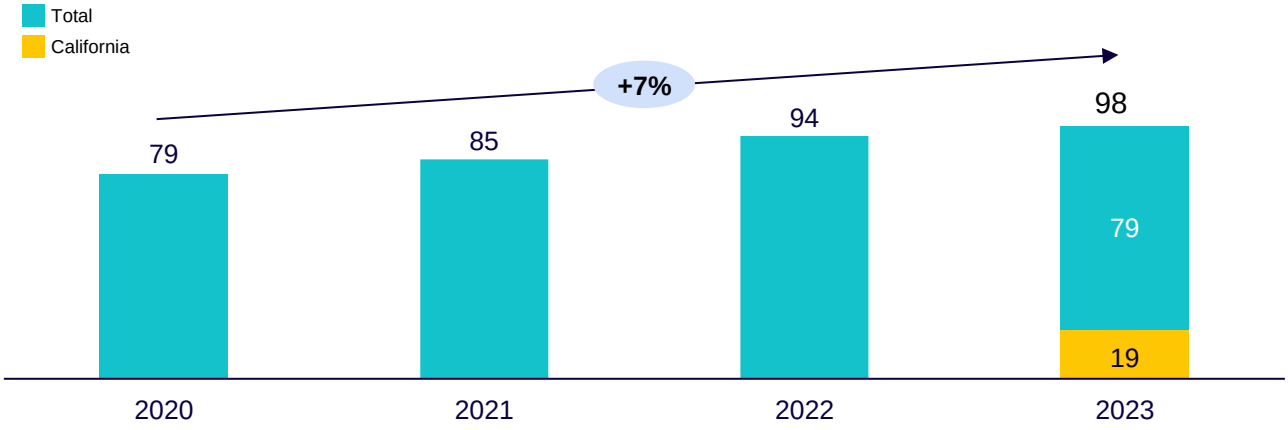

Figure 50 | Number of RE100 Companies Headquartered in the USA

Source: Re100 Report

The significance of California's large tech presence lies in the carbon intensity of its major firms' operations. Companies like Apple, Google, Meta, and Equinix operate high-energy data centers both in California and globally. Given their substantial emissions, their carbon abatement initiatives and reliance on renewable energy play a crucial role in supporting California's renewable energy market. Despite their high-emission operations, these companies are part of RE100 and have made significant strides in meeting their commitments.

Table 28 highlights key projects and milestones driving their renewable energy adoption.

Company	Sustainability Efforts and Milestones
	Apple Park, Apple Headquarters, is powered entirely by renewable energy sources The facility features extensive solar panels and utilizes biogas fuel cells, contributing to energy self-sufficiency
	Partnerships to develop data centers adjacent to solar and wind farms across the U.S., including California, and development of a nuclear-powered data center for AI operations
Meta	Engaged in partnerships to develop solar energy facilities in California and implement energy-efficient data centers
EQUINIX	Achieved 96% renewable coverage for global data center energy consumption, receiving an A rating for CDP

Table 28 | Tech Companies and their Sustainability Efforts/Accomplishments

Like other mature jurisdictions, California's progressive culture plays a key role in promoting awareness and education on renewable energy. Table 29 highlights government and educational initiatives aimed at advancing knowledge and capabilities in renewable energy adoption.

Institution Type	Advocate	Beneficiary	Content
Government	Climate Action Counts Initiative	Public	State initiative to mobilize Californians to take climate action at home and in their neighborhoods to help build resilient communities Aims to educate and inspire people to reimagine the power of volunteerism by taking impactful, everyday actions in their communities
	Outreach, Education, and Awareness Program	Public	Coordinates outreach efforts, provides technical assistance, and supports community-based organizations in promoting renewable energy benefits, emphasizing low-income and disadvantaged communities

Institution Type	Advocate	Beneficiary	Content
Educational Institutions	University of California San Diego	Students	Implemented a graduation requirement mandating students complete a course on climate change
	University of California Los Angeles	Students	Conducting decarbonization study funded by the State of California to accelerate its transition away from fossil fuels
	University of California Santa Cruz	Students & Public	Developing centralized power stations driven by renewable energy to replace its existing natural gas-powered systems

Table 29 | Awareness Programs by Institution Type and its Contents

California has some of the most prestigious public universities in the United States with programs that tailor to development and innovation of renewable energy technologies. These schools are also strong players in terms of advocacy and raising awareness.

6.3.2 California REC Supply

California is a leading contributor to U.S. renewable electricity production, making its REC production among the highest in the country. Figure 51 illustrates California's production capacity, highlighting its surplus REC generation beyond RPS requirements.

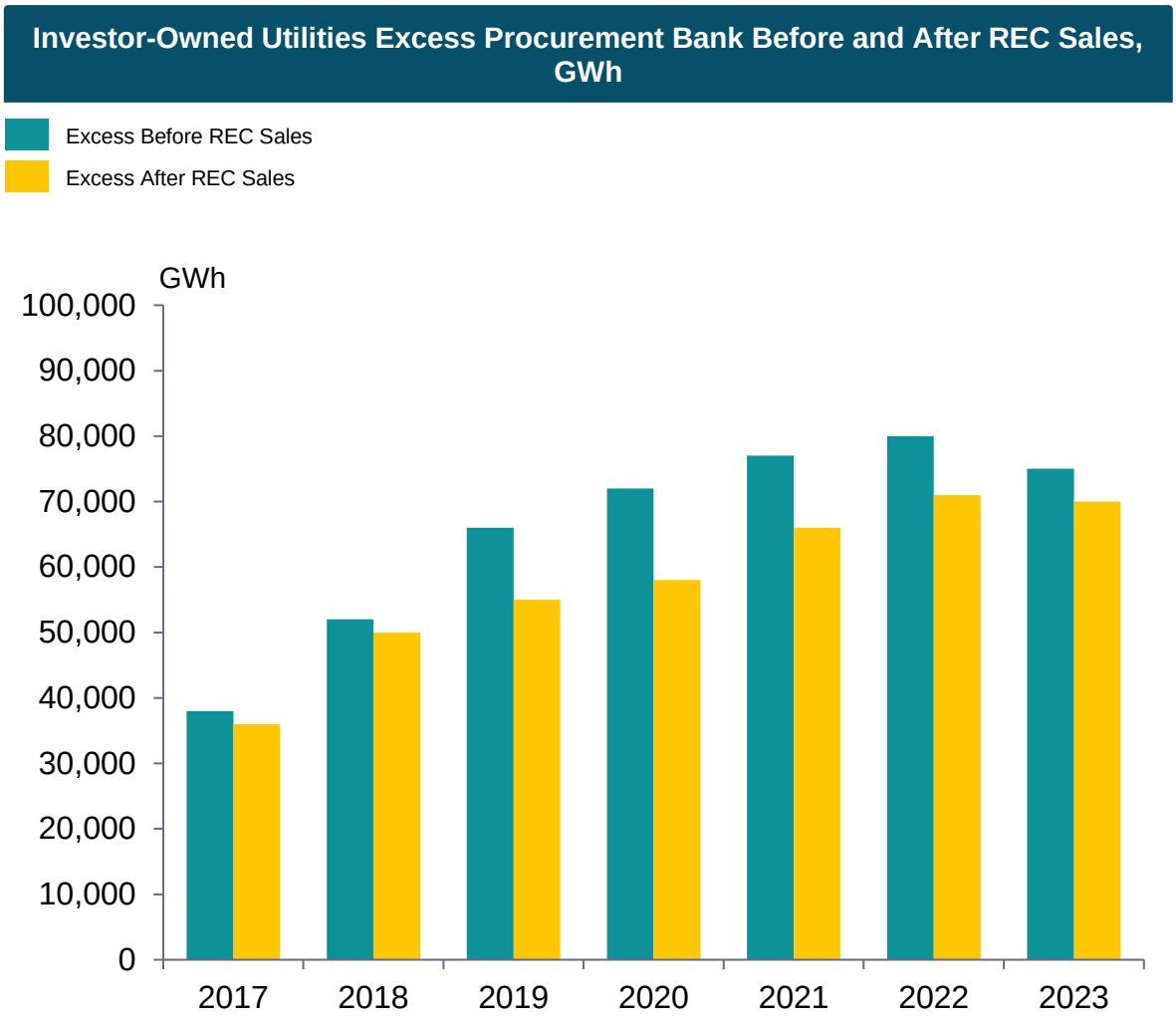

Figure 51 | Investor-Owned Utilities Excess Procurement Bank Before and After REC Sales in GWh

Source: California Public Utilities Commission

Investor-owned utilities (IOUs) have accumulated a significant surplus of RECs beyond their RPS obligations, leading to an oversupply in California. This excess allows IOUs to sell RECs to voluntary markets and neighboring states. Reflecting California's progressive energy culture, IOUs voluntarily exceed renewable energy requirements, further contributing to the REC surplus.

Meanwhile, the average cost of solar production has been rising. Figure 52 illustrates the cost per watt from 2015 to 2024.

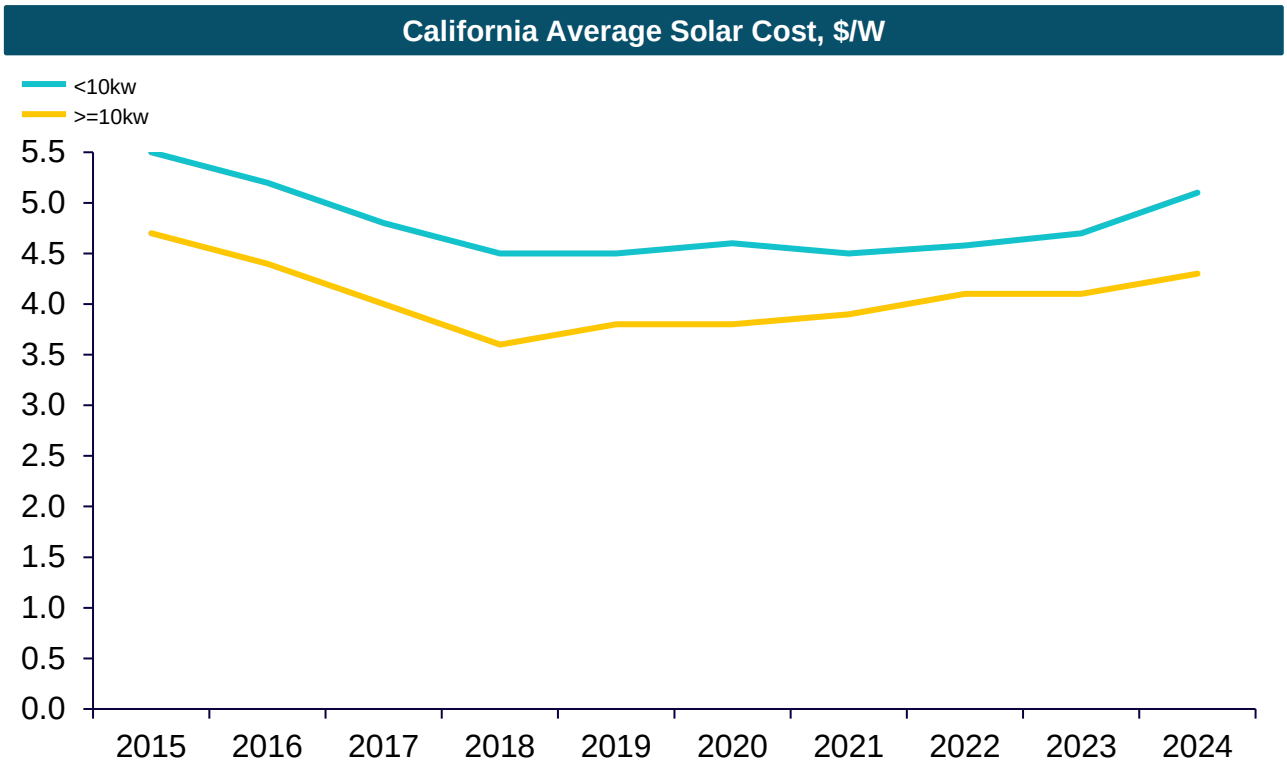

Figure 52 | Cost per Watt of Solar Technology from 2015 – 2024

Source: California Energy Commission

Despite rising solar production costs in recent years, solar energy remains the dominant renewable technology in California and continues to expand, underscoring the state's commitment to renewable energy. The increase in costs is driven by multiple factors, including supply chain disruptions, rising interest rates, and the shift toward ethically sourced materials, further reflecting California's values and priorities.

6.4 Claiming, Verification and Surrendering of RECs

California's REC trading process operates through bilateral contracts rather than a centralized platform, making WREGIS and the CEC heavily reliant on self-reported trades. The cross-regional trading of RECs adds complexity to claiming, verification, and surrendering processes. However, Figure 53 presents a simplified overview of the end-to-end REC trading process.

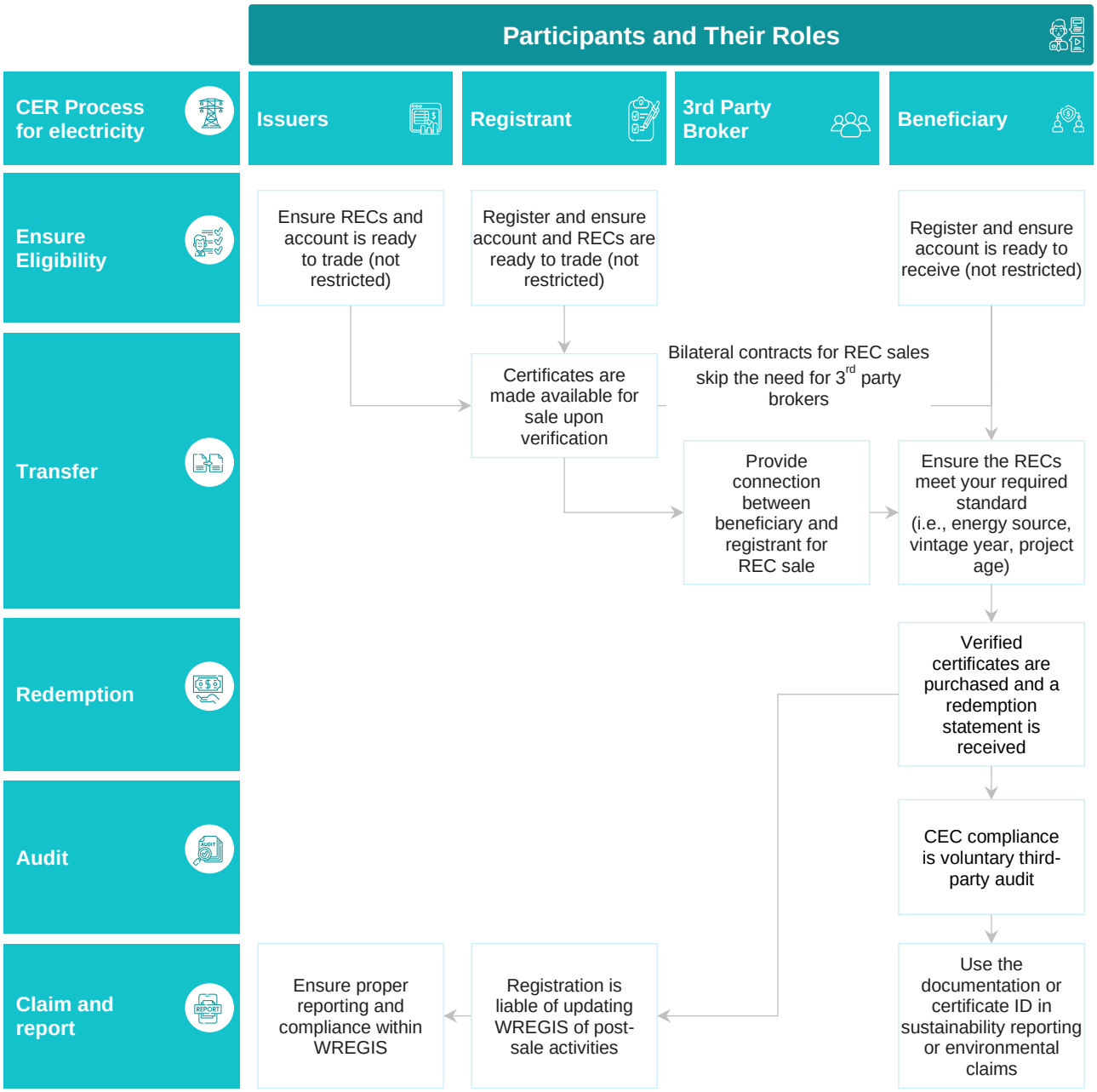

Figure 53 | End-to-End Claiming, Verification, and Surrendering Process

Source: Arthur D. Little Analysis

This process highlights California's reliance on sellers to self-report REC transfers, raising questions about compliance and how the CEC prevents double counting. To address this, several safeguards are in place: firstly, the CEC assigns unique serial numbers to all RECs registered within WREGIS. Secondly, WREGIS participates in inter-registry coordination, developing protocols for importing and exporting RECs across different registries.

6.5 Impact Assessment on REC Capacities

California's renewable electricity production continues to grow and is expected to maintain this trajectory. Figure 54 compares California's production to total U.S. renewable generation. While California represents a fraction of the national total, it accounts for 10% of the country's renewable energy production, making it the second-largest contributor among all 50 states.

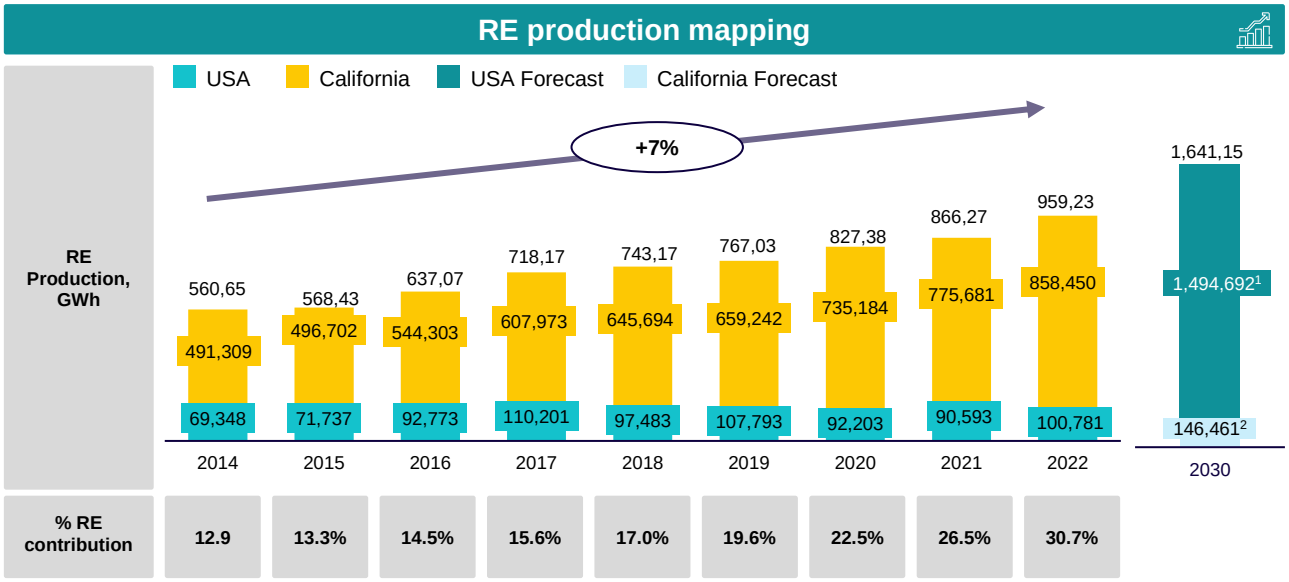

Figure 54 | U.S. and California Renewable Electricity Production in GWh

Source: California Energy Commission, IRENA Report

The U.S. renewable electricity contribution nearly tripled from 2014 to 2022, with production growing at a 7% CAGR. In comparison, California's renewable electricity production grew at a 5% CAGR. California's growth is driven by its RPS requirements, progressive culture, voluntary corporate demand, and supportive federal and state policies.

6.6 Lesson Learned and Applicability to the Philippines

California's REC market success is driven by strong federal and state-level support, independent climate policies, and a progressive sustainability culture. The Inflation Reduction Act and various government initiatives have fostered both small- and large-scale RE investments, while California's state autonomy allows it to set its own aggressive climate policies. Additionally, high public sustainability awareness has further propelled both the mandatory and voluntary REC markets.

The Philippine government should develop nationwide RE support schemes while empowering local governments to create regional initiatives. Raising public sustainability awareness through

education campaigns and corporate engagement can further drive REC adoption and strengthen the market.

Aspect	Key Success Factors	Solutions and Best Practices	Implications for the PH
Operational Framework – Regulatory Framework	California receives support from the federal government through its policies and initiatives such as the Inflation Reduction Act	Numerous initiatives and support policies originating from various government levels to drive small and large-scale RE investment	PH Government to develop support schemes with country wide adoption and support local government offices to develop their own local support initiatives for RE investment
Operational Framework - Regulation	California can develop its own state level policies to support its own climate change agenda, maintaining autonomy outside the federal government		
Demand Drivers	California's progressive culture drives the states renewable energy efforts at the mandatory and voluntary market	Organize awareness campaigns, engage business and the public to promote eco-friendly practices	Evaluate level of sustainability awareness among PH citizens and implement awareness programs to boost eco-conscious consumption

Table 30 | Key Success Factors in California's REC Market

California's REC market faces challenges due to political inconsistency, reliance on self-reporting, and rising material costs. Federal policies shift with elections, creating uncertainty in long-term RE incentives. Additionally, California's self-reporting system relies on WREGIS for transaction tracking, posing risks of double counting. Meanwhile, the state's strong ethical and sustainability focus prioritizes social responsibility over cost efficiency, influencing pricing dynamics.

The Philippines should establish long-term RE policies to ensure stability, create its own REC trading platform, or integrate with global standards, and prioritize cost-efficient RE development to maximize market returns.

Aspect	Challenges	Key Takeaways
Legal Framework	**Political inconsistency**: Federal level policy may change every 4-8 years from influential presidential elections	• Establish longevity of RE policy and support schemes to avoid sudden cancellations
	Reliance on self-reporting: California relies on REC suppliers to report transactions to WREGIS, also relying on WREGIS to properly track and prevent double counting	• PH should establish their own trading platform or utilize international standards and platforms, monitored by their own institution and protocol to limit reliance on independent variables
Pricing and Market Dynamic	**Rising material costs:** Californian culture and progressive nature emphasizes ethical practices and material purchases, valuing ethics, and social responsibility over cost efficiency in some instances	• RE development should prioritize cost efficiency to maximize returns

Table 31 | Key Challenges in California's REC Market

7. Jurisdiction 5: Germany

7.1 Summary and Market Overview

7.1.1 Germany GO Market Summary

With over 20 years of development, Germany has built a robust and growing voluntary Guarantees of Origin (GO) market, reinforcing its status as a global leader in renewable energy, particularly in solar and wind.

Operationally, Germany aligns with EU directives, integrating sustainability initiatives such as emission allowances, renewable energy targets, and a GO standard based on the European Energy Certificate System (EECS). The government-run GO register oversees issuance, verification, and surrendering, ensuring compliance and transparency. Emerging technologies are also being explored to enhance tracking accuracy, prevent double counting, improve inter-register communication, and integrate digital identities into Germany's GO system and grid infrastructure.

Market demand for GOs is driven by corporations and utilities, fueled by strong consumer eco-consciousness and regulatory pressure. However, domestic issuance remains constrained due to the double marketing ban, leading Germany to import GOs from surplus-producing countries such as Norway and Sweden.

Beyond certification, GOs have helped reduce producers' reliance on government subsidies, accelerating renewable energy development and supporting Germany's 2030 target of 80% renewable energy generation. Figure 55 summarizes Germany's GO market structure and key trends.

Overview

Maturity & Compre-hensiveness	Tracking System & Standard	Voluntary Corporate Participant	Regulatory Framework	Relevance to PH
24 years Mature & Accelerating	**GO** Local Standard	**RE100** Mainly among MNCs & RE100 companies	**Voluntary** Fully voluntary market	**High** Strong in solar and Wind energy

Objectives — **Findings**

1 Operational Framework

Policy & Regulations	Governance	Operational Framework	Platform & Technology
17 Laws, Resolution, Decrees & Decision to accelerate REM	**Federal Ministry for Economic Affairs & Climate Action** Federal agency	**Carbon abatement** GOs and Emission Allowance	**GO** Local Government Registry

2 Demand Drivers & Market Dynamics

Corporate	Government	Public	Market Impact
RE100, CSR RE100 operations and CSR Initiatives	**No Mandatory Market** National Climate Targets	**Eco-Conscious** Prioritize sustainable products	**Import Reliant** Double marketing ban limits GO issuance

3 Claiming, Verification & Surrendering of RECS

REC Verification	REC Claiming
Guarantee of Origins Register (HKNR) Issuance, verification and tracking done through the HKNR	**Initiated by Utilities** Used to avoid double counting

4 Impact on Increasing RE Capabilities

Impact
Sustainability Leader in Renewable Energy Production Shifting to sector-wide investments and lump-sum support to drive GO adoption and accelerate renewable energy development

5 Impact on Increasing RE Capabilities

Key Best Practices	Key Challenges
• **International alignment** with EU standards & directives • **Government oversight** of GO transactions in HKNR	• Double marketing ban leading to **high imports** • **Market opacity** in prices and volume of GO transactions

Figure 55 | Summary of Germany's GO Market

7.1.2 Overview of Germany's Carbon Abatement Initiatives

Germany's carbon reduction efforts are led by the **Federal Ministry of Economic Affairs and Climate Action (BMWK)** and guided by **European Union (EU)** directives, which are adapted into national legislation. These initiatives fall into two main categories: Carbon Pricing and Renewable Energy.

Carbon pricing strategies are based on the EU Emissions Trading System (EU ETS), which allows corporations to purchase emission allowances based on their carbon output. This system primarily applies to large industrial facilities, power plants, and aviation. To cover other emission sources, Germany introduced the National Emissions Trading System (nEHS) through the Fuel Emissions Trading Act (BEHG) in 2021.

Renewable Energy targets in Germany aim for an 80% share of total electricity production by 2030. One of the key mechanisms supporting this goal is the Guarantees of Origin (GOs) system, which certifies the renewable origin of electricity. Germany's GO framework is based on the European Energy Certificate System (EECS), developed, and maintained by the Association of Issuing Bodies (AIB).

7.1.3 Development of Germany's GO Market

Germany's GO market development can be divided into two main phases: **Market Establishment** (2000–2018) and **Market Growth** (2019–Present). The first phase focused on policies supporting renewable energy development and the establishment of GO registry governance. The second phase introduced policies aimed at accelerating GO adoption among producers, utilities, and corporations.

Germany offers three key lessons for the Philippines in developing its GO market:

Strong GO Demand: A highly eco-conscious population drives suppliers and corporations to commit to sustainability targets, creating strong demand for GOs

International Integration: Alignment with international standards and international trading channels, e.g., AIB HUB, allows Germany to trade with neighboring countries

Limited GO Issuance: A double marketing ban prevents renewable energy sources receiving Renewable Energy Sources Act (EEG) subsidies from being issued GOs, restricting overall market supply

7.1.4 Trends in Germany's GO Market

Figure 56 illustrates GO transaction trends for issuance, imports, and cancellations from 2017 to 2024. Despite low domestic issuance due to the double marketing ban, Germany carefully manages supply-demand dynamics, keeping prices stable at €1–2 per MWh. To address the GO shortfall, Germany imports surplus GOs from neighboring countries, particularly Norway and Sweden. Meanwhile, export volumes remain minimal and negligible.

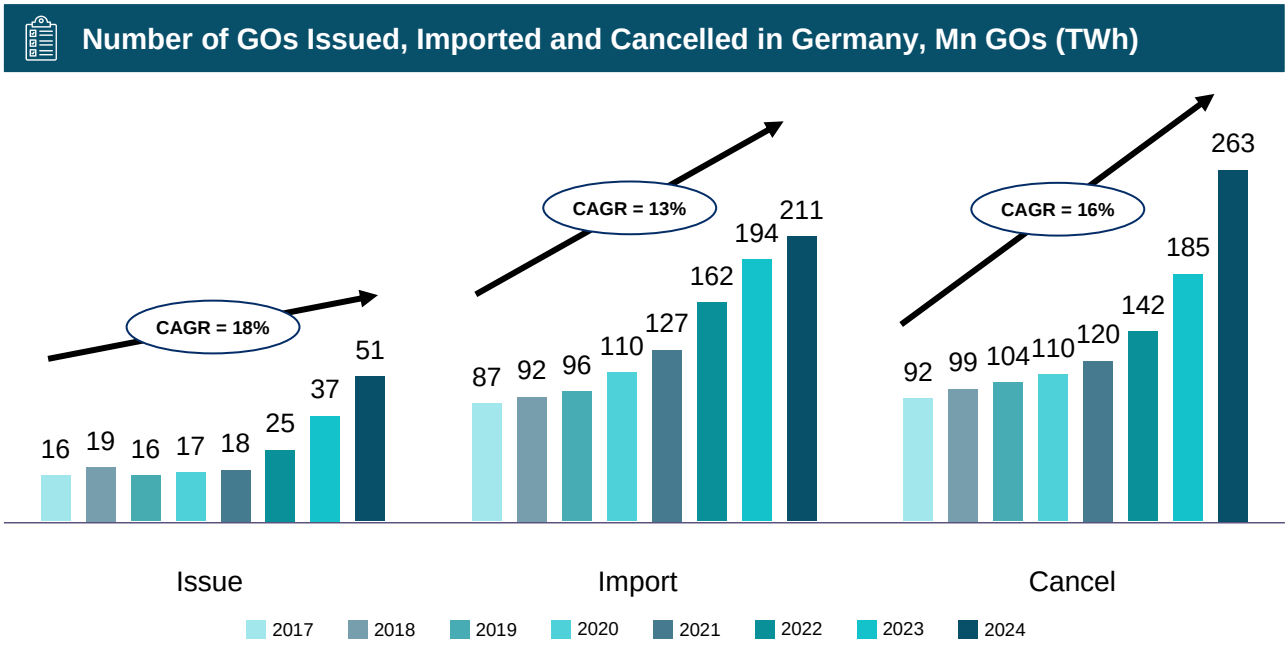

Figure 56 | Number of GOs Issued, Imported and Cancelled in Germany, Mn GOs (TWh)

Source: AIB, UBA

7.2 Analysis on Operational Framework

7.2.1 Overall Market Phases

Germany's GO market operational framework has been developed over 24 years across two key market development phases. The Market Establishment phase (2000 – 2018) reflects the gradual policy evolution and GO register development. The establishment period had the foundational phase and establishment phase, during which GO was introduced by Germany. The Market Growth phase (2019–Present**)** is driven by increased GO adoption among producers, utilities, and corporations. Figure 57 illustrates the trends in GO issuance in relation to market and regulation maturity and will be further analyzed in section 7.2.2.

Market Establishment I (2000 – 2012): Laid the groundwork for the GO market by promoting sustainability awareness and driving the expansion of renewable energy production, supported by key policies such as the Renewable Energy Sources Act and the Germany Industry Act

Market Establishment II (2013 – 2018): Designed and implemented the system and framework for issuing, tracking, and trading Guarantees of Origin (GOs), including the establishment of the German Guarantee of Origin Register, the enactment of ordinances regulating its operations, and Germany's accession to the Association of Issuing Bodies (AIB)

Market Growth (2019 – Present): Boosted corporate adoption of Guarantees of Origin (GOs) through incentives and legally binding mandates while reducing producers' dependence on EEG subsidies to drive GO issuance

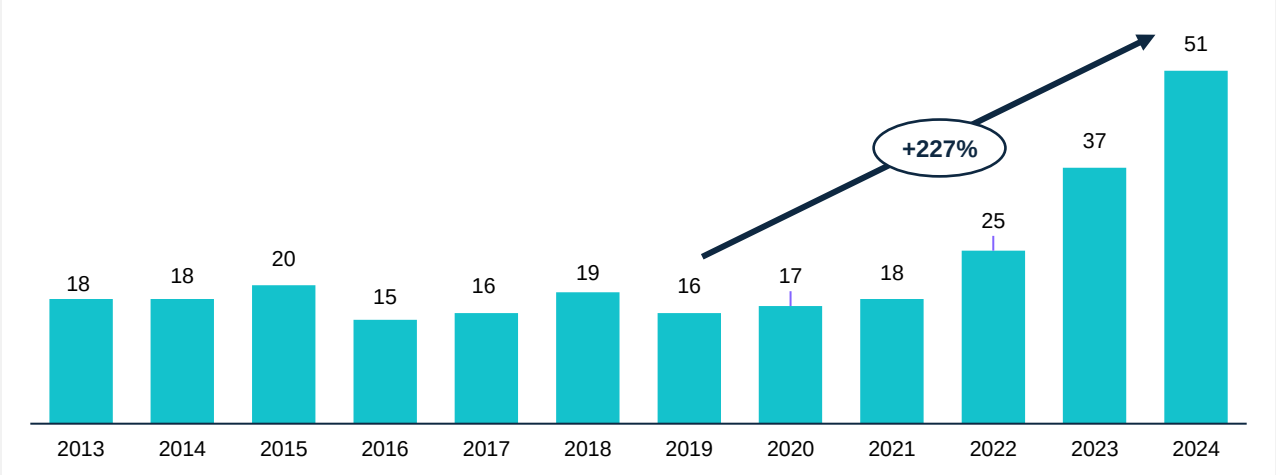

Figure 57 | Number of GOs issued in Germany, Mn GOs (TWh)

Source: AIB, UBA

7.2.2 Market Establishment Phase (2000 – 2018)

The market establishment phase was shaped by German and EU policies that **introduced GOs** into **Germany's renewable energy sector.** Key regulations, such as the Renewable Energy Sources Act (EEG) and the GO and Regional GO Implementing Ordinance (HKRNDV, 2013), played a crucial role in accelerating renewable energy development and creating a secure, transparent, and robust register for GO issuance, tracking, and verification.

This phase also helped **familiarize utilities and corporations with GOs as a tool to demonstrate sustainability commitments.** A major regulatory milestone was the 2005 Amendment to the German Energy Industry Act (EnWG), which mandated electricity disclosures for utilities. This was further reinforced by a 2013 amendment, requiring that any renewable energy disclosed to consumers be authenticated with GOs, strengthening market credibility.

However, in the early years of the German GO register (HKNR), the absence of formalized and mature regulations led to **volatile issuance trends**. A **turning point** came with the GO Implementing Ordinance (HkNDV, 2018) and the EU Renewable Energy Directive II (RED II, 2018), which standardized GO issuance, expanded the scope of eligible energy sources, and strengthened regulatory requirements, significantly improving GO security and reliability in substantiating renewable energy usage. Table 32 outlines key policies and events that contributed to the establishment of Germany's GO market from 2000 to 2018.

Regulation	Date Issued	Focus Areas	Content	Impact on GO Market
Renewable Energy Sources Act (EEG)	January 2000	Renewable Energy Production	• **Aim:** Accelerate sustainable renewable energy production • **Tools:** Guaranteed grid access and priority dispatch for renewable energy alongside Feed-in Tariffs and market premiums for renewable energy producers	**Increased supply** of renewable energy for issuance of RECs
EU Renewable Energy Directive	October 27, 2001	Introduction of GOs	• **Aim:** Accelerate deployment of renewable energy development in EU • **Tools:** Introduction of GO, Alignment of Germany to EU renewable goals, Prioritized market transparency	**Introduced standardized GO system** as an alternative to feed-in tariffs
Establishment of European Energy Exchange (EEG)	2002	Market Trading Platform	• **Aim:** Create unified trading platform for electricity in Germany • **Tools:** Merger of two German power exchanges (Leipzig Power Exchange and European Energy Exchange)	**Established foundation** for central trading platform to increase accessibility of GO trading
German Energy Industry Act 2005 Amendment	July 13, 2005	Mandated Electricity Disclosures	• **Aim:** Align with EU electricity market directive • **Tools:** Mandate electricity disclosure requirement for electricity suppliers	**Increase transparency** of renewable energy supply, increasing GO demand
Establishment of HKNR and	January 1, 2013	Registry for GOs	• **Aim:** Provide standardized framework for REC issuance and management requirements. • **Tools:** Transparent and government-supervised registry tracking GOs throughout their	**Enhance transparency, standardization and market confidence** in the

Regulation	Date Issued	Focus Areas	Content	Impact on GO Market
GO and GRO[1] implementing Ordinance (HKRNDV)			lifetime, Mandate electricity suppliers to disclose renewable energy supply only after canceling equivalent GOs	German GO Market
EEG 2014 Amendment	June 27, 2014	Facilitate Adoption of GO	• **Aim:** Accelerating German renewable energy development • **Tools:** Phasing out of feed-in tariffs for direct marketing, compliance with EECS and introduction of market-based mechanics	Allow producers to **sell renewable energy at a premium on the market** while still being able to trade GOs unlike the feed-in tariff system.
Renewable Energy Sources Ordinance (EEV)	February 17, 2015	Operations of Registry	• **Aim:** Provide standardized framework for GO issuance and management requirements • **Tools:** Detailed regulations for operations of HKNR	Increase **market transparency** and **consumer confidence** in GOs issued by HKNR
Germany became member of Association of Issuing Bodies	2016	International Integration	• **Aim:** Provide standardized framework for GO issuance and management requirements • **Tools:** Adopt AIB's EECS standard, Access to AIB Hub for cross-border trading, Greater assurance in GO quality through AIB	**Increased access to international market** while **raising credibility of GOs**

[1] GRO refers to Guarantee of Regional Origins (GOs granted to RE produced within a specific region and can only be used by end consumers within specific region)

Regulation	Date Issued	Focus Areas	Content	Impact on GO Market
Structured Trading of GOs on EEX	2017	Market Trading Platform	• **Aim:** Create unified trading platform for GOs in Germany • **Tools:** Structured & exchange-based trading platform, real-time market data, Lower costs incurred in GO trading	**Increased accessibility** to GO market for buyers and sellers
GO implementing Ordinance (HkNDV)	November 21, 2018	Registry for GOs	• **Aim:** Provide standardized framework for GO issuance and management requirements • **Tools:** Established clear procedures and fees involved in GOs and reinforced measures to prevent double counting	**Increase market transparency** and **consumer confidence** in GOs issued by HKNR
EU Renewable Energy Directive 2018	December 11, 2018	International Integration	• **Aim:** Accelerate deployment of renewable energy development in EU • **Tools:** Expand scope of GO, Mandatory GO Issuance, Strengthen requirements for GOs	**Increase supply of GOs in Germany** while **enhancing cross-border trade of GOs** within EU member states through stronger inoperability between systems and greater transparency

Table 32 | Policies and Events Contributing to Germany's GO Market Establishment (2000 – 2018)

7.2.3 Market Growth Phase (2019 – Present)

The market growth phase was driven by German and EU policies that **accelerated renewable energy expansion and GO adoption** among utilities and corporations. Key regulations, such as the Supply Chain Due Diligence Act (LkSG, 2023) and the Corporate Sustainability Reporting Directive (CSRD, 2023), pushed businesses to set stricter sustainability targets, further reinforced by rising consumer demand for verified sustainability commitments. This led to **stronger demand for GOs** as a market-based proof of renewable energy usage.

Despite Germany's progress in renewable energy development, GO issuance remained constrained by the double marketing ban. In response, the government shifted renewable energy support from EEG per-unit subsidies to sector-wide investment incentives, reducing reliance on government funding. These policies strengthened GOs as a key market mechanism for renewable energy growth, driving a **227% increase in GO issuance** between 2019 and 2024, with **a CAGR of 34%,** as shown in Figure 57. Table 33 outlines the key policies and events that contributed to the growth of Germany's GO market from 2019 to the present.

Regulation	Date Issued	Focus Areas	Content	Impact on GO Market
Supply Chain Due Diligence Act	June 11, 2021	Sustainability Adoption	• **Aim:** Increase corporate accountability for environmental impacts and increase demand for GOs • **Tools:** Mandatory due diligence obligations, Reporting & disclosure requirements, financial penalties, and legal liability	Made **GOs more essential** to corporate sustainability strategy and **increase demand for GOs**
EEG 2021 Amendment	January 1, 2021	Increased RE Development	• **Aim:** Accelerate sustainability commitments in Germany • **Tools:** Sustainability targets, Increased tender volume for onshore wind and solar energy, Incentives for green hydrogen	Increase in supply of renewable energy for **greater GO issuance**
Growth Opportunities Act	August 2023	Increased RE Development	• **Aim:** Stimulate economic growth in Germany • **Tools:** Provision of investment premium for energy-saving technologies, Enhanced depreciation options for climate-friendly investments, Tax incentives for sustainable projects	Increase in supply of renewable energy for **greater GO issuance**

Regulation	Date Issued	Focus Areas	Content	Impact on GO Market
EEG 2023 Amendment	January 1, 2023	National Target	• **Aim:** Accelerate sustainability commitments in Germany • **Tools:** Increased sustainability targets, Enhanced support schemes for RE producers, Removal of EEG surcharge	Increase in supply of renewable energy for **greater GO issuance**
Building Energy Act (GEG)	January 1, 2024	Encourage RE Adoption	• **Aim:** Accelerate sustainability commitments in Germany • **Tools:** Require all newly installed heating system to use at least 65% renewable energy	Increase **demand for GOs** while promoting development of RE technology for increased RE supply
Corporate Sustainability Reporting Directive	In Progress	Encourage Sustainability Target Adoption	• **Aim:** Increased supply of RE through imports • **Tools:** Mandatory sustainability reporting framework, Double materiality principle (impact and financial), Audits	**Increased transparency and accountability** of corporation's sustainability contributions leads to **greater GO demand**

Table 33 | Policies and Events contributing to Germany's GO Market Growth (2019 – Present)

7.2.4 Key Regulators

Within Germany, there are 4 key organizations involved in implementing policies for the GO market and renewable energy sector:

Federal Environmental Agency (UBA)

- Independent federal agency under federal ministry for economic affairs and climate actions
- Responsible for environmental protection, research and policy implementation
- Serves as Germany's official representative within the AIB

Guarantees of Origin Register (HKNR)

- National registry operating under authority of the UBA
- Specialized platform for issuing, tracking and cancelling GOs in Germany

Germany Energy Agency (DENA)

- Germany's primary center of expertise for energy efficiency, renewable energy and energy transition
- Supports German government in policy recommendations and strategic insights
- Development of digital infrastructure used in GO market and renewable energy sector

Association of Issuing Bodies (AIB)

- Develop and maintain the European Energy Certificate System (EECS) that governs the issuance, transfer and cancellation of GOs
- Enables cross-border GO trade between participating countries
- Ensures compliance with the EU RED II

7.2.5 REC Certification System

Germany's **local GO register and framework** are managed through the Herkunftsnachweisregister (HKNR), overseen by the German Environment Agency (UBA). Within the German GO register, only installation operators (generators), traders, and electricity suppliers (utilities) can create accounts and hold GOs. Corporations must partner with suppliers to cancel GOs for renewable energy usage.

A detailed list of entities and their roles in Germany's GO lifecycle is provided in Table 34.

Entities	Roles	Representative Organizations
Register Administration (HKNR)	Official digital registry operated by UBA responsible for issuance, transfer, cancellation and tracking of GOs in Germany	Herkunftsnachweisregister, German Guarantee of Origin Register
Installation Operator (Generator)	Operator of a renewable energy plant that generates renewable electricity eligible for GO issuance	EnBW Energie Baden-Württemberg AG E.ON Climate & Renewables
Trader	Intermediary entity that buys and sells GOs within the market and facilitates transactions between installation operators and electricity suppliers	Axpo Solutions AG Statkraft
Electricity Supplier (Utilities)	Licensed companies that deliver electricity to end consumers (e.g. households, businesses and industries). Only entity that can cancel GOs.	EnBW Energie Baden-Württemberg AG E.ON Climate & Renewables
Corporations	Organizations that procure GOs to verify and substantiate their renewable energy consumption, supporting their sustainability commitments and regulatory compliance. Procurement of GOs can occur through either direct purchase from market platforms or traders or purchasing renewable energy products from electricity suppliers.	Schwarz Gruppe Merck KGaA
Environmental Auditor	Accredited bodies responsible for reviewing and ensuring accuracy, reliability and compliance of data provided by account holders within the scope of their accreditation.	TÜV SÜD

Table 34 | Entities and their roles in Germany's GO lifecycle

The GO lifecycle and key participant roles are outlined in Figures 60 to 62. Figure 62 highlights Germany's GO issuance and certification process, which relies heavily on the government-regulated registry (HKNR) while showcasing the primary supply and demand sources driving the market.

Unlike Viet Nam and Singapore, where authorized service providers and platform operators play a central role in GO trading, Germany's GO transactions occur primarily over the counter (OTC) or through Power Purchase Agreements (PPAs) between end users and electricity suppliers, without a dominant centralized trading platform.

Like third-party auditors in other jurisdictions, environmental auditors in Germany conduct independent audits of the GO registry's processes, ensuring transparency, regulatory compliance, and accountability throughout the entire GO lifecycle, reinforcing the credibility and robustness of Germany's GO certification system.

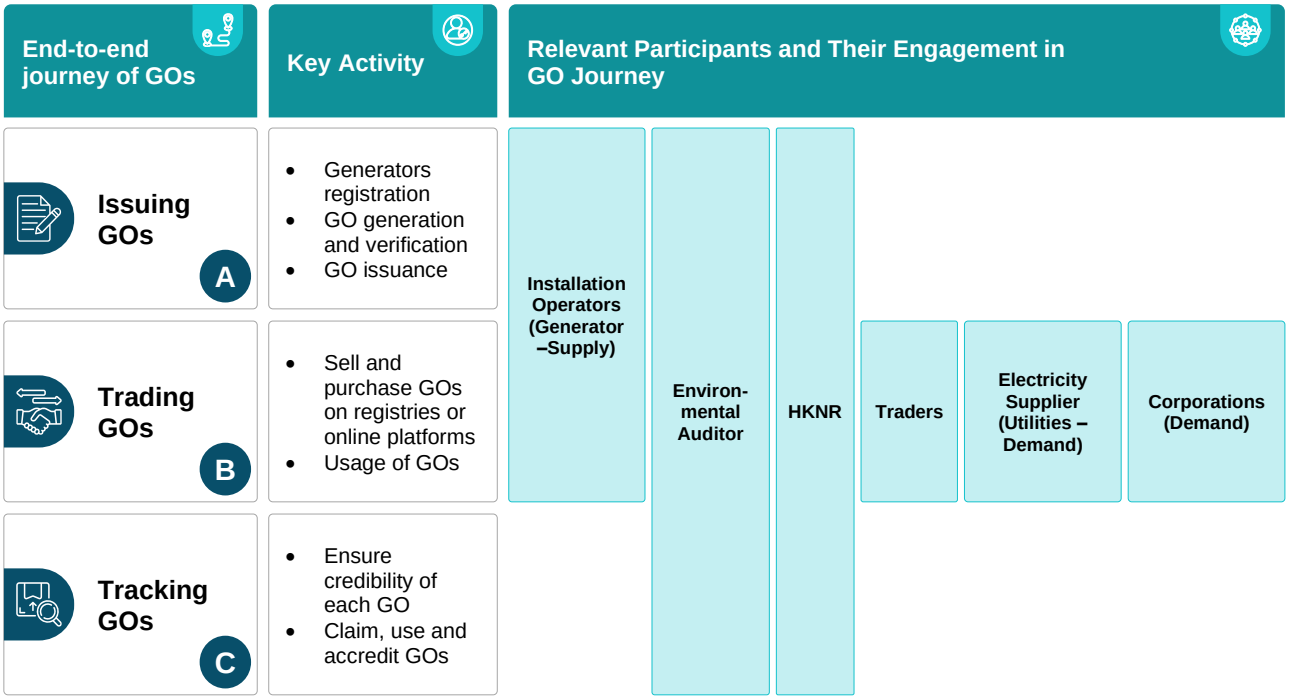

Figure 58 | Germany GO Journey and Participants Engagement Map

Source: Arthur D. Little Analysis

Figure 60 outlines the **GO issuance process** in Germany, detailing each participant's role from installation registration to GO tracking post-issuance. The process begins with installation operators submitting issuance requests, which are verified and processed by the HKNR before GOs are issued to the operator's account. The HKNR ensures the renewable energy's eligibility, while environmental auditors conduct independent audits to verify compliance. The issuance and verification process are strictly regulated under the HkRNDV (2013) to uphold GO reliability and transparency in the German market.

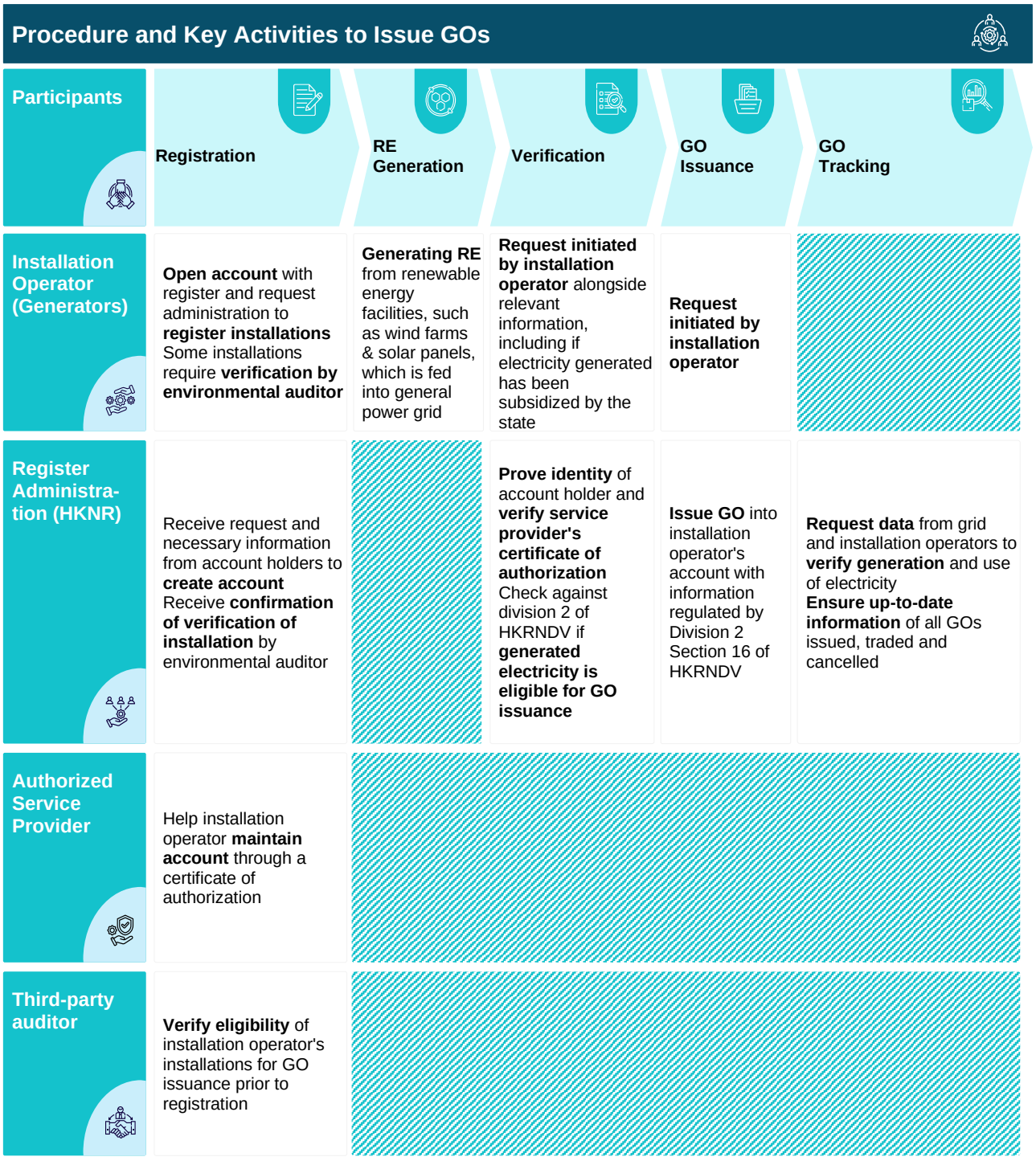

Figure 59 | GO Issuance Process Flow

Source: Arthur D. Little Analysis

Figure 60 outlines the **GO trading and cancellation process** in Germany, detailing each participant's role at every stage. While both corporations and utilities can purchase GOs, only utilities are authorized to own, use, and cancel them, requiring corporations to partner with utilities for GO cancellation.

Once utilities apply GOs for electricity disclosures, the HKNR cancels them immediately to prevent double counting. Additionally, unused GOs expire after one year and are automatically invalidated by the HKNR. The trading and cancellation process is strictly regulated under the HkRNDV (2013) to uphold market transparency and compliance.

Procedure and Key Activities to Trade and Cancel GOs

Participants	Need for Identification	GO Trading	GO Usage and Cancellation	Go Tracking
Installation Operator (Generators)		Account holder initiates request for transfer of GO to a different account holder		Keep record of **all transactions** and **detailed information** of electricity generation methods
Electricity Supplier (Utilities)			**Only entity allowed** to cancel GOs, **restricted** only to GOs for renewable energy they supplied	
Electricity Customer (Corporation)	• **Assess sustainability goals and RE commitments** to align with global standards and corporate strategies • **Determine certificate needs**, i.e., RECS or carbon credits, based on reporting frameworks like GHG Protocol or local regulatory requirements • **Determine specific REC requirements** i.e., energy type (Solar, wind, biomass), geographic origin, and whether bundled or unbundled certificates and to support specific Scope emissions		**Directly** purchase renewable products from electricity suppliers to use GOs associated or **indirectly** claim GOs purchased through electricity supplier	
Register Administration		**Transfer GO** at request of account holder after **ensuring security, accuracy and reliability of register** will not be jeopardized by transfer	**Verify GO authenticity** before cancelling GO for installation operator	**Track and monitor GO activities** to ensure **integrity. accountability, and compliance**

Figure 60 | GO Trading and Cancellations Process Flow

Source: Arthur D. Little Analysis

7.2.6 Digital Infrastructure

Germany's **GO infrastructure** uses similar systems as international standards like I-REC and TIGR for tracking of GOs, namely digital registries and unique identification.

Digital Registry: GOs are recorded in a centralized digital registry which provides detailed information, such as production date, location, and energy type

Unique Identification: Each GO is assigned a unique identification number to track it from issuance to cancellation

Germany is actively exploring blockchain technology to enhance grid infrastructure and improve the efficiency of renewable energy systems. In inter-register transactions, blockchain integration across European GO registers strengthens security, transparency, speed, and cost-effectiveness. Locally, the DIVE project (Digital Identities as Trust Anchors in the Energy System) explores the use of digital identities in blockchain to improve tracking, grid stability, and cost savings.

However, challenges such as technological immaturity and high energy consumption hinder widespread adoption in the renewable energy sector. While still in its early stages, Germany continues to explore blockchain's potential to streamline GO life cycle processes.

7.3 Assessment of REC Demand Drivers and Market Dynamics

Germany's GO market experiences strong demand from corporations and utilities but faces supply constraints. High sustainability awareness and regulatory policies incentivizing and mandating corporate sustainability commitments drive demand. However, GO supply remains limited due to restricted issuance under the double marketing ban.

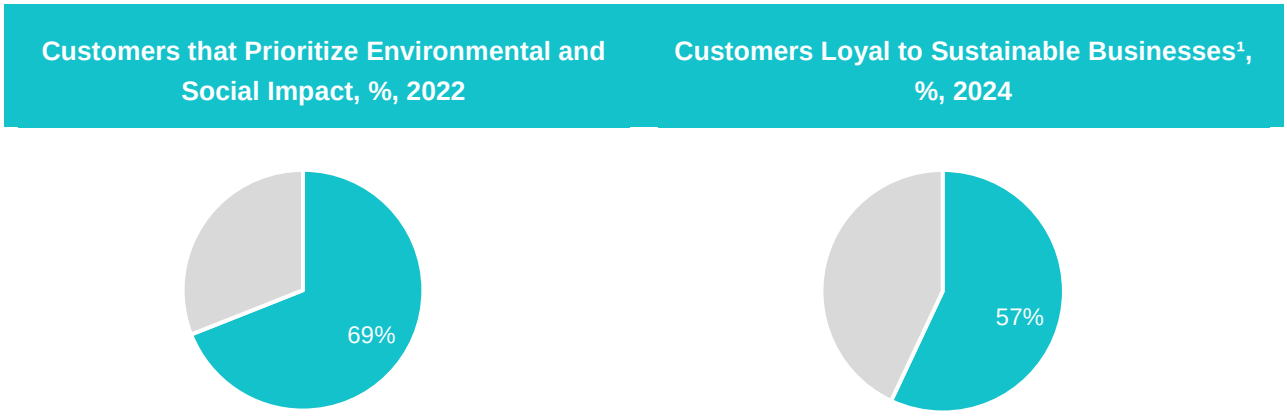

Figure 61 | Consumer Trends in Germany Towards Sustainability

Source: CGA

Germany's **eco-conscious population** is a major driver of Guarantees of Origin (GO) adoption, as corporations and utilities respond to growing consumer demand for sustainable products. Figure 61 presents findings from CGA by NIQ's 2022 and 2024 surveys, which highlight rising sustainability preferences among German consumers. The surveys identified the top three ethical and sustainable priorities: local production, low waste and pollution, and recycling initiatives.

On a broader scale, Germany remains a **sustainability leader**, with a €37.3 billion investment planned for renewable energy projects. The country ranks 3rd in the 2024 Environmental Protection Index and 4th in the 2024 Sustainable Development Report, reinforcing its strong commitment to environmental responsibility. These rankings, alongside shifting consumer habits, signal a nationwide transition toward sustainable living, strengthening consumer loyalty to brands that align with these values.

To accelerate this transition, Germany and the EU have introduced a mix of **incentives and legally binding mandate**. The Supply Chain Due Diligence Act (2023) requires companies to assess and mitigate human rights and environmental risks within their supply chains. The German Climate Protection Act (2019) sets sector-specific emission reduction targets. At the regional level, the EU Green Deal (2019) mandates the use of GOs to certify renewable electricity usage and enforces the Corporate Sustainability Reporting Directive (CSRD) to ensure compliance with environmental and social standards. As an EU member state, Germany has aligned its national policies with key EU directives, reinforcing its sustainability commitments.

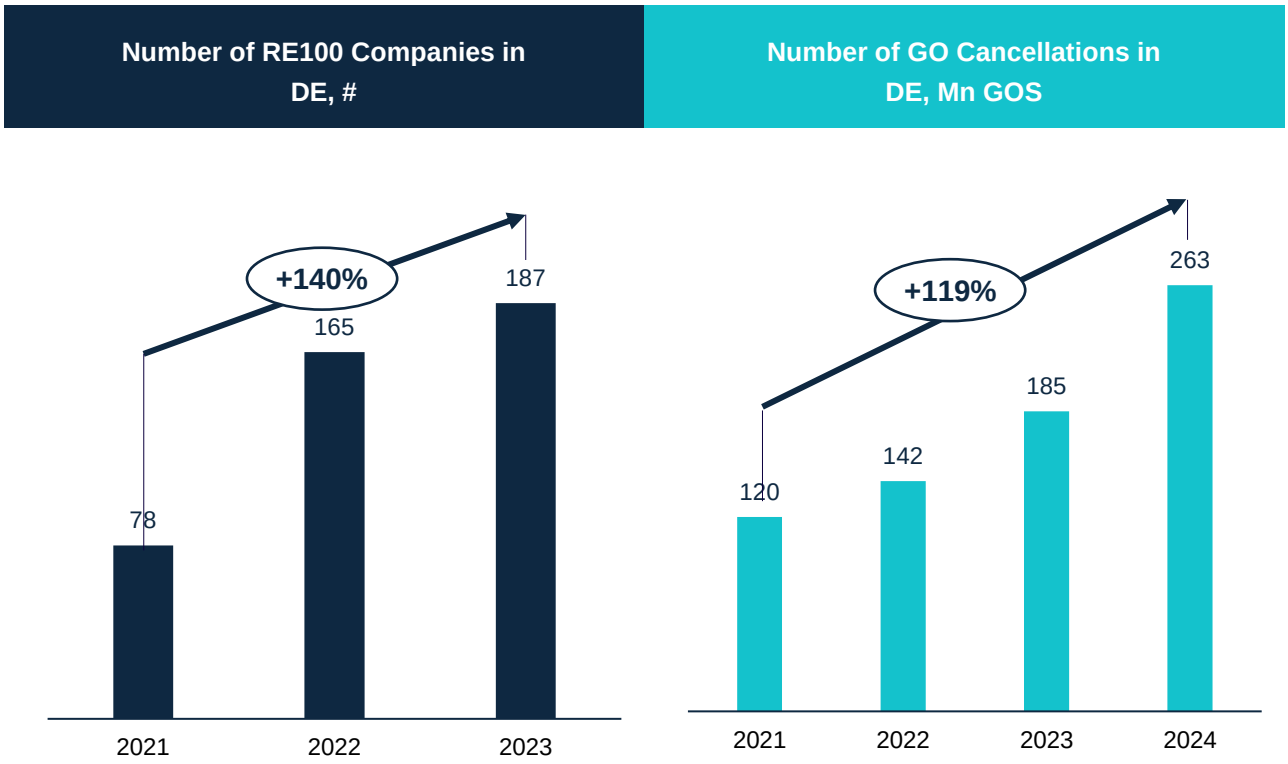

Figure 62 | RE100 Adoption and GO Demand Trend in Germany

Source: RE100 Report, AIB, UBA

As consumer expectations evolve and regulatory pressure increases, corporations and utilities are increasingly incentivized to set ambitious sustainability targets. This trend is reflected in the growing number of RE100 commitments and rising GO cancellations, as shown in Figure 62. **GOs play a pivotal role in this transition**, allowing businesses to demonstrate their commitment to renewable energy and environmental responsibility, ultimately driving Germany's strong demand for GOs.

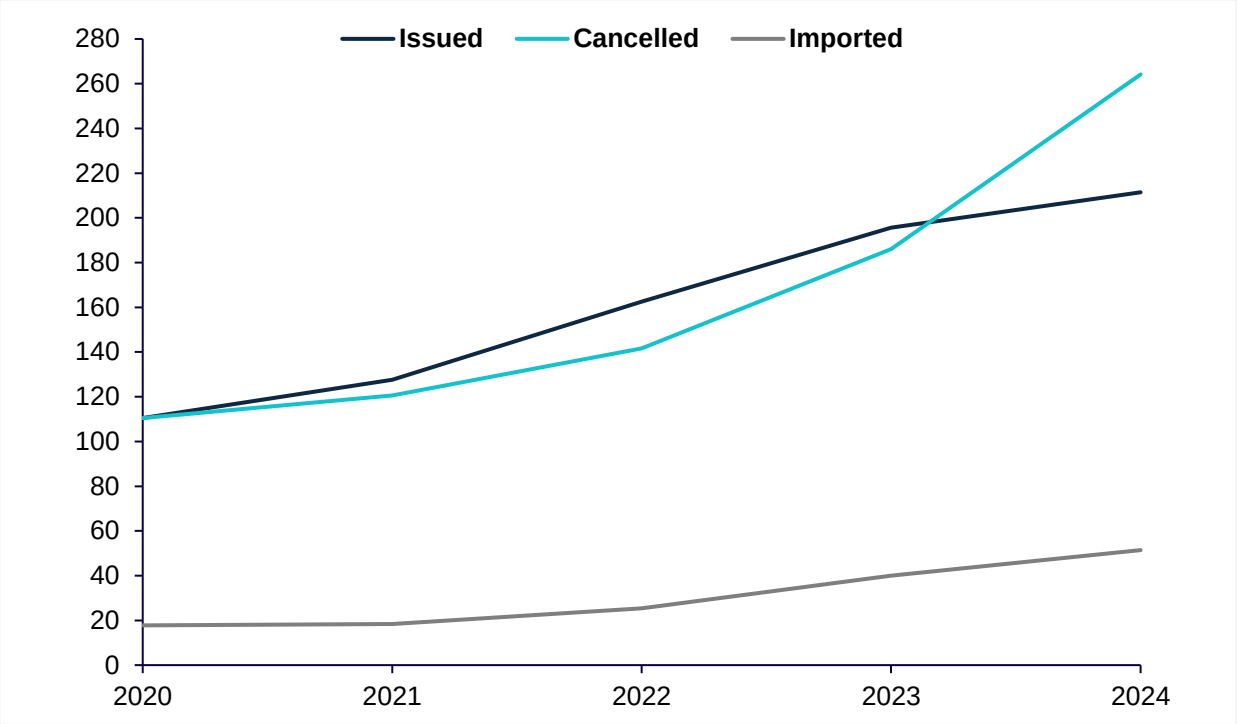

Figure 63 | Trends of GO Issuance, Cancellations, and Imports in Germany from 2020 to 2024, K GOs

Source: AIB, UBA, S&P Global

Despite being a global leader in renewable energy, Germany faces a **domestic GO supply shortage due to regulatory constraints on issuance.** To bridge this gap, Germany imports GOs from neighboring countries with surplus certificates. This supply-demand balance has kept GO prices relatively low compared to other European markets, averaging €1–2 per MWh. Germany's international integration through the Association of Issuing Bodies (AIB) facilitates these imports via the European Energy Certificate System (EECS) and the AIB Hub, a centralized platform for secure GO exchanges across Europe.

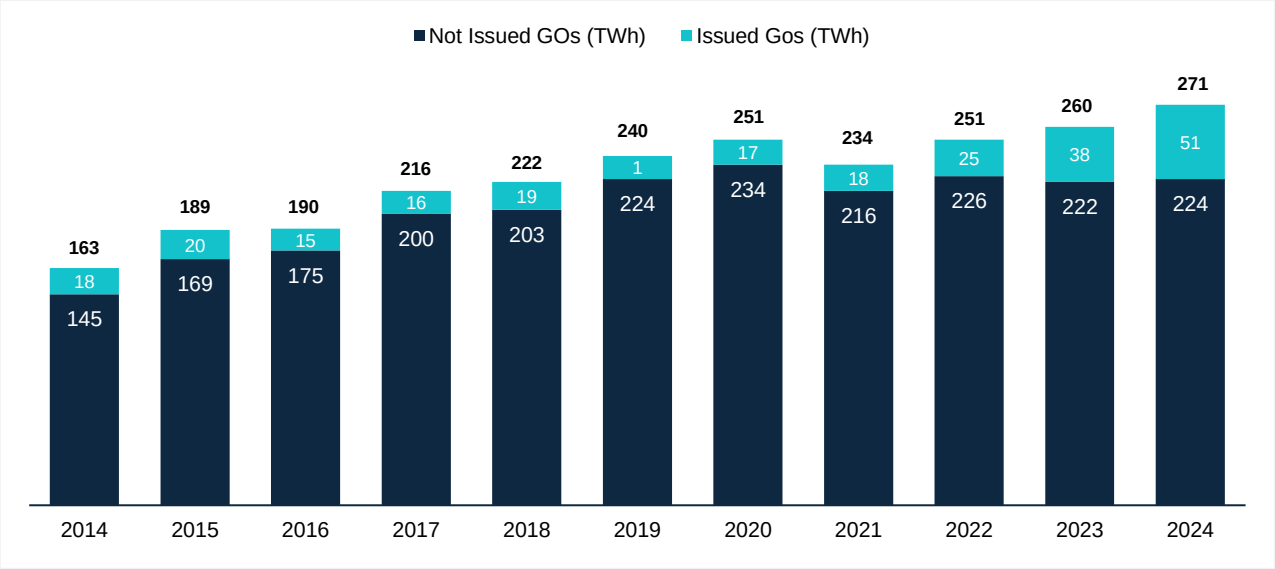

Figure 64 | Proportion of Renewable Energy issued GOs (TWh)

Source: AIB, IRENA Report, Fraunhofer ISE

Germany's low GO issuance is primarily due to the **double marketing ban**, which prohibits renewable energy installations receiving EEG subsidies from being issued GOs. This regulation prevents double compensation for the environmental benefits of renewable energy production.

With the EEG introduced in 2000 and an average subsidy period of 20 years, most installations have been **ineligible for GO issuance**. As a result, only 11% of renewable energy production was certified with GOs in 2014.

However, since 2021, Germany has been **phasing out EEG subsidies** in favor of alternative support mechanisms, such as investment subsidies and mandated market sales, allowing more renewable energy producers to qualify for GO issuance. Further details on these support mechanisms are outlined in Objective 5. This transition has led to a **steady increase in GO issuance**, reaching 20% of total renewable energy production in 2024.

7.4 Claiming, Verification and Surrendering of RECs

The claiming, verification, and surrendering of Renewable Energy Certificates (RECs) **primarily rely on electricity suppliers and are managed by the Herkunftsnachweisregister (HKNR)**. The HKNR provides a structured framework for market participants, ensuring:

GOs are **issued** to generators' accounts.

Trading is initiated by the initial account holders.

Cancellations are exclusively initiated by electricity suppliers.

Corporations must collaborate with electricity suppliers to claim renewable energy usage, either by directly purchasing renewable energy products or partnering for GO cancellation. Beyond operating the registry, the government ensures compliance among internal agencies (UBA, HKNR) and registered market participants, while also implementing policies to drive GO market growth on both the supply and demand sides.Figure 65 illustrates the full process flow and participant involvement across various GO transactions.

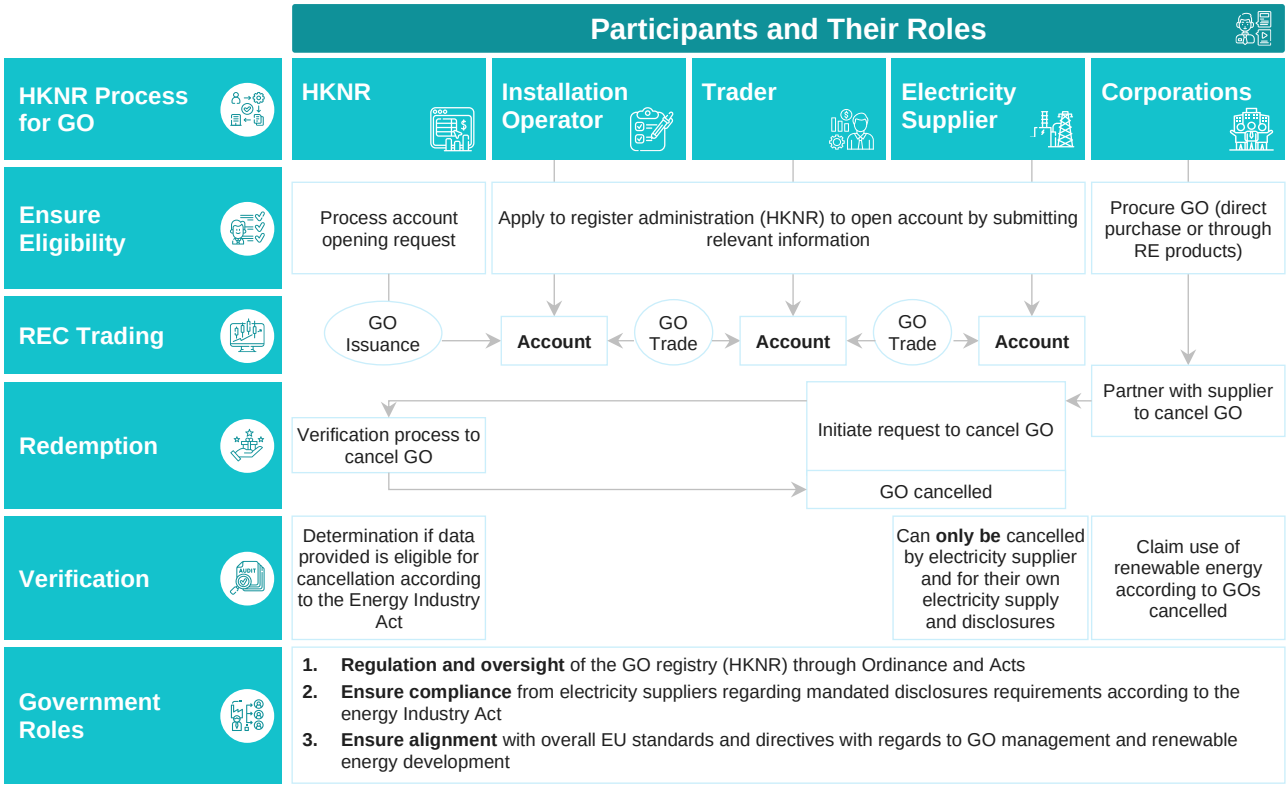

Figure 65 | Claiming, Verification and Surrendering Process of GOs in Germany

Source: Arthur D. Little Analysis

7.5 Impact Assessment on REC Capacities

Germany's Guarantee of Origin (GO) market has closely evolved alongside the country's renewable energy expansion, supporting its energy transition and **sustainability target of 80% renewable energy by 2030**.

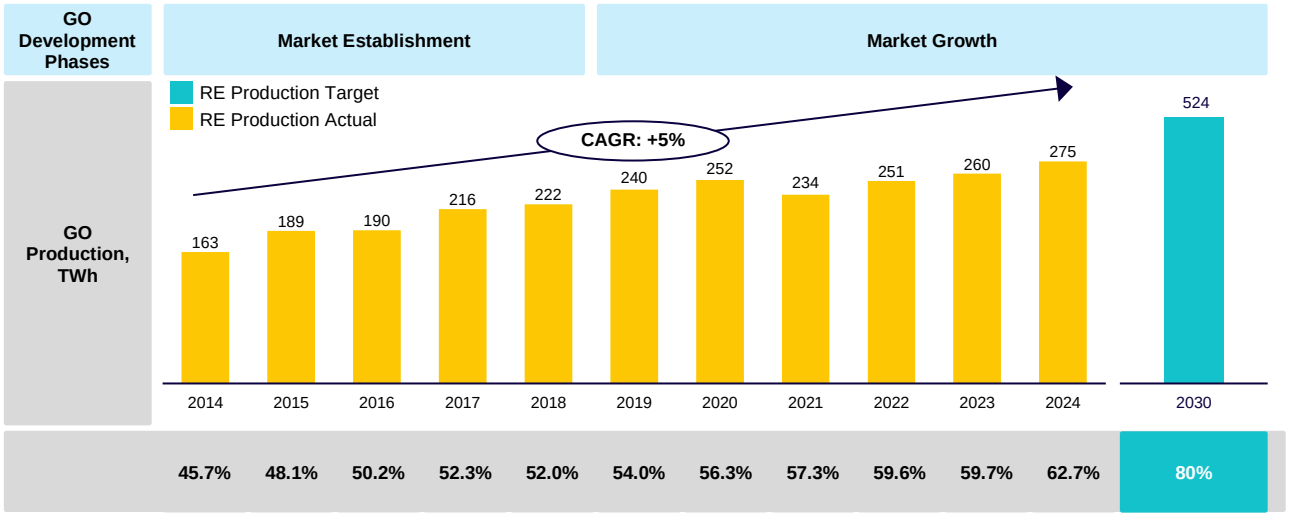

Figure 66 | RE Production Mapping with GO Development Phases

Source: BMWK, IRENA Report

As seen in Figure 66, renewable energy production has grown at a **5% CAGR**, which some may see as insufficient to meet the 2030 target. However, with renewables contributing **63% of electricity generation in 2024** and continuing to grow at a **3% CAGR**, Germany's sustainability transition remains strong.

This progress is driven by both increased renewable energy production and reduced national electricity consumption. However, these advancements also bring challenges, including grid electricity oversupply, leading to negative electricity prices and increased volatility in energy supply and pricing volatility, due to the intermittent nature of renewables

Before the introduction of GOs, Germany supported renewable energy producers through subsidies under the **Renewable Energy Sources Act (EEG) in 2001**, which excluded subsidized installations from GO issuance. Key subsidy mechanisms include:

Feed-in Tariffs (FiTs): Guaranteed prices set by the government for small-scale renewable energy producers selling electricity to the grid.

Market Premium Scheme: Large-scale renewable producers receive a premium payment when selling electricity at market prices below a government-set reference price.

Auction Participation: Renewable energy producers compete in auctions to determine the market premium per kWh of electricity produced.

To increase GO adoption and reduce reliance on subsidies, Germany is shifting from financial support per unit of renewable energy toward **sector-wide market-based initiatives** that encourage GO issuance and integration. These include:

Mandated Open Market Sales: New wind and solar power plants must sell electricity at market prices in the wholesale electricity market.

Infrastructure Enhancements: Government investments in energy storage infrastructure help renewable energy producers balance supply and demand fluctuations.

One-Off Investment Cost Subsidies: State-backed guarantees of approximately €16 billion to support wind energy development, addressing sector-wide challenges.

By expanding GO adoption, Germany is fostering a **market-driven approach to renewable energy development**, further integrating GOs into its sustainability strategy while ensuring a stable and competitive energy market.

7.6 Lesson Learned and Applicability to the Philippines

Germany's GO governance benefits from strong regulatory oversight, international alignment, and growing sustainability commitments. Its GO registry is managed by the government, ensuring transparency and compliance with EU directives, while international integration through the AIB facilitates cross-border trade. Consumer and corporate demand further drive market growth.

For the Philippines, building in-house REC registry capabilities, collaborating with regional partners like Singapore and Australia, and enhancing public sustainability awareness will foster a robust REC market and ecosystem.

Aspect	Key Success Factors	Solutions and Best Practices	Implications for the PH
Operational Framework - Regulation	Germany's GO registry is managed within the government, ensuring clear oversight and robust governance alongside alignment with broader EU directives	Collaboration between key independent government agencies	Build up capabilities to operate REC registry within the government
Operational Framework – International Integration	Germany is a member of the AIB and aligns domestic policies with broader EU directives and standards	Build on international (EU) activities to accelerate GO adoption and enable cross-border trade	Collaborate with neighbouring countries, such as Singapore and Australia
Demand Drivers	Germany's GO demand is driven by growing consumer and corporate commitments to sustainability	Promote national sustainability priorities	Evaluate level of sustainability awareness among Philippines citizens and implement initiatives to boost eco-conscious consumption

Table 35 | Key Success Factors in Germany's GO Market

Germany's renewable energy market faces challenges such as the double marketing ban, which restricts GO issuance, and limited market transparency due to over-the-counter trading.

To prevent similar issues, the Philippines can design RE support schemes that avoid conflicts with REC eligibility, such as minimizing overlapping subsidies. Additionally, implementing mandatory

REC trade reporting, adopting centralized trading platforms, and leveraging emerging technologies like blockchain can enhance market transparency, traceability, and trust.

Aspect	Challenges	Key Takeaways
Double Marketing Ban	Most of Germany's renewable energy is ineligible for GO issuance due to double marketing ban	Avoid subsidies and mechanisms for renewable energy producers that may lead to repeated claims of environmental benefits, such as feed-in tariffs and carbon credits, to maintain REC eligibility
Lack of Market Transparency	GO trades occur over the counter or through power purchase agreements, leading to limited public transparency in trading prices and volumes	• Implement measures such as mandatory GO trade reporting and the adoption of centralized trading platforms • Emerging technologies like blockchain could further improve traceability and trust in the market

Table 36 | Key Challenges in Germany's GO Market

8. Appendix I: Rationale for Selecting Jurisdiction

8.1 Global REC Market

8.1.1 Market Dynamics

The global REC market is a key driver of renewable energy development and economic growth, valued at USD 12.72 billion in 2023. It is projected to reach USD 136.35 billion by 2033, with a 26.7% CAGR from 2023 to 2033. The market's primary growth drivers include major carbon-neutral commitments from RE100 companies and sustainability efforts in high-emission industries such as oil & gas and technology.

RE100 is a global corporate renewable energy initiative uniting large businesses committed to 100% renewable energy. Established in 2014 during Climate Week NYC, it is led by The Climate Group in partnership with the Carbon Disclosure Project (CDP)—both international nonprofit organizations. Now in operation for over a decade since 2014, RE100 has grown to 400+ members worldwide, reinforcing corporate commitments to renewable energy adoption.

8.1.2 Market Trends

Global REC prices are rising as renewable energy adoption grows, outpacing supply due to surging demand and renewable project development challenges. REC pricing is primarily driven by supply and demand dynamics. As jurisdictions implement stricter renewable energy targets and compliance measures, demand and prices are expected to rise. Additionally, corporations are setting more ambitious renewable energy goals, further driving voluntary market demand, and influencing REC pricing.

8.1.3 Market Presence

Some jurisdictions have had an established REC market for decades. The most mature and well-developed REC markets are found in North America, Europe, and parts of the Asia-Pacific region. Standout jurisdictions with highly mature REC markets include the United States, Germany, and Australia, each with over 10–20 years of market development.

8.2 Criteria for Jurisdiction Selection

The global REC market offers numerous examples of mature markets, providing valuable lessons for the Philippines. To guide its development, a curated list of mature and relevant REC markets has been compiled for analysis. An objective was established to shortlist five of the most mature and applicable markets across different regions for in-depth analysis. To determine the selected jurisdictions, a high-level assessment was conducted using five key criteria. Table 37 outlines these criteria and their respective assessment areas.

Criteria	Assessment
Market Maturity and Comprehensiveness	Assess if the country has a well-developed REC market or if it is in an emerging stage, offering applicable insights for both immediate implementation and future growth.
Tracking System & Technology	Review the sophistication of the tracking systems, blockchain, digital platforms, certifications, to help ensure transparency and reliability for the REC market
Voluntary Corporate Participants	Measure the level of corporate involvement and demand for RECs, as strong corporate interest drives the voluntary REC market.
Regulatory Framework	Evaluate the existence of a voluntary market, mandatory market, or both, to which preferably a mixed approach or voluntary market.
Regional Relevance	Assess the market's similarity in terms of geography, economic structure, and renewable energy goals, especially for relevant insights transferrable to the Philippines.

Table 37 | List of Criteria and its Rationale

8.3 Jurisdiction Analysis and Findings

An initial assessment was done Table 38 will show the list of potential countries corresponding to the region.

Region	Country	
North America	Canada	
	United States of America	
Europe	Germany	
	The Netherlands	

Region	Country	
Asia Pacific (excluding Southeast Asia)	Australia	
	Japan	
	Republic of Korea	
Southeast Asia	Indonesia	
	Malaysia	
	Singapore	
	Thailand	
	Viet Nam	

Table 38 | Potential Jurisdictions for Analysis Listed by Region

8.3.1 Canada

Canada's REC market is moderately mature but fragmented, primarily driven by corporate demand due to the absence of a nationwide Renewable Portfolio Standard (RPS).

- **Maturity and comprehensiveness** – The market is moderately mature, with provinces developing their own RPS requirements or relying on the voluntary corporate market to shape the landscape. Some provinces, like Nova Scotia and Alberta, have established their own RPS frameworks.
- **Tracking system and technology** – Canada utilizes regional REC tracking systems, such as the Western Regional Energy Generation Information System (WREGIS), which is compatible with U.S. states like California.
- **Voluntary corporate participants** – Corporate demand is strong, driven by companies seeking to enhance environmental impact and achieve net-zero goals. Key participants include major Canadian and multinational corporations, such as the Royal Bank of Canada and Toronto-Dominion Bank (TD Bank).

- **Regulatory framework** – Canada's regulatory structure mirrors that of the United States, where provinces develop their own RPS requirements. Provinces such as Alberta and Nova Scotia have established mandatory REC markets, but there is no federal-level RPS or national REC market. Across all provinces, the voluntary REC market is primarily driven by corporate demand.
- **Regional relevance** – While Canada differs from the Philippines in climate, economic drivers, and political landscape, a provincial-level analysis may offer valuable insights into RPS management and corporate engagement.

8.3.2 United States of America

The United States has an advanced REC market in certain states, with state-level governments dictating REC policies and jurisdiction, like Canada. Many states with RPS requirements have been operating for over 20 years.

- **Maturity and comprehensiveness** – The maturity of the U.S. REC market varies by state, but the U.S. overall is one of the world's leading renewable energy producers, supported by a proactive voluntary market.
- **Tracking system and technology** – The U.S. uses regional REC tracking systems, such as WREGIS and the PJM Generation Attribute Tracking System (PJM-GATS), which operate across multiple states. The use of blockchain technology depends on the system—WREGIS does not use blockchain, while PJM-GATS has a pilot program in testing.
- **Voluntary corporate participants** – The U.S. has high corporate demand for RECs and hosts the most RE100 company headquarters globally. The voluntary market is largely driven by progressive state cultures and broad acceptance of renewable energy technologies.
- **Regulatory framework** – The U.S. regulatory structure is state-driven. While the federal government can support state-level RPS programs through initiatives and incentives, it cannot mandate RPS requirements or override state-level policies.
- **Regional relevance** – The U.S. has moderate regional relevance to the Philippines in terms of climate, economic drivers, and political landscape. Relevance varies by state, with some states offering greater insights into RPS management and corporate engagement, even if regional similarities are less pronounced.

8.3.3 Germany

Germany is considered to have the most advanced REC market in Europe, with over 20 years of development. Strong decarbonization commitments across Europe continue to drive REC demand.

- **Maturity and comprehensiveness** – Germany's REC market is highly mature and advanced, using Guarantees of Origin (GOs) under a strict regulatory framework governed by the Renewable Energy Sources Act (EEG).
- **Tracking system and technology** – Germany's GO system enables reliable tracking across Europe, supporting both national and cross-border transactions. Additionally, blockchain-based enhancements are being explored to improve digital tracking and security.
- **Voluntary corporate participants** – Strong corporate demand for renewable energy and RECs is driven by commitments to decarbonization, particularly from leading automotive manufacturers such as BMW, Mercedes, Volkswagen, and Volvo.
- **Regulatory framework** – Germany's GO market is primarily voluntary, with companies and consumers purchasing GOs as a commitment to sustainability rather than due to mandatory requirements.
- **Regional relevance** – While Germany shares few regional similarities with the Philippines, it offers valuable insights as a mature energy market, particularly in market structure, government-led initiatives, and corporate engagement.

8.3.4 The Netherlands

The Netherlands is another highly mature European REC market, closely resembling Germany in its regulatory framework and market development.

- **Maturity and comprehensiveness** – The Netherlands has a well-established REC market with a robust support system for renewable energy sources. Strong corporate demand, backed by EU sustainability initiatives, further strengthens the market.
- **Tracking system and technology** – The Netherlands also uses the Guarantee of Origin (GO) system for reliable REC tracking, both domestically and across Europe. Additionally, blockchain technology is being developed for GO integration.
- **Voluntary corporate participants** – The Netherlands sees high corporate demand for bundled RECs through Power Purchase Agreements (PPAs), driven by corporate sustainability commitments and renewable energy procurement strategies.
- **Regulatory framework** – The Dutch government has set a nationwide renewable energy target, supported by policies and financial incentives. However, there is no mandate for entities to produce, sell, or retire RECs, making the Dutch REC market entirely voluntary.

- **Regional relevance** – Like Germany, the Netherlands shares few regional similarities with the Philippines. However, it offers valuable insights into GO system integration, market structure, government-led initiatives, and corporate engagement.

8.3.5 Australia

Australia is a highly mature and comprehensive REC market in the Asia-Pacific region, with one of the world's most structured regulatory frameworks supporting its renewable energy target.

- **Maturity and comprehensiveness** – Australia established its early Renewable Energy Target (RET) in 2001, which later evolved into two distinct schemes, the Large-scale Renewable Energy Target (LRET) and the Small-scale Renewable Energy Scheme (SRES). These schemes created two types of RECs: Large-scale Generation Certificates (LGCs) and Small-scale Technology Certificates (STCs).
- **Tracking system and technology** – Australia operates its own REC trading platform, the REC Registry, which facilitates trade and manages end-to-end transactions, including creation, trading, and retirement of LGCs and STCs. This centralized system streamlines compliance but currently lacks advanced technologies like blockchain, with no indications of future integration.
- **Voluntary corporate participants** – Australia observes strong corporate participation from RE100 companies operating within Australia, as well as strong local players such as Woolworths and BHP. Similarly to other westernized countries, Australia's voluntary market participation is driven by its progressive culture and commitments to decarbonization.
- **Regulatory framework** – Australia has strong corporate participation, with RE100 companies operating in the country and local players such as Woolworths and BHP. Like other Western economies, voluntary REC participation is driven by progressive cultural attitudes and corporate decarbonization commitments.
- **Regional relevance** – Australia shares moderate regional similarities with the Philippines, particularly in its solar-dominant renewable energy mix and climate conditions. It provides valuable insights, especially in regulatory frameworks and REC tracking systems.

8.3.6 Japan

Japan has a moderately mature and evolving REC market, offering insights into system design, corporate participation, and sustainability goals.

- **Maturity and comprehensiveness** – Japan's REC market is moderately mature, primarily driven by corporate demand and experiencing substantial growth in alignment with carbon reduction targets and renewable energy goals.
- **Tracking system and technology** – Japan employs a centralized digital tracking system, using: the J-Credit Scheme administered by the Ministry of Economy, Trade, and Industry (METI) and Non-Fossil Fuel Certificates (NFCs) along with Green Power Certification.

- **Voluntary corporate participants** – Japan has high corporate participation, led by RE100 members such as Sony, Toyota, and Panasonic. Public awareness and engagement from municipalities and public institutions further boost REC demand.
- **Regulatory framework** – Japan does not have a mandatory REC market. Corporate initiatives play a key role in driving renewable energy adoption, supported by government incentives, the Feed-in Tariff (FIT) scheme, and the NFC system.
- **Regional relevance** – Japan shares moderate regional similarities with the Philippines. While their regulatory, economic, and climate structures differ, Japan provides valuable lessons on fostering a strong voluntary corporate REC market.

8.3.7 Republic of Korea

Republic of Korea is a mature and comprehensive REC market, despite being newer than other jurisdictions, with 12 years of establishment. It introduced a mandatory market in 2012, complemented by a growing voluntary market led by corporate participation.

- **Maturity and comprehensiveness** – Established in 2012, Republic of Korea's REC market operates under a nationwide mandate for electricity and power producers. It is characterized by its scale, diversity, regulatory framework, corporate demand, and commitment to high certification standards.
- **Tracking system and technology** – REC issuance and tracking are managed by the Korea Power Exchange (KPX) in compliance with the country's RPS requirement, supporting renewable energy targets.
- **Voluntary corporate participants** – Corporate participation in the voluntary market is expanding as large Korean corporations work toward carbon neutrality and renewable energy goals. In addition to major companies like Hyundai, many others purchase RECs to offset emissions and meet sustainability targets.
- **Regulatory framework** – Republic of Korea's mandatory market was established in 2012 with the RPS requirement, initially mandating power producers with over 500MW capacity to generate a portion of electricity from renewable sources. The voluntary market is primarily corporate-led, driven by international sustainability standards and carbon-neutral commitments.
- **Regional relevance** – While Republic of Korea differs from the Philippines in regulatory structure, market scale, economic drivers, and climate, it offers valuable insights in flexibility, tracking systems, corporate engagement, and rapid REC market development.

8.3.8 Indonesia

Indonesia is an emerging REC market, primarily relying on international frameworks and government-driven demand. While renewable energy and REC adoption are expected to grow, the market requires further development before achieving substantial progress.

- **Maturity and comprehensiveness** – Established 7 years ago, Indonesia's REC market remains relatively immature, with developments in solar, wind, biomass, hydropower, and geothermal energy.
- **Tracking system and technology** – Indonesia depends on international frameworks such as I-REC, which provides a globally recognized structure for REC issuance and tracking. Discussions are underway for a domestic REC system to align with national policies and local market conditions, but no official plans for development or release have been announced.
- **Voluntary corporate participants** – Demand is growing, led by State-Owned Enterprises (SOEs) and multinational corporations operating in Indonesia. Many entities focus on sustainable practices such as waste management and energy efficiency as cost-effective sustainability strategies.
- **Regulatory framework** – Indonesia has no mandatory REC requirements, but the government has announced renewable energy and carbon abatement goals, encouraging SOEs to drive sustainability efforts. Leading contributors include PT Pertamina and PT PLN, which play key roles in the local renewable energy market.
- **Regional relevance** – Indonesia has high regional relevance to the Philippines, as both are emerging Southeast Asian markets with similar economic profiles and renewable energy ambitions. Indonesia's experience with I-REC and corporate-led REC demand offers directly applicable insights for the Philippines.

8.3.9 Malaysia

Malaysia is a developing REC market, established around 6 years ago, with a growing corporate participation and reliance on I-REC, like Indonesia.

- **Maturity and comprehensiveness** – Malaysia's REC market is structured and developing, primarily consisting of voluntary participation with steady growth. It is largely driven by the adoption of I-REC and the Green Electricity Tariff (GET) program, supported by Tenaga Nasional Berhad Exchange (TNBX). In 2024, Malaysia launched the Malaysia Green Attribute Tracking System (mGATS) and the Bursa Carbon Exchange platform, both integrated with I-REC.
- **Tracking system and technology** – Malaysia utilizes the I-REC framework, ensuring international REC standards. TNBX facilitates I-REC activities, while the GET program enhances tracking by bundling RECs with renewable electricity purchases.
- **Voluntary corporate participants** – Demand is rising among multinational corporations, including Nestlé, Petronas, and TNB, which purchase I-REC credits to align with RE100 and carbon neutrality goals. The GET program has also made RECs more accessible to both corporate and public buyers.

- **Regulatory framework** – Malaysia operates a voluntary REC market, entirely corporate-driven, with no RPS requirements mandating entities to produce, purchase, sell, or retire RECs. The market is supported by government initiatives under the Renewable Energy Transition Roadmap (RETR), which outlines renewable energy growth targets for 2025 and 2035.
- **Regional relevance** – Malaysia has high regional relevance to the Philippines, given its similar market structure, economic profile, and renewable energy landscape. Malaysia also provides a directly applicable model for the Philippines through its renewable energy goals, corporate REC demand, and voluntary REC structures utilizing I-REC.

8.3.10 Singapore

Singapore is a moderately mature and growing REC market, established about 8 years ago. Due to limited land availability, Singapore has high demand for renewable energy and REC imports.

- **Maturity and comprehensiveness** – Singapore is a leading voluntary REC market in Asia, driven by advanced technology and strong corporate demand. The government is also highly ambitious in achieving renewable energy and carbon abatement goals.
- **Tracking system and technology** – Singapore utilizes SP Group's REC platform, which leverages blockchain technology to provide a secure and transparent REC transaction and tracking system.
- **Voluntary corporate participants** – There is strong corporate demand from multinational corporations and major local firms with sustainability commitments and RE100 participation, including Google, DBS Bank, and Singtel.
- **Regulatory framework** – Singapore operates an entirely voluntary REC market, driven by corporate interests without an RPS requirement. However, the government supports the market through incentives and initiatives, setting national sustainability goals and frameworks.
- **Regional relevance** – Singapore shares moderate regional similarities with the Philippines in terms of climate and environmental conditions. However, due to its limited land capacity, Singapore will increasingly rely on renewable energy and REC imports. While its economic and digital infrastructure is more advanced than other Southeast Asian nations, Singapore's renewable energy demand presents opportunities for the Philippines as a potential REC export market.

8.3.11 Thailand

Thailand is an emerging REC market, established around 8 years ago. While it has developed its own REC trading platform, it still utilizes I-REC certification. The market is driven by industrial and corporate participation.

- **Maturity and comprehensiveness** Thailand's renewable energy market is still developing, with minor advancements in solar, wind, biomass, hydropower, and geothermal energy generation.

- **Tracking system and technology** – PTT Public Company Limited launched Thailand's first one-stop REC trading platform, integrating I-REC certification. The platform also leverages blockchain technology to facilitate secure REC tracking and trading for local and multinational corporations.
- **Voluntary corporate participants** – Thailand's voluntary market includes a wide range of industrial and corporate participants. PTT plays a key role in the country's renewable energy development, while multinational corporations, such as Toyota, contribute significantly due to large manufacturing operations in Thailand.
- **Regulatory framework** – Thailand operates an entirely voluntary REC market, driven by corporate sustainability commitments and contributions to national energy goals. The government has set ambitious targets, aiming for 30% renewable energy in the national energy mix by 2030.
- **Regional relevance** – Thailand shares strong regional similarities with the Philippines and other Southeast Asian markets. It provides valuable insights into developing a local REC tracking system, integrating I-REC certification, and fostering a renewable energy market within a highly industrial economy.

8.3.12 Viet Nam

Viet Nam is an emerging REC market, established 6 years ago, relying on international certifications such as I-REC and TIGR. Corporate initiatives and RE100 operations primarily drive demand.

- **Maturity and comprehensiveness** – Viet Nam's renewable energy market is still developing, but growing rapidly, particularly in solar and wind energy expansion. The country demonstrates strong market scalability with continued renewable infrastructure growth.
- **Tracking system and technology** – Viet Nam utilizes I-REC and TIGR tracking systems, enabling seamless cross-border transfers through globally recognized certification platforms. Additionally, the Vietnamese government is developing its own REC trading and tracking system to support future market growth.
- **Voluntary corporate participants** – Demand is increasing, particularly among multinational corporations with sustainability targets and operations in Vietnam. Key participants include Nike and Samsung, which rely on Vietnam for manufacturing operations.
- **Regulatory framework** – Viet Nam operates an entirely voluntary REC market, with no government mandates for REC production, trading, or retirement. Despite this, the government has set ambitious targets, aiming for 27% renewable energy in the national energy mix by 2030.
- **Regional relevance** – Viet Nam shares high regional relevance with the Philippines, as both are emerging Southeast Asian markets with similar economic profiles and renewable energy

ambitions. Vietnam provides a directly applicable model, leveraging I-REC and TIGR frameworks, corporate-driven demand, and rapid renewable energy growth.

8.3.13 Summary and Final Jurisdiction Selection

A high-level analysis was conducted for each potential country, with individual assessments placed side by side to provide a holistic comparison. This approach helped identify the five jurisdictions selected for the Review of International Experience on RE Certificate Markets Analysis. Figure 67 represents a side-by-side comparison of each country based on the five key criteria, offering a high-level overview. This comparison allows for a closer evaluation of each country's compatibility with the Philippines for further analysis.

Region	Country	Market Maturity and Comprehensiveness Factors			Market Relevancy Factors	
		Maturity	Tracking System & Technology	Voluntary Corporate Participant	Regional Relevance	Regulatory Framework
North America		High	High	High	Low	Both
		High	Moderate	High	Low	Primarily Voluntary
Europe		High	High	High	Low	Primarily Voluntary
		High	High	Moderate	Low	Primarily Voluntary
Asia Pacific		High	High	High	Low	Both
		Moderate	Moderate	High	Moderate	Primarily Voluntary
		Moderate	Moderate	High	Moderate	Both
Southeast Asia		Moderate	High	High	Moderate	Primarily Voluntary
		Low	Low	Moderate	High	Primarily Voluntary
		Low	Low	Moderate	High	Primarily Voluntary
		Low	Low	Moderate	High	Primarily Voluntary
		Low	Low	Moderate	High	Primarily Voluntary

Figure 67 | High Level Analysis of Every Potential Country

In the side-by-side comparison, countries were sorted by relative market maturity. However, in selecting the top five jurisdictions, all criteria were considered, with maturity and regional relevance carrying the most weight. The objective was to choose markets with high maturity, regional relevance, strong tracking systems, and active voluntary corporate participation. Additionally, at

least one jurisdiction from each global region was selected. Based on these criteria, the following five jurisdictions were chosen for further analysis:

- The United States of America
- Germany
- Australia
- Singapore
- Viet Nam

Justification for the United States – The U.S. has a highly mature REC market with strong voluntary corporate participation and a robust regulatory framework encompassing both mandatory and voluntary markets. While national regional relevance is low, selecting a specific state for analysis can provide greater alignment with the Philippines.

Justification for Germany – Germany has an advanced REC market, with advanced tracking systems and strong corporate participation. While its regional relevance is lower, its well-structured market offers valuable insights for the Philippines' market development.

Justification for Australia – Australia demonstrates market maturity, a comprehensive tracking system, and strong corporate participation. Although regional similarities are limited, its strong regulatory framework and consistent market growth make it a valuable case study.

Justification for Singapore – Singapore's REC market is moderately mature, relying on international supply. However, it has an advanced tracking system and strong voluntary corporate participation. Singapore's selection is strategic, as further analysis may provide insights into its potential as a customer for Philippine REC exports.

Justification for Viet Nam – While Viet Nam's REC market is less mature, it is experiencing rapid development in both REC adoption and renewable energy expansion. Given its high regional relevance and similarities to the Philippines, Viet Nam's development approach offers applicable insights.

The selection of U.S.A, Germany, Australia, Singapore, and Viet Nam provides a diverse mix of highly mature and emerging markets, offering insights from jurisdictions with varying levels of maturity, corporate engagement, and regional relevance.

8.4 USA State Selection Methodology

The U.S. is one of the world's leading renewable energy producers, but its fifty states have vastly different renewable energy landscapes. To narrow the focus to a single state for analysis, a three-step filter methodology was developed.

Filter 1: States with a Renewable Portfolio Standard (RPS) requirement were retained for consideration, eliminating twenty-two states that lack an RPS policy. The presence of an RPS requirement allows for the evaluation of both mandatory and voluntary REC markets, offering valuable insights for the Philippines in developing its own mandatory REC framework. Table 39 lists the twenty-eight states that have a state-level RPS requirement.

States With RPS Requirement			
California	Colorado	Connecticut	Delaware
Hawaii	Illinois	Maine	Maryland
Massachusetts	Michigan	Minnesota	Missouri
Montana	Nevada	New Hampshire	New Jersey
New Mexico	New York	North Carolina	Ohio
Oregon	Pennsylvania	Rhode Island	Texas
Vermont	Virginia	Washington	Wisconsin

Table 39 | States with an RPS Requirement

Filter 2: The 28 RPS states were assessed based on their renewable energy targets and market scale, selecting states with a goal of 50% or greater renewable electricity generation by 2030. This criterion serves as a proxy for market maturity, ensuring insights are drawn from the most advanced renewable energy markets in the United States. Table 40 presents a selection of states with higher renewable energy targets and greater market maturity.

State	Renewable Energy Goal
California	60% Renewable electricity by 2030
Hawaii	100% renewable electricity by 2045
Maine	80% Renewable electricity by 2050
Maryland	50% renewable electricity by 2030
Nevada	50% renewable electricity by 2030
New Jersey	50% renewable electricity by 2030
New Mexico	50% renewable electricity by 2030
New York	70% renewable electricity by 2030
Vermont	75% renewable electricity by 2032
Virginia	100% clean energy by 2045
Washington	100% clean electricity by 2045

Table 40 | States with a Renewable Electricity Generation Goal of 50% or Greater by 2030

Source: State RPS Requirements/Documents

Filter 3: The remaining 11 states were assessed based on their dominant renewable energy technology, selecting those that closely align with the Philippines' renewable energy portfolio. By focusing on states with similar energy compositions, the analysis can extract market development strategies and policy insights that are directly applicable to the Philippines' REC market. Table 41 presents the final selection of six states that demonstrate market ambition, maturity, and portfolio alignment with the Philippines.

State	Renewable Energy Goal	Technology
California	60% Renewable electricity by 2030	Solar
Hawaii	100% renewable electricity by 2045	Solar
Maryland	50% renewable electricity by 2030	Solar
Nevada	50% renewable electricity by 2030	Solar
New Jersey	50% renewable electricity by 2030	Solar
New Mexico	50% renewable electricity by 2030	Solar

Table 41 | Shortlisted States with Their Most Prominent Renewable Energy Technology

Source: State RPS Requirements/Documents

Using the three-step filter process, the 50 U.S. states were narrowed down to six comparable states for further analysis. A high-level evaluation was then conducted on these states to select the final state for in-depth study.

8.5 USA State Analysis and Findings

Using the three-step filtering process, six states have been identified for potential study. The need for an initial analysis was identified for each of the short-listed states to determine which single U.S. state should be used in the jurisdiction analysis. A high-level analysis of each state has been conducted to finalize the selected state.

The six states selected for analysis are:

- California
- Hawaii
- Maryland

- Nevada
- New Jersey
- New Mexico

To determine the final state for analysis, the same five criteria as the jurisdiction selection process were used to analyze each state and determine the final state for jurisdiction analysis.

The criteria for analysis:

- Market maturity and comprehensiveness
- Tracking system and technology
- Voluntary corporate participation
- Regulatory framework
- Regional relevance

8.5.1 California

California is a highly mature REC market and a pioneer in the U.S. renewable energy landscape, driven by state legislation, strong corporate participation, and a progressive culture.

- **Maturity and comprehensiveness** – Established in 2002, California's REC market has been in operation for over 20 years. It is a leader in the U.S. renewable energy market, recognized for its size, diversity, regulatory framework, corporate demand, and commitment to high standards.
- **Tracking system and technology** – California utilizes the Western Regional Energy Generation Information System (WREGIS), an independent tracking entity and platform that monitors, verifies, and tracks REC transactions, ensuring uniqueness and traceability. WREGIS does not incorporate blockchain or other advanced technologies.
- **Voluntary corporate participants** – California has high corporate demand from RE100 companies and big tech firms such as Google, Microsoft, Meta, and Equinix, all of which are headquartered in the state. Given the carbon-intensive nature of tech operations, these companies pursue decarbonization and sustainability goals, often voluntarily purchasing RECs to meet carbon neutrality and environmental targets.
- **Regulatory framework** – California has a mandatory REC market, established through its Renewable Portfolio Standard (RPS) in 2002, targeting 60% renewable electricity generation by 2030. It also has a strong voluntary market, primarily driven by RE100 commitments and corporate sustainability initiatives.

- **Regional relevance** – California shares high regional similarities with the Philippines, particularly in climate and renewable energy portfolio composition.

8.5.2 Hawaii

Hawaii is a mature renewable energy market, offering insights into an REC market shaped by the hospitality and tourism industries—a key regional parallel to the Philippines' economic landscape.

- **Maturity and comprehensiveness** – Hawaii is another highly mature and comprehensive REC market, operating for over 20 years of operations since its RPS establishment in 2001. In 2015, Hawaii became the first U.S. state to set a 100% renewable electricity goal by 2045.
- **Tracking system and technology** – Hawaii also relies on WREGIS to monitor and verify REC transactions, as it lacks an independent REC trading platform. Like California, Hawaii uses WREGIS solely as a tracking tool for REC trading and compliance. The platform does not integrate blockchain technology, and there are no announced plans for future implementation.
- **Voluntary corporate participants** – While Hawaii has low participation from RE100 company headquarters, its REC market is driven by the hospitality and tourism industry—the state's primary economic sector. Tourism's environmental impact (land use, pollution, and emissions) has led to a push for sustainability practices, including renewable energy adoption to address concerns about overtourism.
- **Regulatory framework** – Hawaii has a mandatory REC market through its RPS requirement established in 2001 and a voluntary market driven largely by the hospitality and tourism sector. According to the Hawaiian government, tourism accounted for 17% of the state's GDP in 2017 when considering direct and indirect impacts, rising to 23% when including all economic effects.
- **Regional relevance** – As a multi-island state with a tropical climate, Hawaii shares high regional similarities with the Philippines. It also has a comparable renewable energy portfolio and similar economic drivers, making it a valuable case study.

8.5.3 Maryland

Maryland is another state actively advancing its renewable energy sector, with solar energy as its primary contributor, followed by hydropower. The state is home to major industries, including life sciences, biotechnology, aerospace, and defense, and hosts key federal agencies such as the National Security Agency (NSA) and U.S. Cyber Command.

- **Maturity and comprehensiveness** – Maryland established its RPS in 2004, later updated in 2019 to require 50% renewable electricity generation by 2030. As of now, renewable energy accounts for 13% of in-state electricity generation.
- **Tracking system and technology** - Maryland utilizes the PJM Generation Attribute Tracking System (PJM-GATS) to monitor and verify REC transactions. The state is also testing blockchain technology for real-time tracking and verification.

- **Voluntary corporate participants** – Maryland's voluntary REC market is primarily driven by its life sciences, biotechnology, and research institutions, including the National Institutes of Health (NIH) and Johns Hopkins University. The state also has a strong aerospace, defense, and cybersecurity sector, given its proximity to Washington, D.C..
- **Regulatory framework** – Maryland operates a mandatory REC market under its RPS requirement (established in 2004). Its voluntary market is supported by industries linked to federal agencies, particularly in research and development.
- **Regional relevance** – Maryland has low regional relevance to the Philippines, as its seasonal climate (including winter) introduces unique market conditions that differ from those in the Philippines' tropical environment.

8.5.4 Nevada

Like California, Nevada has a growing tech sector, particularly in data center development, cybersecurity, and technology manufacturing. Additionally, tourism, mining, aerospace, defense, and agriculture play key roles in its economy. Given the high emissions from technology and agriculture, there is a strong need for renewable energy adoption.

- **Maturity and comprehensiveness** – Nevada established its Renewable Portfolio Standard (RPS) in 1997, later updated in 2019 to target 50% renewable electricity generation by 2030. It is considered one of the oldest and most mature renewable energy markets in the United States.
- **Tracking system and technology** – Nevada primarily uses WREGIS but has also developed its own tracking system, Nevada Tracks Renewable Energy Credits (NVTREC). NVTREC tracks RPS obligations and progress, functioning similarly to WREGIS. Unlike WREGIS, RECs listed in NVTREC cannot be traded outside Nevada, ensuring all RECs (Portfolio Energy Credits - PECs) remain within the state. Blockchain technology has been explored for NVTREC but has not been implemented.
- **Voluntary corporate participants** – Nevada has strong corporate demand for RECs, particularly from high-energy industries such as data centers, aerospace, defense, and agriculture. Similar to California, Nevada's data center growth increases demand for clean energy solutions.
- **Regulatory framework** – Nevada has a mandatory REC market, established through its RPS in 1997, while its voluntary market is driven by corporate demand in high-emission sectors.
- **Regional relevance** – Nevada has high regional relevance to the Philippines due to its solar-dominant renewable energy mix. However, its desert climate differs significantly from the Philippines' tropical environment.

8.5.5 New Jersey

New Jersey is a mature renewable energy market, driven by a progressive culture and strong corporate demand from the pharmaceutical, healthcare, and financial services sectors. It has the second-oldest RPS requirement in the U.S.

- **Maturity and comprehensiveness** – New Jersey implemented its RPS in 1991, making it the second-oldest in the U.S. (after Iowa in 1983). In 2018, the state updated its RPS target to require 50% renewable energy by 2030.
- **Tracking system and technology** – New Jersey utilizes the PJM Generation Attribute Tracking System (PJM-GATS) for REC monitoring and verification. Blockchain technology is currently under testing for real-time REC tracking, but no timeline for full integration has been announced.
- **Voluntary corporate participation** – New Jersey's voluntary REC market is corporate-driven, particularly by pharmaceutical companies (e.g., Johnson & Johnson), healthcare institutions, and financial services firms.
- **Regulatory framework** – New Jersey operates the second-oldest mandatory REC market in the U.S., with its RPS established in 1991. Its voluntary market runs in parallel, driven by corporate sustainability initiatives.
- **Regional relevance** – Like Maryland and other East Coast states, New Jersey has low regional relevance to the Philippines due to its seasonal climate. However, the Philippines could gain insights from New Jersey's approach to renewable energy integration in the healthcare sector.

8.5.6 New Mexico

New Mexico has a mature renewable energy market, with its REC market operating for over 20 years since the establishment of its RPS requirement in 2002. The state is rich in natural resources, particularly oil and gas, making mining and extraction operations a significant part of its economy.

- **Maturity and comprehensiveness** – New Mexico established its RPS in 2002 and updated its target in 2019, aiming for 85% renewable energy by 2045.
- **Tracking system and technology** – New Mexico utilizes WREGIS to track RECs and transactions, functioning similarly to California, where it is primarily used as a compliance tool. Unlike Nevada, New Mexico does not have its own internal REC tracking system.
- **Voluntary corporate participation** – New Mexico's corporate sector is emissions-intensive, driven by its large oil and gas operations. Companies such as Chevron, which operates extensively in the Permian Basin, face increasing pressure to accelerate sustainability efforts and meet carbon abatement targets.

- **Regulatory framework** – New Mexico operates a mandatory REC market, established through its RPS in 2002, while its voluntary market is corporate-driven, particularly by the oil and gas sector.
- **Regional relevance** – New Mexico shares moderate similarities with the Philippines in terms of climate and renewable energy portfolio composition.

8.5.7 USA State Selection

With the high-level overview of each shortlisted U.S. state complete, Figure 68 presents a summary of each state and its key criteria. Sorted alphabetically, each state is rated across multiple criteria, providing a side-by-side comparison to facilitate the final selection of a state for further analysis.

State	Market Maturity and Comprehensiveness Factors			Market Relevancy Factors	
	First Regulation Year	Tracking System & Technology	Voluntary Corporate Participant	Regional Relevance	Regulatory Framework
California	2002	High	High	High	Both
Hawaii	2001	High	Moderate	High	Both
Maryland	2004	High	Moderate	Low	Both
Nevada	1997	High	Moderate	Moderate	Both
New Jersey	1999	High	Moderate	Low	Both
New Mexico	2004	High	Moderate	Moderate	Both

Selected state for further analysis

Figure 68 | Comparison of High-Level Analysis on Six Short-Listed States

Among the six shortlisted states, California was selected for further study due to several key factors:

- **Market Maturity** – California has a well-established REC framework, with its RPS requirement in place since 2002.
- **Corporate Participation** – The state hosts a high concentration of RE100 companies and big tech firms, supporting a strong voluntary REC market alongside its mandatory market.
- **Renewable Energy Profile** – California shares climate similarities and a comparable renewable energy technology mix with the Philippines.
- **Industry Leadership** – California is recognized as a pioneer in the U.S. renewable energy transition, making it a valuable case study.

9. Appendix II: Project Methodology and Approach

To address the key deliverables of **Scope B: Review of International Experience on REC Markets**, activities, approach and tools required had been developed to fulfill each objective and provide comprehensive analysis.

9.1 Objective 1: Develop Rationale for Selecting Jurisdictions

9.1.1 Activities

To achieve Objective 1, the project undertook the following activities:

- Select Jurisdictions
  - Conducted a preliminary review of global REC markets to identify potential jurisdictions with well-functioning REC systems.
  - Assessed the maturity and comprehensiveness of each potential jurisdiction, focusing on their governance, market design, and integration
  - Developed clear criteria for selection, emphasizing mandatory and voluntary REC markets, regulatory frameworks, and their relevance to the Philippine energy transition.
  - Finalized a list of at least five jurisdictions, each accompanied by a rationale for selection based on predefined criteria.
  - Validated findings:
    - Ensured that the selection aligns with global best practices and expert recommendations.
    - Engaged in consultations with international energy market analysts, policy advisors, and academic researchers to validate the selected jurisdictions.

9.1.2 Approach and Tools

The research was conducted using the following approach and tools:

- Conducted desk research to identify potential markets and developed criteria to validate the selected jurisdictions
- Consulted with experts to confirm the relevance and translatability of the selection criteria and selected jurisdictions to the Philippines.

9.2 Objective 2: Analysis of Operational Frameworks of Selected Jurisdictions

9.2.1 Activities

To achieve Objective 2, the project undertook the following activities:

- Performed Analysis Operational Frameworks
  - Studied governance structures - Roles and responsibilities of regulatory bodies and market operators were studied within REC registries.
  - Examined certification processes - Examined how RECs are issued, tracked, and audited, ensuring accountability and compliance.
  - Investigated technological infrastructure - Investigated the use of digital platforms such as blockchain technology, in supporting registry operations and enhancing market efficiency.
  - Assessed regulatory oversight - Mechanisms that ensure market integrity and transparency, including policies for market monitoring and enforcement were assessed.

9.2.2 Approach and Tools

The research was conducted using the following approach and tools:

- Benchmarked operational frameworks through comparative analysis across jurisdictions.
- Evaluated technological infrastructure supporting REC registries, such as platforms and tools.
- Consulted with experts to validate findings from practitioners experienced in REC markets.

9.3 Objective 3: Examine REC Demand Drivers and Market Dynamics

9.3.1 Activities

To achieve Objective 3, the project undertook the following activities:

- Identified Drivers for REC Demand
  - Identified regulatory requirements that mandate REC purchases such as RPS and the Green Energy Option (GEOP).
  - Explored corporate sustainability commitments and consumer preferences driving voluntary REC demand.
  - Analyzed economic incentives, including tax credits and subsidies that promote REC adoption.

  - Investigated the role of public awareness and educational campaigns in shaping REC demand.
  - Highlighted opportunities for co-existence between voluntary and mandatory REC markets by analyzing potential supply-demand synergies.
- Analysis of Market Dynamics and Price Trends
  - Collected and analyzed historical pricing for RECs in selected jurisdictions.
  - Examined supply-demand balance, market liquidity, and trading volumes to assess market efficiency.
  - Identified factors influencing REC price trends, such as policy changes, technological advancement, and market sentiment.
  - Documented case studies of market fluctuations and responses to policy interventions to provide actionable insights.

9.3.2 Approach and Tools

The research was conducted using the following approach and tools:

- Gather data through desk research from global REC markets
- Study price trends, liquidity, and demand patterns through market analysis.
- Conduct stakeholder and expert interviews to validate market dynamics and gather perspectives from industry leader and policymakers such as the DOE and NREB.
- Leverage data from internal database and external sources to enhance the comprehensiveness of the analysis.

9.4 Objective 4: Study Claiming, Verification, and Surrendering of RECs

9.4.1 Activities

To achieve Objective 3, the project undertook the following activities:

- Mapped out Claiming and Verification Processes
  - Examined the application procedures and eligibility criteria for claiming RECs in selected jurisdictions.
  - Studied verification standards and methods used to ensure the validity and authenticity of RECs including third-party audits and digital registries.

  - Analyzed tracking mechanisms and document best practices to prevent double counting and ensure transparency

- Explored Integration of Voluntary RECs in Mandatory Markets
  - Investigated how voluntary RECs are surrendered and accounted for within mandatory REC markets.
  - Studied regulatory frameworks that govern the use of voluntary RECs for compliance purposes, identifying potential restrictions or opportunities.
  - Analyzed the market impact of integrating voluntary RECs for into mandatory systems, including potential benefits and challenges.
  - Documented examples of jurisdictions that have successfully integrated voluntary RECs and highlight key outcomes

9.4.2 Approach and Tools

The research was conducted using the following approach and tools:

- Analyzed procedures and standards
- Reviewed case studies to benchmark international best practices
- Consulted with stakeholders to validate findings and gather practical insights

9.5 Objective 5: Assess Impact on Increasing RE Capacities

9.5.1 Activities

To achieve Objective 5, the project undertook the following activities:

- Analyzed the Impact on RE Capacities
  - Collected data on RE capacity growth in selected jurisdictions before and after REC market implementation.
  - Analyzed investment trends in RE projects driven by REC market dynamics, including funding flows and investor behavior.
  - Studied the role of REC markets in facilitating financing mechanisms and the development of new RE projects.
  - Documented policy outcomes and case studies that demonstrate the tangible impact of REC markets on increasing RE capacities.

9.5.2 Approach and Tools

The research was conducted using the following approach and tools:

- Review case studies to benchmark the impact of REC markets on RE growth globally.
- Consult stakeholders to validate findings and incorporate practical insights from industry experts and policymakers.
- Leverage internal database and external data sources to ensure a comprehensive analysis

9.6 Objective 6: Derive Lessons Learned and Applicability to the Philippines

9.6.1 Activities

To achieve Objective 6, the project undertook the following activities:

- Studied lesson learnt and best practices of jurisdictions
  - Synthesized key success factors from operational frameworks, demand drivers, and market dynamics in selected jurisdictions.
  - Identified common challenges faced by these jurisdictions and analyze the strategies employed to address them.
  - Documented innovative solutions and best practices that can be applied to the Philippine context
  - Highlighted lessons particularly relevant to local market conditions, regulatory environments, and stakeholder needs.
- Assessed applicability to the Philippines
  - Assessed how synthesized lessons can be adapted for the Philippine VREM, considering local market nuances.
  - Developed specific policy recommendations to enhance the VREM using international insights.
  - Proposed implementation frameworks for integrating best practices into the Philippine context.
  - Documented potential challenges and mitigation strategies for applying international lessons to the Philippine market.

9.6.2 Approach and Tools

The research was conducted using the following approach and tools:

- Evaluated and benchmark REC systems through comparative analysis across selected jurisdictions.
- Developed policy recommendations to ensure actionable, localized insights.
- Conducted stakeholder consultations to validate findings and gather expert perspectives on their applicability to the Philippines.

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