

# GPSC

## Internal Carbon Pricing 2024



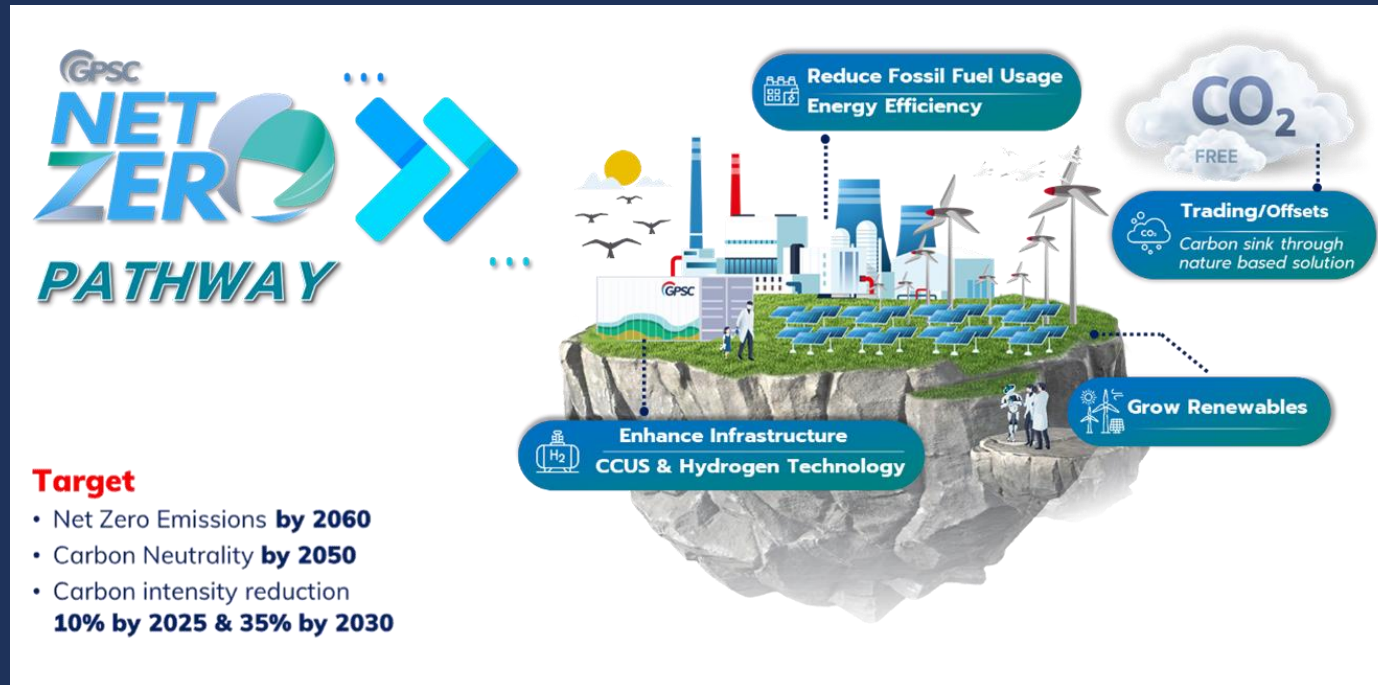
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# Introduction

In the global pursuit of a sustainable future, the transition to net-zero emissions has become a defining challenge and opportunity. GPSC has established strategies in response to climate change under the concept of “**Moving towards a Low-Carbon Electricity Business and Net Zero Greenhouse Gas Emissions**” through technology and innovation development and the use of **internal carbon pricing (ICP)** to manage risks and seek new market opportunities to handle the impacts of climate change for achieving **carbon neutrality by 2050 and net zero emissions by 2060**.



GPSC applies an **internal carbon price (ICP)** as a planning tool to help identify revenue opportunities, manage risks, and as an incentive to optimize energy efficiency, thereby reducing costs and guiding capital investment decisions.

For new investment decisions, GPSC applies ICP as one of the key factors for long-term business resiliency.

ICP will help ensure business decisions which account for climate-related risks and opportunities to drive low-carbon investment on a comparable basis.

# Introduction

Internal Carbon Pricing (ICP) is applied as a strategic tool to enhance long-term business resiliency and guide **investment and operational decisions (all business decision-making processes)** by integrating environmental costs into financial evaluations. A **shadow price of 15 USD/tCO<sub>2</sub>e, covering Scope 1 and Scope 2 emissions**, is applied across all new investment projects, including conventional and renewable projects.

- **Conventional Projects:** Gas-fired, coal-fired, and waste-to-energy (WTE) power plants that incur ICP expenses, discouraging high-emission investments.
- **Renewable Projects:** Solar, wind, biomass, biogas, hydro, and hybrid renewable systems (e.g., RE + energy storage) that receive ICP income, incentivizing low-carbon development.

This ICP framework has been established through **technical analyses** and aligns with IPCC methodologies while adhering to international standards such as the GHG Protocol and IEA guidelines. It is used to assess both financial and environmental performance, with the potential to shift project viability from negative to positive, thereby supporting low-carbon development and aligning with global carbon pricing trends.

The following sections will describe how GPSC implements ICP to achieve the following objectives.

1. Conduct cost-benefit analysis
2. Advancing Energy Efficiency and Low-Carbon Growth
  - Drive Energy Efficiency, Reduce upstream value chain emissions
  - Drive low-carbon investments, Identify and seize low-carbon opportunities
3. Incentivize consideration
  - Incentivize consideration of climate-related issues in decision making
  - Incentivize consideration of climate-related issues in risk assessment
4. Influence strategy and/or financial planning
5. Navigate regulations
6. Setting and/or achieving of climate-related policies and targets
7. Set a carbon offset budget
8. Stress test investments

# Conduct cost-benefit analysis



# Conduct cost-benefit analysis

GPSC conducts a cost-benefit analysis to evaluate how Internal Carbon Pricing (ICP) affects investment decisions by comparing project returns with and without ICP by considering the impact on Net Present Value (NPV) and Internal Rate of Return (IRR), which are the financial indicators typically used for assessing the economic viability and profitability of capital investment projects.

## Methodology:

- Apply a shadow price of **15 USD/tCO<sub>2</sub>e**.
- Calculate NPV and IRR before and after applying ICP.
- Use results to guide investment decisions.

## Example of ICP Implementation Projects

No.	Date	Name of Project	Type of Project	CAPEX (MTHB)	Potential GHG (MtCO <sub>2</sub> e)	Before applying shadow price		After applying shadow price		Final Investment Decision made
						NPV (MTHB)	IRR (%)	NPV (MTHB)	IRR (%)	
1	June	Confidential	Electricity Generation	Confidential	1.3	6,541	7.7	480	5.30	Fuel switching from coal to gas
2	End of Nov		Electricity Generation							Change configuration from 4 to 2 units

cost-benefit analysis

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# Advancing Energy Efficiency and Low-Carbon Growth

- Drive energy efficiency
- Drive low-carbon investments
- Identify and seize low-carbon opportunities
- Reduce upstream value chain emissions

# Advancing Energy Efficiency and Low-Carbon Growth

GPSC is committed to proactive climate change management by aligning management strategies with the company's corporate goals and mission as follows:

- 1) Implement sustainable resource utilization based on the eco-efficiency principle by enhancing the efficiency of electricity and steam production processes and adopting additional GHG emission reduction measures.
  - **To drive energy efficiency, reduce upstream value chain emissions**
- 2) Identify research and development opportunities in electricity and steam production with renewable energy that is safe and environmentally friendly.
  - **To drive low-carbon investments, and identify and seize low-carbon opportunities**
- 3) Raise awareness and encourage participation in GHG reduction by having environmentally friendly operations and building engagement of both internal and external stakeholders in a sustainable manner.
  - To change internal behavior and conduct external stakeholder engagement, including suppliers, shareholders, customers, and communities.

**TABLE 7 GPSC'S ICP IMPLEMENTATION STRATEGY**

	Near-Future Term (2021-2022)	Longer term (2023-2030)		Ultimate Goal (2031-2050)
ICP Objectives	To increase internal capacity and learn to apply internal carbon pricing.	To Reduce Greenhouse Gas Emission.	To Increase renewable energy.	To achieve Net Zero carbon emissions
Coverage Scope of GHG Emissions	Scope 1 Scope 2	Scope 1 Scope 2 Scope 3	Scope 1 Scope 2 Scope 3	Scope 1 Scope 2 Scope 3
Decision Making Areas	Investment Decisions	Investment Decisions Operation Decisions	Investment Decisions Operation Decisions	Investment Decisions Operation Decisions
ICP Approach	Implicit Price Shadow Price	Shadow Price Internal Carbon Fee/Internal trading system	Shadow Price Internal Carbon Fee/Internal trading system	Shadow Price Internal Carbon Fee/Internal trading system
ICP Value	US\$15/tCO2e	Shadow Price = US\$15/tCO2e and Confidential	Confidential	Confidential

The implementation plan for the ICP, informed by the findings from various case studies, has been structured into three distinct phases. GPSC has completed Phase 1 and is currently progressing with Phase 2. The evaluation of Phase 3 will take place following the completion of Phase 2.



# Drive Energy Efficiency, Reduce upstream value chain emissions

Following the first GPSC goals and mission, which is to implement sustainable resource utilization based on the eco-efficiency principle by enhancing the efficiency of electricity and steam production processes and adopting additional measures to reduce GHG emissions. Different types of fossil fuels are considered in conjunction with the ICP to select the most energy-efficient investment for **driving energy efficiency** and **reducing upstream value chain emissions**.

Example of ICP expense evaluation for a conventional investment project

Fuel		IPCC* Emission Factor (CO <sub>2</sub> ,CH <sub>4</sub> ,N <sub>2</sub> O)	
Natural gas		0.05845	tCO <sub>2</sub> e/MMBTU-HHV
Coal Sub-bituminous/Bituminous		2.54538	tCO <sub>2</sub> e/Ton coal
Waste (Incremental CO <sub>2</sub> e from land-fill municipal waste*)		0.26900	tCO <sub>2</sub> e/Ton Waste

ตัวอย่าง ICP Expense สำหรับ โครงการ Conventional ICP expense

Power Plant Type	Plant Capacity		Capacity factor	Power generation	Steam generation	Power Efficiency (Heat rate GT)	Total Fuel consumption		ค่า IPCC Emission Factor (CO <sub>2</sub> ,CH <sub>4</sub> ,N <sub>2</sub> O)		CO <sub>2</sub> e Emission	ICP Expense	CO <sub>2</sub> e Intensity of MWh <sub>eq</sub>
	MW	TPH	%	kWh/year	Ton/year	BTU-HHV/kWh	Consumption	Unit	tCO <sub>2</sub> /unit of fuel	fuel unit	tCO <sub>2</sub> e/year	USD/Year	Steam to Power = 3 MP Steam 24 bar, 253 °C
Natural Gas Type A	1	0.0	90%	7,884,000	-	7,000	55,188	MMBTU-HHV	0.05845	tCO <sub>2</sub> /MMBTU-HHV	3,226	48,383	0.41
Natural Gas Type B	1	0.0	90%	7,884,000	-	8,000	60,000	MMBTU-HHV	0.05845	tCO <sub>2</sub> /MMBTU-HHV	3,686	55,295	0.47
Natural Gas Type C	1	1.0	90%	7,884,000	7,884	10,000	78,840	MMBTU-HHV	0.05845	tCO <sub>2</sub> /MMBTU-HHV	4,608	69,119	0.44
Natural Gas Type D	1	2.0	90%	7,884,000	15,768	10,000	157,680	MMBTU-HHV	0.05845	tCO <sub>2</sub> /MMBTU-HHV	5,530	82,943	0.42
Natural Gas Type E	1	2.0	90%	7,884,000	15,768	14,000	110,376	MMBTU-HHV	0.05845	tCO <sub>2</sub> /MMBTU-HHV	6,451	96,766	0.49
Coal Type A (Bituminous 26 MMBTU/ton Coal)	1	0.0	90%	7,884,000	-	10,000	2,426	Ton coal	2.54538	tCO <sub>2</sub> /Ton coal	6,175	92,620	0.78
Coal Type B Bituminous 26 MMBTU/ton Coal)	1	1.0	90%	7,884,000	7,884	10,000	3,032	Ton coal	2.54538	tCO <sub>2</sub> /Ton coal	7,718	115,776	0.74
Coal Type C Bituminous 26 MMBTU/ton Coal)	1	1.0	90%	7,884,000	7,884	12,000	3,639	Ton coal	2.54538	tCO <sub>2</sub> /Ton coal	9,262	138,931	0.88
Coal Type D Bituminous 26 MMBTU/ton Coal))	1	1.0	90%	7,884,000	7,884	14,000	4,245	Ton coal	2.54538	tCO <sub>2</sub> /Ton coal	10,806	162,086	1.03
Waste Type A (Heating Value 3,700 kCal/kg)	1	0.0	85%	7,446,000	-	16,000	8,104	Ton Waste	0.26900	tCO <sub>2</sub> /Ton Waste	2,180	32,700	0.29
Waste Type B (Heating Value 4,500 kCal/kg)	1	0.0	85%	7,446,000	-	16,000	6,676	Ton Waste	0.26900	tCO <sub>2</sub> /Ton Waste	1,796	26,938	0.24

\*CO<sub>2</sub>e municipal waste = 1.4190 tCO<sub>2</sub>e/Ton Waste  
 \*\*CO<sub>2</sub>e land-fill municipal waste = 1.1500 tCO<sub>2</sub>e/Ton Waste Refer Greenhouse Gas Emissions Evaluation from Municipal Solid Waste Management and Mitigation Planning for Municipality in Thailand

# Drive Low-Carbon Investment

## Identify and Seize Low-Carbon Opportunities

Following the second GPSC goals and mission, which is to identify research and development opportunities in electricity and steam production **with renewable energy** that is safe and environmentally friendly. ICP income analysis is applied to new investment projects, including mergers and acquisitions (M&A) and greenfield projects, and is not limited to specific locations. Location-specific information is also considered.

Example of ICP analysis results for a renewable investment project in each studied locations

**2. สรุปสาระสำคัญ: แนวปฏิบัติในการใช้สมมติฐาน Internal Carbon Pricing สำหรับโครงการลงทุนใหม่**

**2.5 ตาราง IGES Grid Emission Factor by location (tCO<sub>2</sub>e/MWh) สำหรับ โครงการ Renewable**

**IGES**  
Institute for Global Environmental Strategies

Countries	IGES Grid Emission Factor by location (tCO <sub>2</sub> e/MWh)
Japan	0.492
Taiwan	0.509
South Korea	0.517
Laos	0.560
Pakistan	0.567
Thailand	0.568
Indonesia	0.847
China	0.890
India	0.920
Vietnam	0.929

**ตัวอย่าง ICP Income สำหรับ โครงการ Renewable**

Countries	Grid Emission Factor (tCO <sub>2</sub> e/MWh)	Solar Capacity factor (% per 1 MW)	Power gross generation (MWh per 1 MW)	GHG Emission Reduction (tCO <sub>2</sub> e/year)	ICP Price (MUSD/tCO <sub>2</sub> e)	ICP Income (MUSD/year)
Japan	0.492	13%	1,139	560	15	8,404
Taiwan	0.509	13%	1,314	669	15	10,032
South Korea	0.517	15%	1,314	679	15	10,190
Laos	0.560	18%	1,577	883	15	13,245
Pakistan	0.567	20%	1,752	993	15	14,901
Thailand	0.568	18%	1,577	896	15	13,434
Indonesia	0.847	18%	1,577	1,336	15	20,033
China	0.890	18%	1,577	1,403	15	21,050
India	0.920	20%	1,752	1,612	15	24,178
Vietnam	0.929	18%	1,577	1,465	15	21,973

# Incentivize consideration

- Incentivize consideration of climate-related issues in decision making
- Incentivize consideration of climate-related issues in risk assessment

# Incentivize consideration

GPSC's approach to internal carbon pricing is a comprehensive framework to support the national and global climate goals, including Thailand's NDCs and the Paris Agreement, that:

- **Incentivize consideration of climate-related issues in decision making** through financial modeling and internal pricing.
  - GPSC applies a shadow price of USD 15/tCO<sub>2e</sub> to investment decisions to encourage low-carbon projects and discourage high-emission ones. The ICP is used to adjust project IRR and NPV, influencing capital allocation toward greener investments.
- **Incentivize consideration of climate-related issues in risk assessment** to future-proof the business.
  - GPSC assesses and integrates climate-related risks into the enterprise risk management framework. This includes scenario analysis and stress testing for carbon pricing impacts on EBITDA, such as carbon tax and carbon cap-and-trade mechanisms.

Table 9: Hotspot Transition Risk Assessment Result- Quantification Analysis

Table 3: Hotspot Transition Risk Assessment Result- Quantification Analysis												
Transition Risks	Risk & Opps (NZE-STEPS)			Impact Areas	Business Implications	Financial Implication (Average estimated time frame: 6 years)	Management measure and adaptation plan	Cost response and timeline to response				
	Time Horizon											
	2026	2030	2050									
Mandatory carbon pricing				Upstream & Direct operation & Downstream	<ul style="list-style-type: none"><li>Cogeneration Power Plants, which have the highest operational capacity, contribute relatively high GHG emissions, and the potential implementation of carbon pricing in Thailand can increase these emissions' costs, leading to rising operating costs.</li></ul>	1,389 Million THB	<ul style="list-style-type: none"><li>Study of carbon tax and carbon cap &amp; trade mechanisms.</li><li>Invest in CO2-saving initiatives by participating in the Thailand Voluntary Emission Reduction Program (T-VER) to contribute to approximately 582,370 verified credits available for trading on the market.</li><li>Decarbonize business through renewable energy expansion, phasing down coal power.</li><li>Implement Internal carbon price (15 USD/tCO<sub>2</sub>e).</li><li>Reduce GHG intensity by 35% in 2030 as compared to 2020.</li></ul>	16,071 Million				
						Opportunity / Risk score key						
						High Opp.	Mod. Opp.	Low Opp.	Limited	Low Risk	Mod. Risk	High Risk

Opportunity / Risk score key						
High Opp.	Mod. Opp.	Low Opp.	Limited	Low Risk	Mod. Risk	High Risk

Based on the climate-related risk assessment results, mandatory carbon pricing poses a significant risk to GPSC's operations. This highlights the need for GPSC to accelerate investments in low-carbon technologies and proactively prepare for both national and international carbon taxes and cap-and-trade mechanisms.

Please see more information at <https://www.gpscgroup.com/storage/download/sd-report/gpsc-sd2023-gpsc-ifs-s2-en.pdf>

# Influence strategy and/or financial planning

# Influence strategy and/or financial planning

GPSC integrates ICP into strategic and investment decisions as a financial planning tool to evaluate project viability, adjust NPV and IRR, and promote renewable energy.

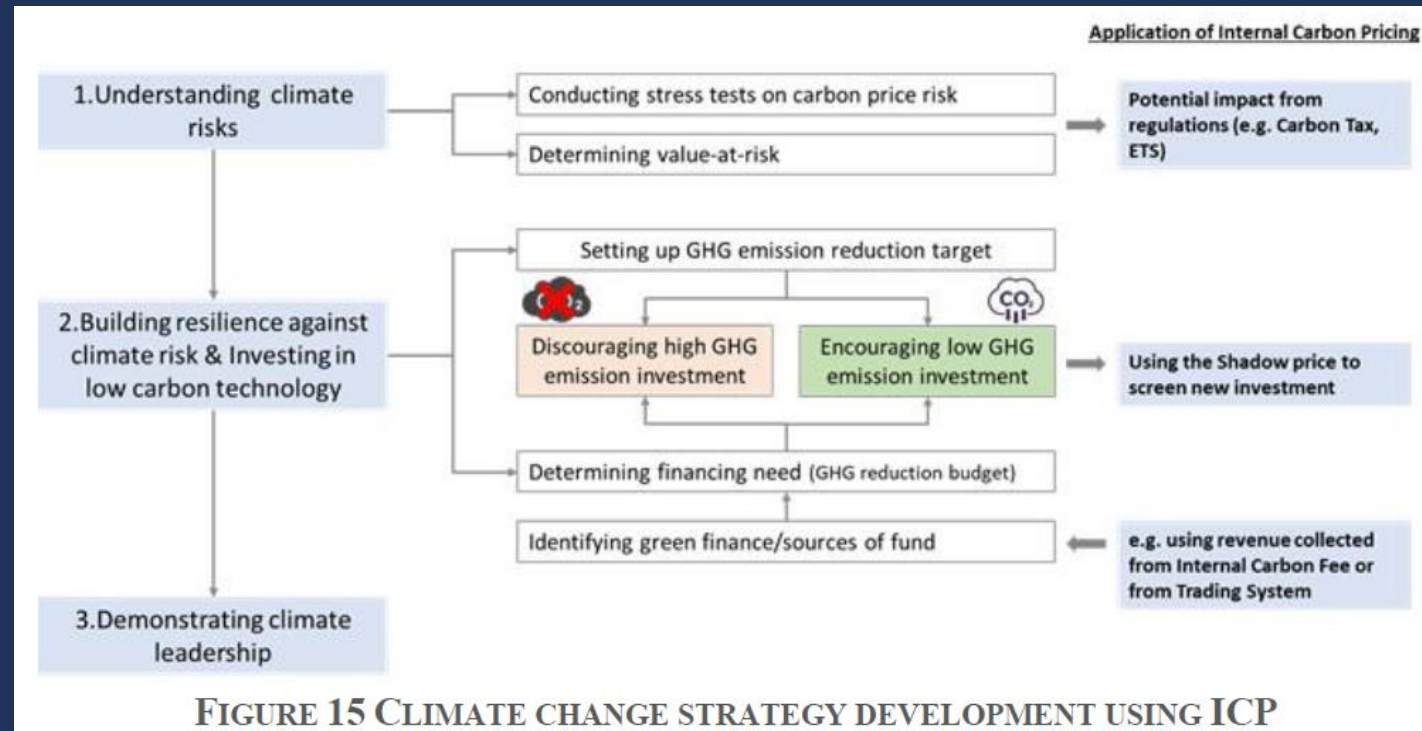


FIGURE 15 CLIMATE CHANGE STRATEGY DEVELOPMENT USING ICP

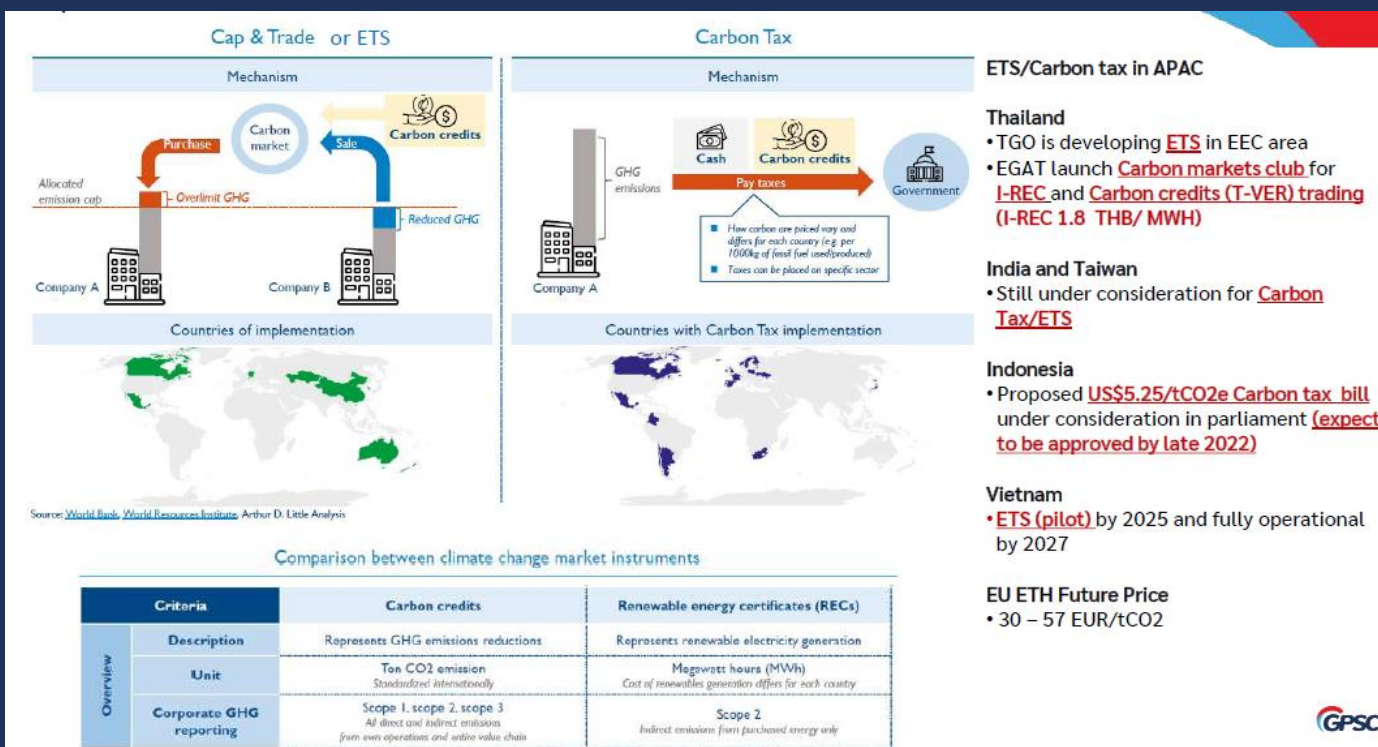
1. ICP is applied to new CAPEX decisions, simulating carbon costs to compare options such as coal and natural gas.
2. For OPEX, GPSC is considering an internal carbon fee to fund low-carbon investments and incentivize GHG emission reductions.
3. Scenario analysis shows profitability could be lower under carbon taxes circumstance, indicating the need for lower-carbon strategies.
4. Governance includes embedding ICP in climate strategy, with a task force for oversight and KPIs to measure impacts.
5. ICP enhances access to green finance through climate risk management and alignment with ESG-related standards.



# Navigate regulations

# Navigate regulations

GPSC's Internal Carbon Pricing (ICP) Implementation and Monitoring Plan serves as a strategic tool to navigate evolving climate regulations by embedding carbon cost considerations into investment and operational decisions. Developed in 2020 and designed for annual updates, the plan uses a shadow price of USD 15/tCO<sub>2</sub>e to simulate future carbon-related regulation, enabling GPSC to assess financial exposure to potential carbon taxes or emissions trading schemes.



Example of navigation regulations results of ETS and carbon tax on the APAC region

The GPSC's ICP implementation plan comprises six components aimed at aligning business operations with Thailand's climate policy and global low-carbon trends.

1. Concept and Strategy
2. Policy, Procedures, Process, and Methodology
3. Communication Plan
4. Implementation Team
5. Work Plan
6. Monitoring Plan

By integrating ICP into capital expenditure decisions and establishing a monitoring framework, GPSC enhances its regulatory readiness, supports low-carbon investments, and builds long-term resilience against climate-related transition risks.

# Setting and/or achieving of climate-related policies and targets

# Setting and/or achieving of climate-related policies and targets

GPSC uses **Internal Carbon Pricing (ICP)** not only as a financial tool but also as a core mechanism to support and achieve the climate-related targets. This includes aligning investments with decarbonization goals, preparing for future carbon regulations, and demonstrating climate leadership. GPSC has established GPSC's Climate Strategies to achieve GPSC's climate-related target under the concept of 'Moving towards a Low-Carbon Electricity Business and Net Zero Greenhouse Gas Emissions to manage risks and seek new market opportunities.

**Internal Carbon Pricing (ICP)** is strategically integrated under GPSC's key climate action of 'Trading & Offset'. By assigning a financial value to GHG emissions, ICP incentivizes investment in CCUS and low carbon technologies. This mechanism guides capital allocation toward low-carbon solutions and enables GPSC to effectively manage climate-related risks and opportunities. As part of the Net Zero Emission Pathway, ICP plays a critical role in driving emissions reductions and supporting compliance or participation in carbon markets and offset schemes.

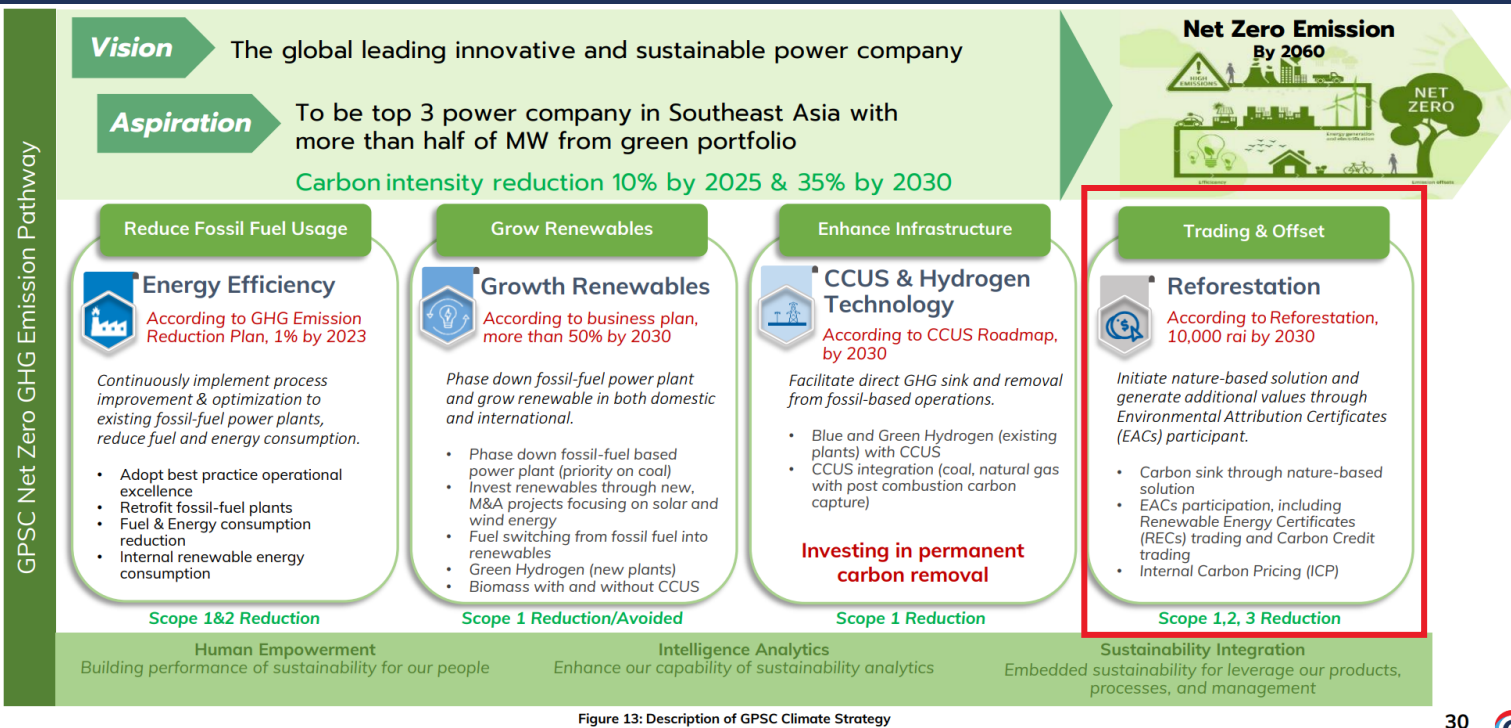
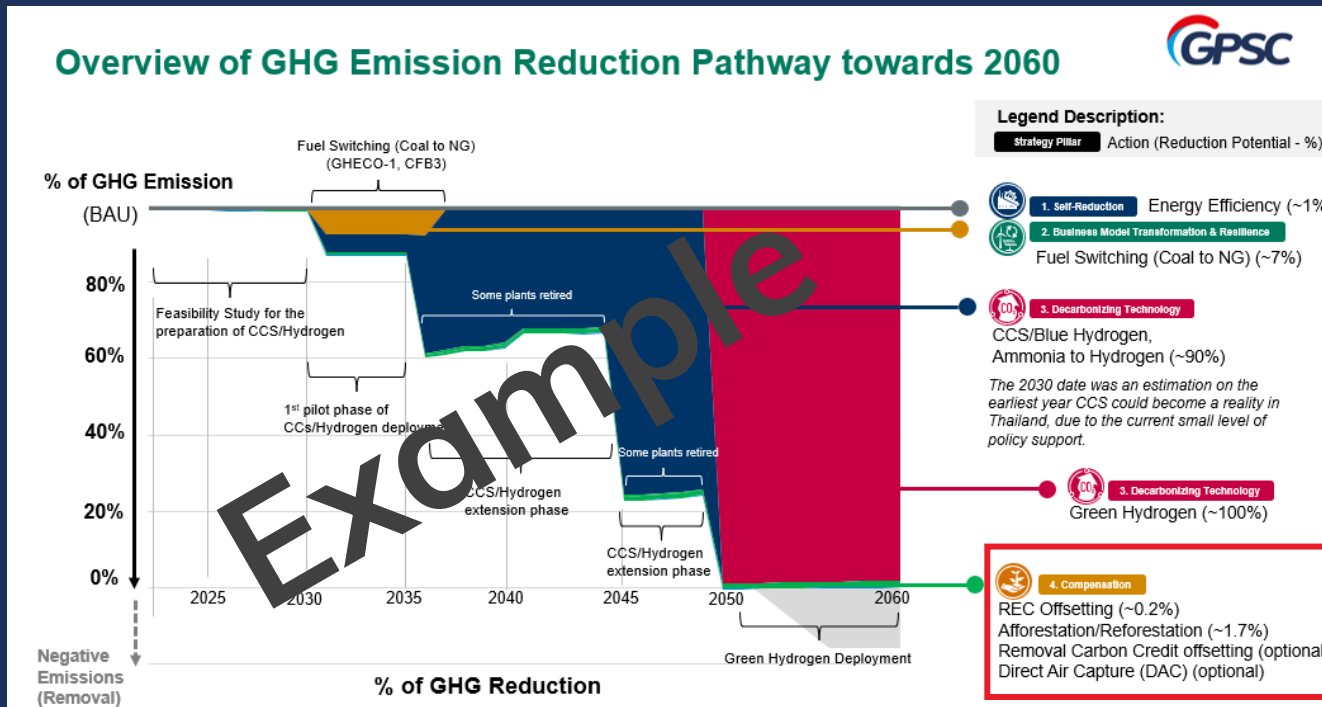


Figure 13: Description of GPSC Climate Strategy

# Set a carbon offset budget

# Set a carbon offset budget

Following the GPSC's key climate action of 'Trading & Offset' which the Internal Carbon Pricing (ICP) is integrated. To enhance its climate strategy and address residual emissions, GPSC committed to developing the Internal Carbon Pricing (ICP) framework by introducing a real internal carbon fee mechanism that allocates revenue into a dedicated carbon offset budget. This development allows GPSC to fund the purchase of high-quality carbon credits, such as T-VER or VCS, to offset emissions that cannot be eliminated through internal abatement. By linking the internal carbon fee to actual emissions from business units, GPSC can create a self-sustaining offset fund that supports the net-zero ambitions, strengthens ESG performance, and prepares the company for future regulatory or market-based carbon pricing mechanisms.



In GPSC's GHG emission reduction pathway development, the ICP is applied to establish a carbon offset budget for residual emissions, ensuring that unavoidable emissions are financially accounted for and aligned with the company's decarbonization strategy.

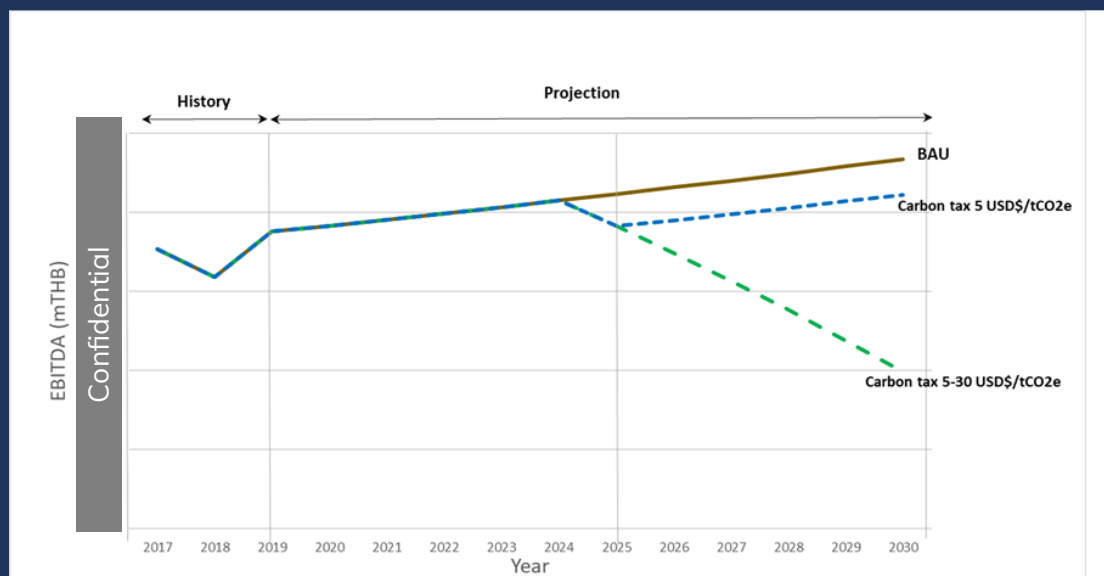




# Stress test investments

# Stress test investments

**Climate Stress Test** is an exercise to assess how climate-related risks (e.g., transition risk) impact a company under stress scenarios. Based on the results of the stress testing, the company will be able to establish climate resilience measures and a strategy that will help to better respond to the threat posed by climate-related risks. Although the use of stress testing to measure climate-related risks is a relatively new development, the stress test is now considered a key element to understand, quantify, and forecast the financial impact of climate risk to assess transition risks in different plausible scenarios.



Scenario Analysis of the GPSC's Climate Risk From Carbon Taxes

## Stress testing of climate risk on profitability by shadow pricing

A stress test of carbon taxes has been conducted at different levels on the profitability, with an assumption of carbon tax introduction in 2025. This analysis helps to understand the sensitivity of GPSC's financial performance to external carbon pricing and consequently allows for determining GPSC's level of climate risk (low, medium, or high) from potential regulatory compliance.

The stress test was conducted under two assumed scenarios as follows, against the baseline scenario (no carbon taxation).

- Scenario 1: a carbon tax (static price) at US\$5/tCO<sub>2</sub>e from 2025 – 2030; and
- Scenario 2: a carbon tax (evolving price) starts at US\$5/tCO<sub>2</sub>e in 2025 and gradually raises to US\$30/tCO<sub>2</sub>e in 2030

# Stress test investments

The result shows that GPSC's EBITDA will decrease under Scenario 1 when US\$5/tCO<sub>2</sub>e is applied as a cost of carbon to GPSC's carbon footprint, while the decrease in EBITDA will be more significant under Scenario 2. Based on these results, GPSC could be considered as "High Risk" from carbon pricing. Overall, GPSC's margins are thin, and price elasticity is high.

**TABLE 24 CARBON PRICING RISK ON PROFITABILITY FOR GPSC**

Scenario	Level of Impact (Cost of carbon comparing to EBITDA)	Likelihood of the scenario	Risk Assessment Result
Scenario 1 a carbon tax (static price) at US\$5/tCO <sub>2</sub> e	Medium	High	High
Scenario 2 a carbon tax (evolving price) at US\$5- 30/tCO <sub>2</sub> e	High	High	High



**FIGURE 22 VALUE-AT-RISK OF GPSC'S SCENARIOS**

# Thank You

