





































Scenario Analysis of Climate-Related Risks

Scope of Scenario Analysis

No.	Operation	Location	Fuel	Installed Capacity (MW)	% in total
1	Khanom Electricity Generating Co., Ltd. (KEGCO)			970	43.70%
2	EGCO Cogeneration Co., Ltd. (EGCO Cogen)			117	5.27%
3	Roi-Et Green Co., Ltd. (RG)			8.8	0.40%
4	Banpong Utilities Co., Ltd. (BPU)			256	11.53%
5	Klongluang Utilities Co., Ltd (KLU)			121	5.45%
6	Chaiyaphum Wind Farm Co., Ltd. (CWF)			80	3.60%
7	SPP Two Co., Ltd. (SPP2)			8	0.36%
8	SPP Three Co., Ltd. (SPP3)			8	0.36%
9	SPP Four Co., Ltd. (SPP4)			6	0.27%
10	SPP Five Co., Ltd. (SPP 5)			8	0.36%
11	Solarco Co., Ltd. (Solarco)			57	2.57%
12	Thappana Wind Farm Co., Ltd. (TWF)			6.9	0.31%
13	Quezon Power (Philippines) Limited Co. (Quezon)			460	20.72%
14	Boco Rock Wind Farm Pty Ltd. (BRWF)			113	5.09%
			Total	2,219.7	100.00%

13% Installed capacity of renewable energy in portfolio in 2019

Legend:

-  Renewable Fuels
-  Natural Gas
-  Biomass
-  Wind
-  Solar
-  Coal

Scenario Analysis of Climate-Related Risks

Aim

- To evaluate climate impact from key physical and transitional risks under specific climate scenarios
- To quantify financial implications of climate impact
- To provide quantitative climate impact information for strategy creation and future management consideration

Methodology

Building upon the result of climate risks and opportunities workshop in 2019, scenario analysis is conducted to evaluate the impact of key physical and transitional risks under selected climate scenarios using information specific to EGCO Group's operations.

Scope of Analysis: 14 Plants accounting for 87% of EGCO Group's total revenue.

Physical Risk

1. Coordination of EGCO Group's operational sites are used as an input in three climate impact evaluation tools;
 - Flood impact evaluation: 1) Climate Central, and 2) World Bank Group Climate Knowledge Portal
 - Water stress impact evaluation: 1) Aqueduct, and 2) World Bank Group Climate Knowledge Portal
2. IPCC's RCP8.5 scenario (Worst case scenario) is applied with 2030 timeframe to assess flood and water stress impact in each geographical area
3. Financial impacts of flood and water stress are quantified based on historical information and EGCO Group's internal data

Transitional Risk

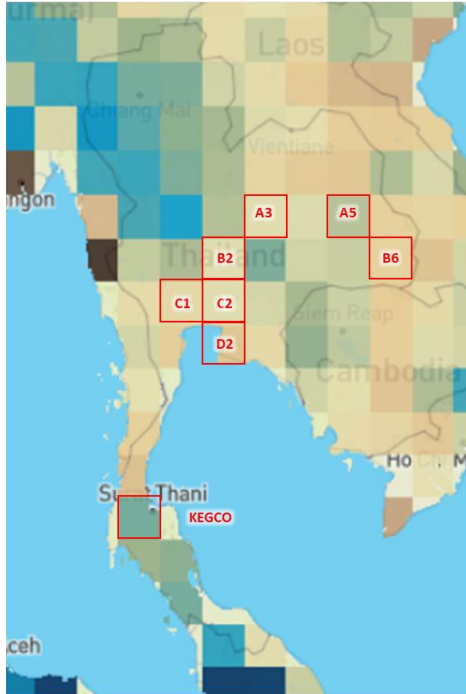
1. EGCO Group's GHG emissions under Business as Usual (BAU) condition are identified
2. GHG emissions reduction required to align with Thailand's Nationally Determined Contribution (NDC) is estimated
3. Financial impact from carbon tax is quantified with using a regional reference from Singapore Carbon Pricing Act 2019

1. Physical Risk: Flood and Water Stress in 2030

Under RCP 8.5 Scenario (Worst case scenario)

Scope of Analysis

THAILAND



PHILIPPINES



AUSTRALIA



Impact from Flood and Water Stress

Area	Plant Name	Type	Flood	Water Stress
A3	CWF	Wind	Low	Low
A5	Roi-ET Green SPP5	Biomass	Low	Low
		Solar	Low	Low
B2	TWF SPP2	Wind	Low	Low
		Solar	Low	Low
B6	SPP3 SPP4	Solar	Low	Low
		Solar	Low	Low
C1	BPU Solarco 1-6	Gas	Low	Low
		Solar	High	Low
C2	KLU Head Office	Gas	High	Low
		Office	High	Low
D2	EGCO Cogen	Gas	Low	High
KEGCO	KEGCO	Gas	High	Low
Quezon	Quezon	Coal	Medium	Low
BRWF	BRWF	Wind	Low	Low

Flood Five locations are likely to be affected by 10-year flood in 2030. Quezon is not directly flooded but land transportation route might be inundated.

Water Stress is measured in terms of water demand divided by water supply, reflecting water scarcity. The only thermal power plant affected is EGCO Cogen, caused by growing local demand rather than supply reduction.

Financial Impact

Flood

Business disruption: ~ **3.1 billion THB per decade**
Equivalent to ~ 10% revenue or ~ 23% Net profit (excluding property damage cost)

Water Stress

Increased management cost of water for EGCO Cogen: ~ **41.7 million THB annually**
Equivalent to ~ 0.13% revenue or ~ 0.31 % Net profit

Assumptions in Physical Risk's Financial Impact Estimation

Financial Impact from Flood in 2030

Financial Impact [THB] = ((Annual electricity generation from affected power plants [GWh] /12 months * 1.5 months)/ Total annual electricity generation [GWh]) * Annual revenue [THB]

Assumptions

- Affected power plants are identified from climate models under RCP8.5 Scenario in 2030 considering sea level rise in combination with 10-year flood level.
- 10-year flood is expected to disrupt the operation for ~ 1.5 months (Based on 2011 Thailand flood which inundated areas nearby KLU for 1.5 months)

Limitations Property and equipment damage are excluded

Financial Impact from Water Stress in 2030

Financial impact [THB] = Water expenditure in 2020 [THB] * (Price increase rate of ~ 5.5% per year)¹⁰

Assumptions

- Affected power plants are identified from climate models under RCP8.5 Scenario in 2030
- Water expenditure to cope with the lack of water in 2020 refers to EGCO Group Cogen mitigation action plan; 24,408,000 THB
- ~ 5.5% Price increase rate per year is based on 56-1 Form of Eastwater Group and Provincial Waterworks Authority Website

Sources of Climate models:

<https://coastal.climatecentral.org/>

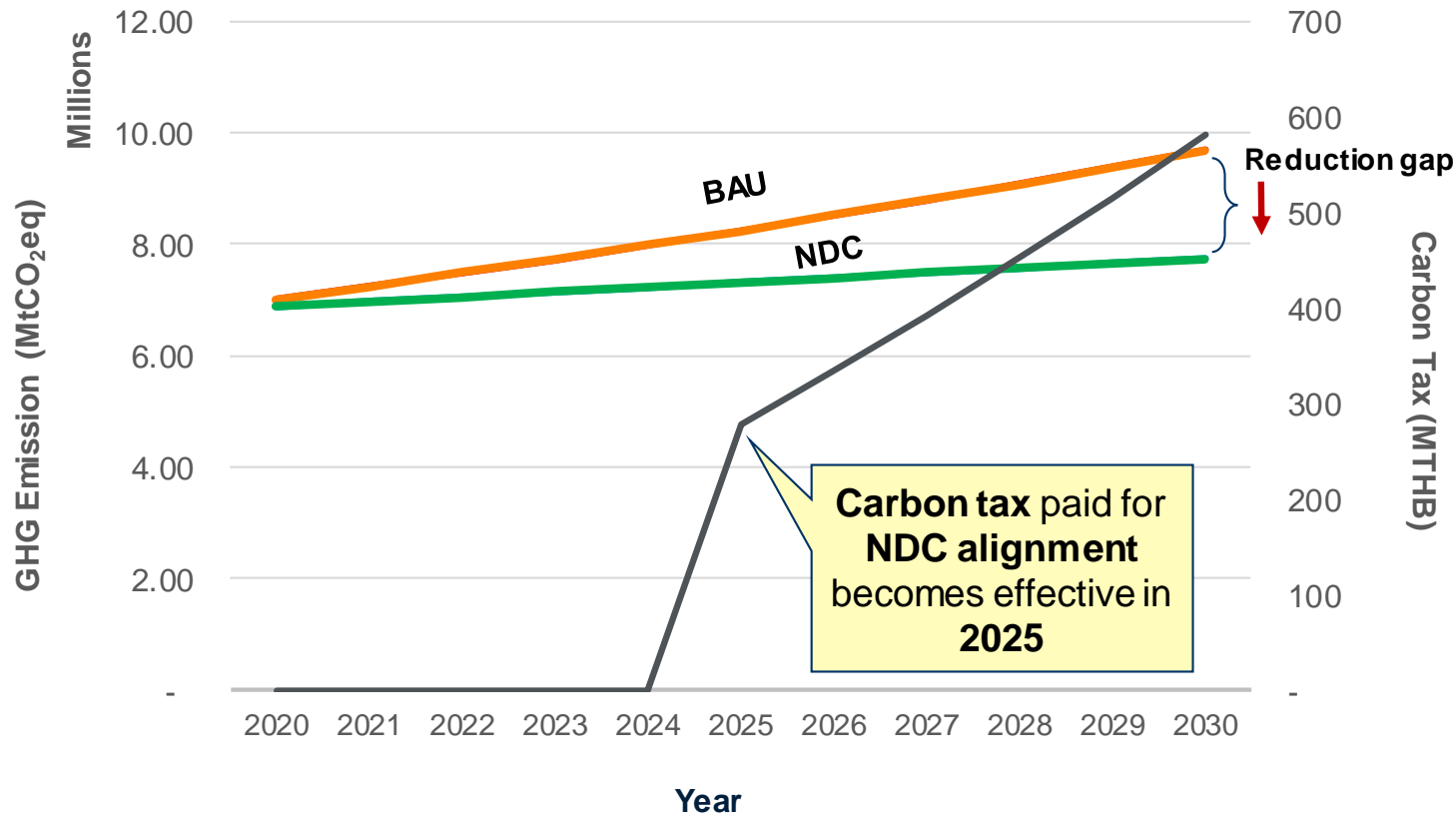
<https://climateknowledgeportal.worldbank.org/country/thailand/climate-data-projections>

Sources of Climate models:

<https://www.wri.org/applications/aqueduct/water-risk-atlas>

2. Transitional Risk: Financial Impact from Carbon Tax in 2030

Under NDC Scenario



Financial Impact

Carbon tax represents one of the regulatory aspects in the transitional changes of climate-related risks.

The financial impacts from carbon tax is expected to affect on EGCO Group's revenue by **~425 MTHB** annually in order to align with national commitment on reduction of GHG.

This cost ~1.1% of revenue or ~3.3% of Net profit.

Note: NDC stands for Nationally Determined Contribution. Thailand NDC aims to reduce GHG emissions by 20-25% when compared to the business-as-usual (BAU) scenario in 2030.

Assumptions in Transitional Risk's Financial Impact Estimation

Financial Impact from Carbon Tax in 2030

Financial Impact [monetary unit] = GHG Emission Gap [tCO₂e/year] * Carbon tax rate [monetary unit/tCO₂e]

Assumptions

- Reduction capacity is aligned with Thailand NDC which is equivalent to **20% reduction** from BAU emissions in 2030.
- Carbon tax is assumed to be implemented and **effective in 2025 onwards**.
- Carbon tax rate is referenced from Singapore Carbon Pricing Act 2019 at the value of **10 USD/tCO₂e**



Source of carbon tax rate: <https://iswitch.com.sg/carbon-tax-singapore/>

This carbon price is primarily assumed as internal carbon price for transitional risk's financial impact estimation

Key Summary

- Under RCP8.5 Scenario (Worst case scenario) in 2030, Head office and four power plants are likely to be affected by **10-year flood** with financial impact of ~ **3.1 billion THB per decade, equivalent to ~ 10% revenue or ~ 23% net profit**. Flood control structures and response plans are recommended for these location to minimize damage and business interruption
- Under RCP8.5 Scenario (Worst case scenario) in 2030, the only thermal power plant affected by **water stress** is EGCO Cogen due to growing local water demand. Estimated financial impact from increased management cost is ~ **41.7 million THB annually, equivalent to ~ 0.13% revenue or ~ 0.31 % net profit**. Installation of on-site water reserves, implementation of water saving measures and local community engagement on water-related risks are recommended to save cost and avoid reputational damage.
- The financial impacts from **carbon tax** is expected to affect on EGCO's revenue by ~**425 MTHB annually** in order to align with national commitment on reduction of GHG. This is equivalent to ~**1.1% of revenue or ~3.3% of net profit**. Regulatory monitoring process is recommended. Efficiency improvement and decarbonization of GHG intensity will also lessen the risk of high cost from carbon tax.



Scope of Scenario Analysis

Climate-Related Scenarios and Target Setting

Aim

- To identify EGCO Group's future climate-related performances in 2030
- To identify climate impact mitigation options and strategy for EGCO Group in 2030
- To raise awareness on climate-related impact on both physical and transitional aspects

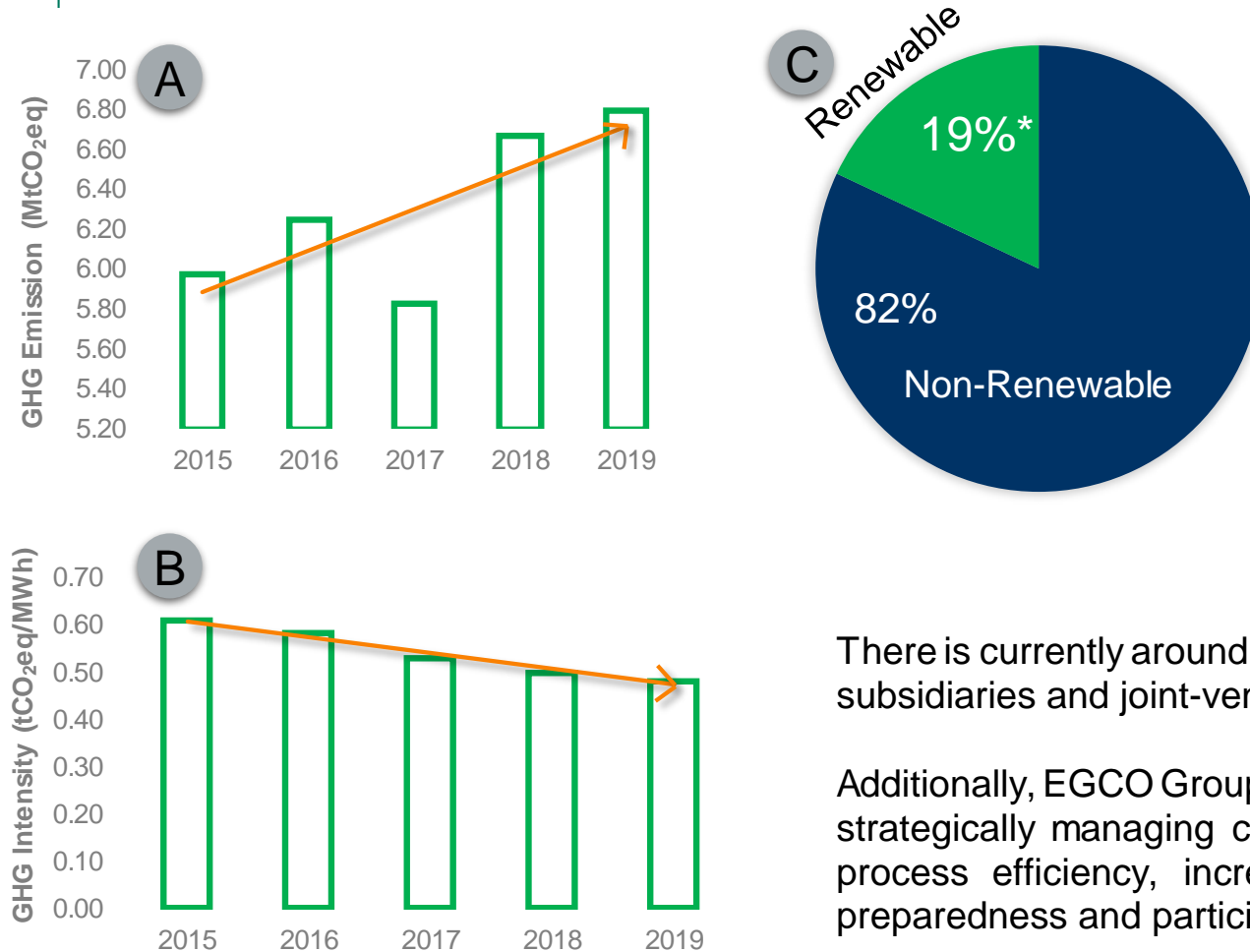
Methodology

The climate-related targets are defined by an analysis of plausible scenarios and possibilities. The opinions and feedbacks from EGCO Group's executives are also taken into consideration. The scenarios included in this analysis comprise of the following:

- Business as Usual (BAU)
- National Determine Contribution (NDC)
- IEA Beyond 2 Degree Scenario (B2DS)
- IEA 1.5 Degree Scenario (1.5DS)
- Sustainable Development Scenario (SDS)
- Sectoral Decarbonization Approach (SDA)
- Zero Emission Scenario

Note: The result of this analysis can be further applied to extended scope of generation capacity due to the reason that all analysis was conducted on percentage basis.

EGCO Group's Current Performance



The **Figure A** represents past performance of EGCO Group GHG emissions (Scope 1) showing an increasing trend over the past five years for ~ 3.3% annually. This correlates with the increased electricity and stream generation of the company.

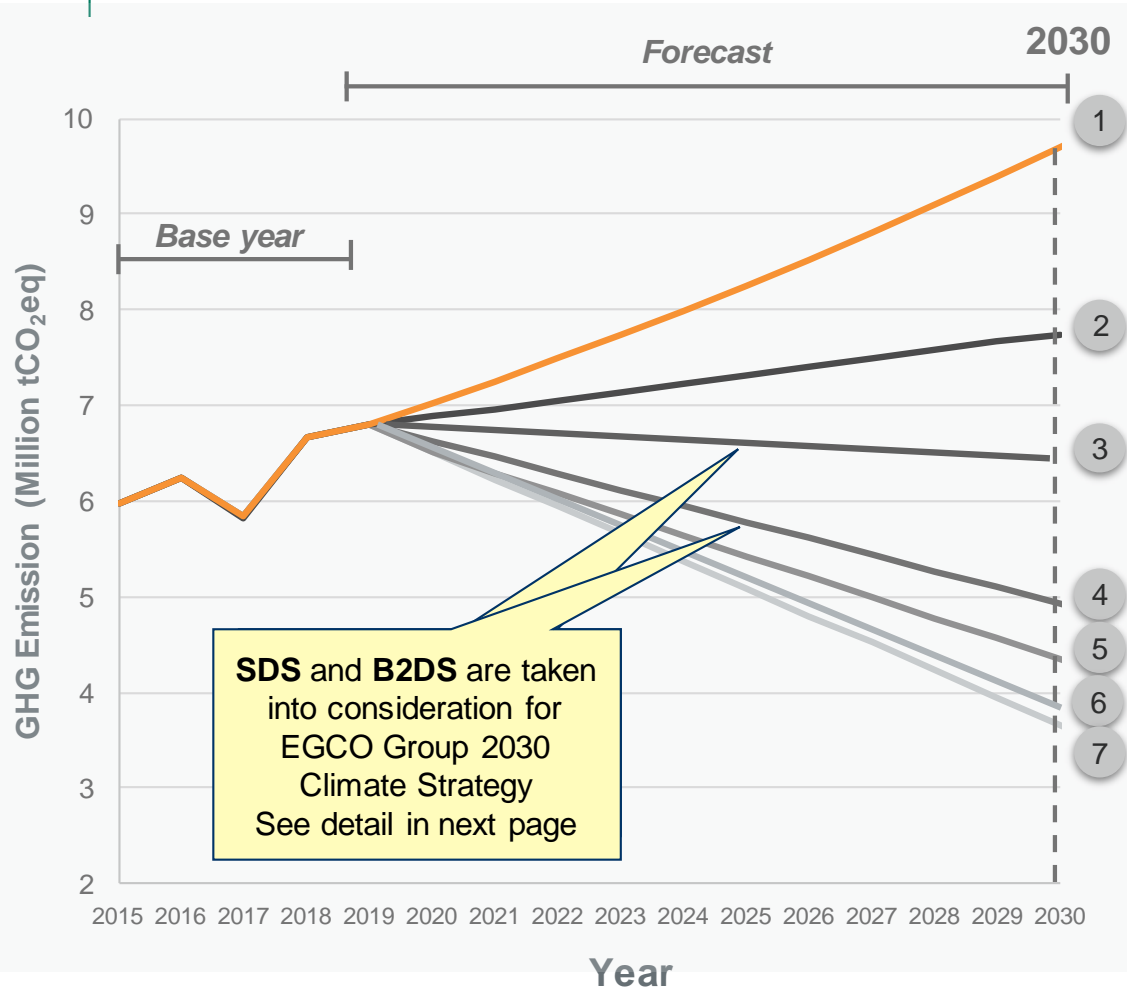
On the other hand, **Figure B** represents EGCO Group GHG intensity with a decreasing trend over the past five years with ~ 5% reduction annually. The last three years showed a sign of steady stage due to the limitation of current technology improvement.

There is currently around 19%* of renewables in EGCO Group portfolio (**Figure C**) including subsidiaries and joint-ventures with a continuous increase in production capacity globally.

Additionally, EGCO Group is placing priorities on climate-related risks and opportunities and strategically managing climate change issues in several ways. This includes maximizing process efficiency, increasing renewables in portfolio, fostering climate-related crisis preparedness and participating in carbon credit and offset programs.

Note: *19% Renewable is referenced from EGCO Group Sustainability Report 2019

Scenario Analysis of EGCO Group's GHG Emissions Towards 2030



7 climate scenarios considered are;

No.	Scenario	Absolute Emission Reduction in 2030	GHG Intensity in 2030
		% (from BAU)	tCO ₂ e/MWh
1	Business As Usual (BAU)	0%	0.48
2	National Determine Contribution (NDC)	-20%	0.38
3	Sustainable Development Scenario (SDS)	-32%	0.33
4	IEA Beyond 2 Degree Scenario (B2DS)	-49%	0.24
5	Zero Emission	-55%	0.22
6	Sectoral Decarbonization Approach (SDA)	-60%	0.19
7	IEA 1.5 Degree Scenario (1.5DS)	-62%	0.18

Input and Assumption for Scenario Analysis

Input for Climate-Related Scenarios

- Absolute GHG Emissions [tCO₂e]
- GHG Intensity [tCO₂e/MWh]
- Electricity and steam output [MWh]
- Current portfolio including list of power plant, capacity, and fuel type
- Forecast on future electricity demand
 - Thailand Power Development Plan (PDP) 2018



Calculation

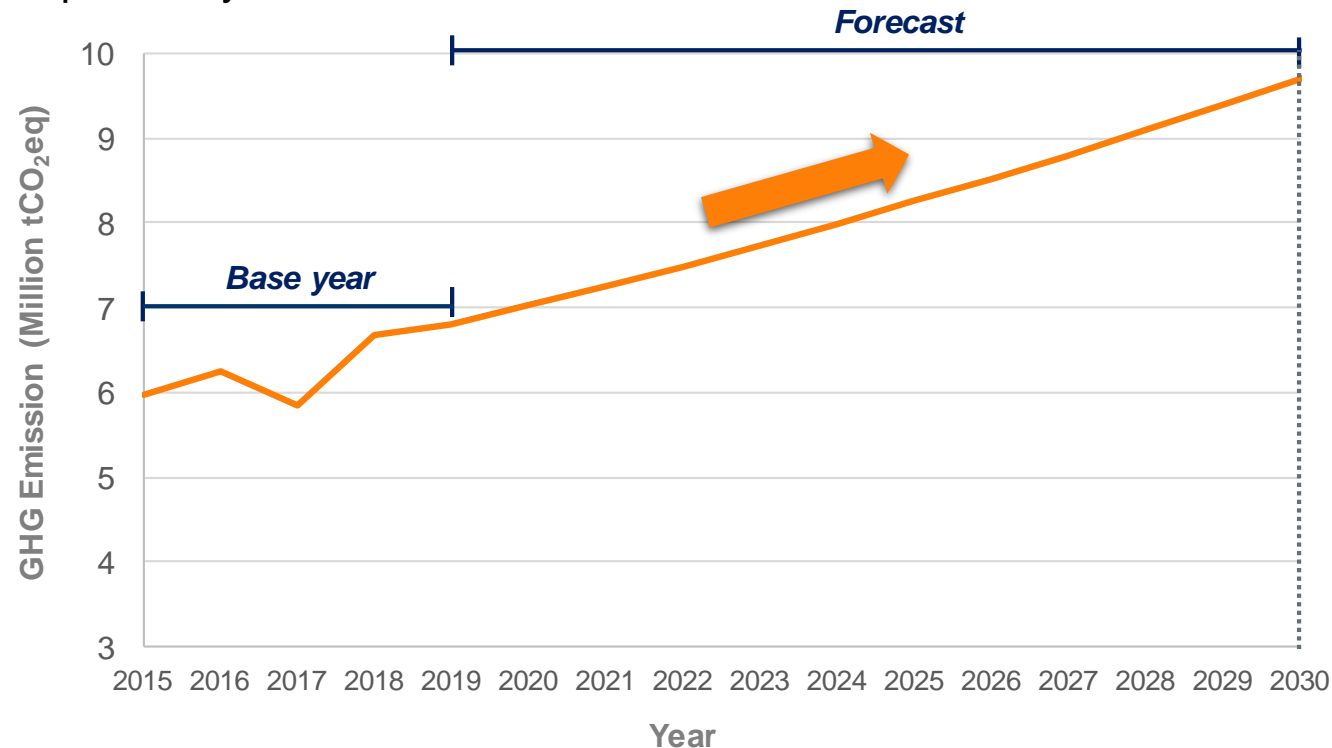
- Basic Growth Rate [%] = $\left(\frac{\text{Present Value} - \text{Initial Value}}{\text{Initial Value}} \right) \times 100$
- Data forecast (Average Growth Rate) [%] = $\left[\left(\frac{\text{Present Value}}{\text{Initial Value}} \right)^{\frac{1}{n}} - 1 \right] \times 100$

Where n = number of periods or years

Climate-Related Scenarios (1/7)

1. Business As Usual (BAU)

Business as Usual (BAU) projects based on the continuation of actions from what has been doing in present without any changes e.g. policy and mitigation control. This refers to the current performance as baseline in order to determine possibility in the future.



Assumption

Forecasting GHG emissions based on annual growth rate approach. The annual growth rate of absolute emissions of 3.3% was applied. The GHG Intensity was fixed at the current level, assuming that it peaks in 2019.

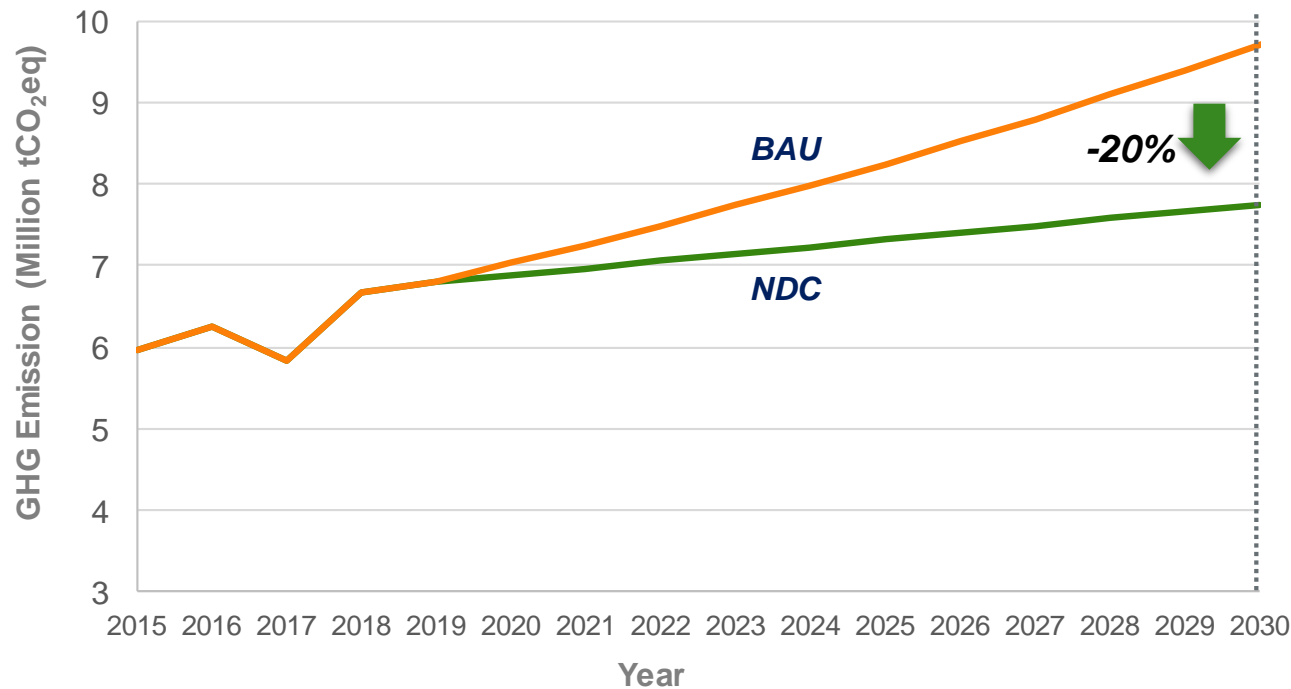
In 2030

Absolute GHG Emissions	0.00 % Reduction
GHG Intensity	0.48 tCO ₂ e/MWh

Climate-Related Scenarios (2/7)

2. National Determined Contributions (NDC)

Scenario that align with Thailand's pledged on supporting the Paris Agreement by proposing NDC which aims to reducing GHG emissions of 20-25% from BAU level in 2030. This is expected to reduce 111 MtCO₂e from 555 MtCO₂e (BAU) by 2030. The target focused on major GHG emissions sources including energy, transportation, waste, and IPPU (Industrial Process and Product Use)



Assumption

Aligning with NDC, EGCO Group reduces absolute GHG emissions by 20% from BAU in 2030 linearly. In this scenario, GHG emissions is still higher than base year (2019) meaning it does not reduce GHG emissions but increasing in a lower trend as compared to BAU.

In 2030

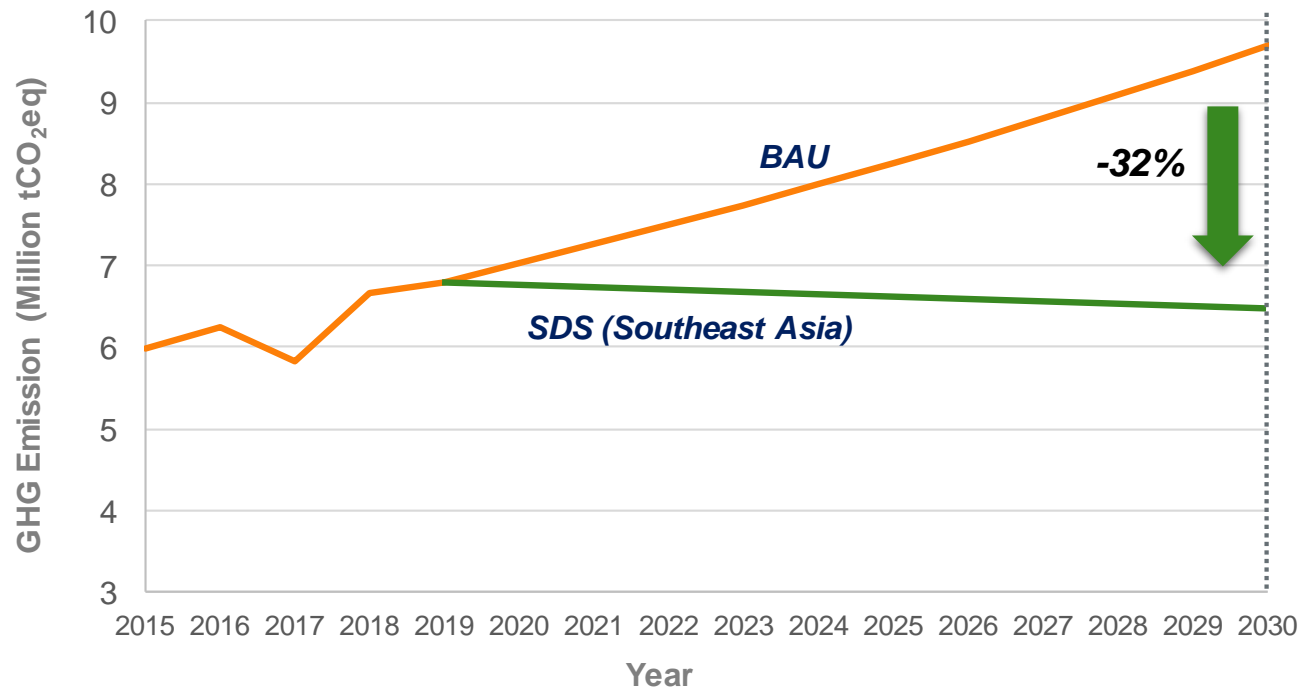
Absolute GHG Emissions - **20%** Reduction

GHG Intensity **0.38** tCO₂e/MWh

Climate-Related Scenarios (3/7)

3. Sustainable Development Scenario (SDS)

Sustainable Development Scenario (SDS) integrates strategy to support Sustainable Development Goals (SDGs) with the focus on addressing climate change, improving air quality, and achieving the universal energy access. In Southeast Asia region, GHG emissions could reach its peak before 2025 while carbon intensity of electricity generation should decrease 80% by 2040.



Assumption

The recommendation on SDS for Southeast Asia region showed that carbon intensity on electric generation should be lower than 0.325 tCO₂e/MWh. In applying this pathway, EGCO Group should reduce GHG intensity by approx. 3.28% annually.

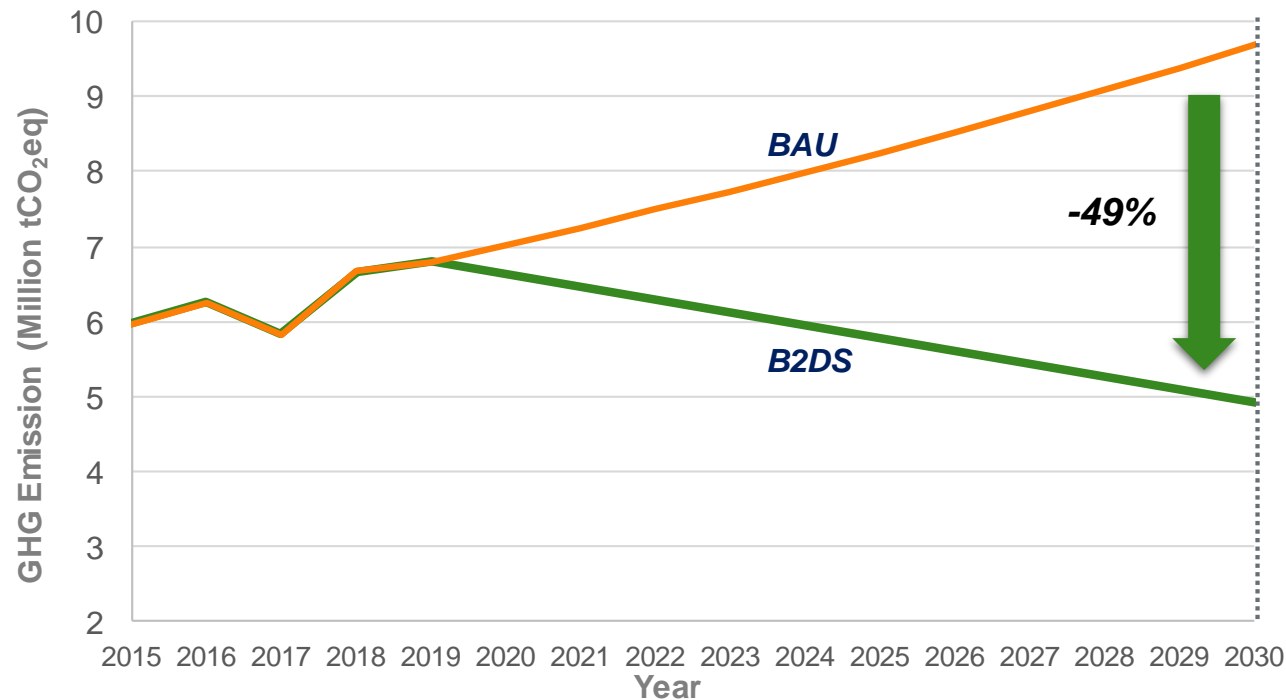
In 2030

Absolute GHG Emissions - **32%** Reduction
GHG Intensity **0.33** tCO₂e/MWh

Climate-Related Scenarios (4/7)

4. Beyond 2 Degree Scenario (B2DS)

2 Degree Scenario (2DS), was developed by International Energy Agency (IEA), complies with Paris Agreement with an aim to hold the increase in the global average temperature to well-below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C in 2100. The scenario requires to cut absolute emission in an annual linear basis.



Assumption

In line with Absolute Emissions Contraction Approach on Science-Based Target Setting, the minimum reduction on company absolute GHG emissions required is -2.5% annual linear terms.

In 2030

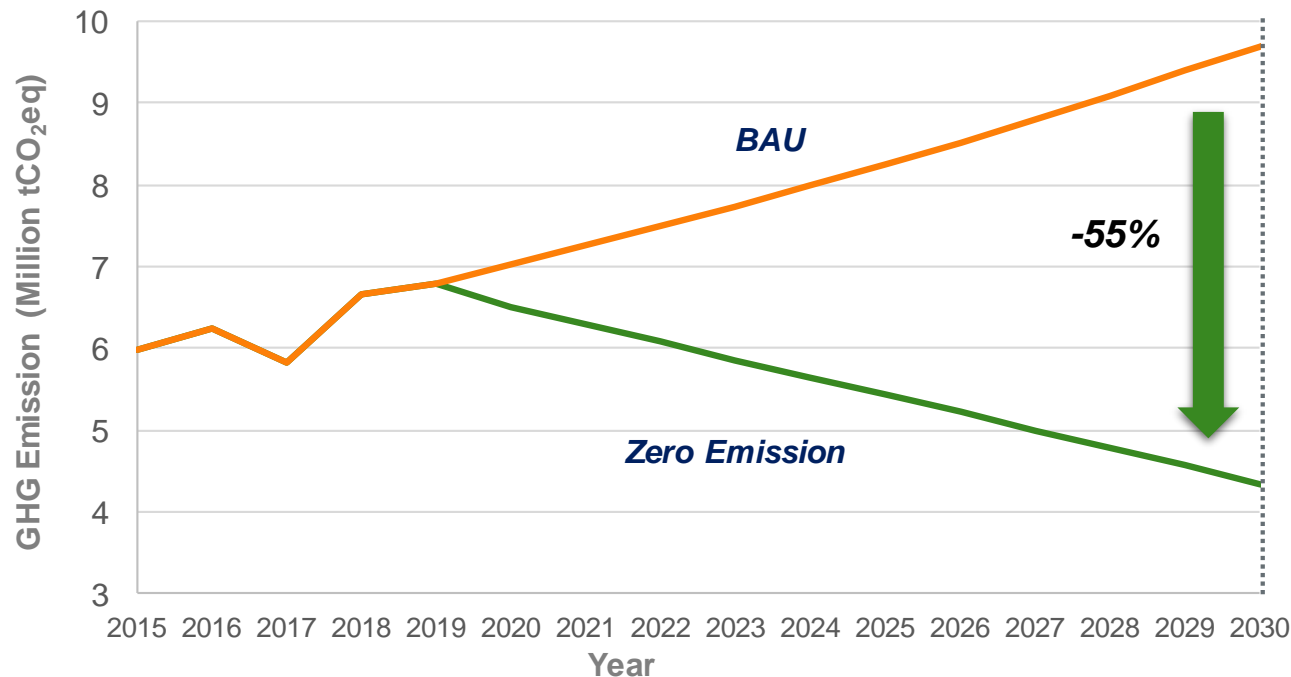
Absolute GHG Emissions - 49% Reduction

GHG Intensity 0.24 tCO₂e/MWh

Climate-Related Scenarios (5/7)

5. Zero Emission Scenario

Zero Emission pushes forward toward decarbonization in 2050. The scenarios can be achieved with positive impacts on the economic and social development while adapting a resilient business model to carbon neutral.



Assumption

A zero emission is set to achieve by 2050. The reduction is made in a linear pathway. In this scenario, no carbon offset is applied.

In 2030

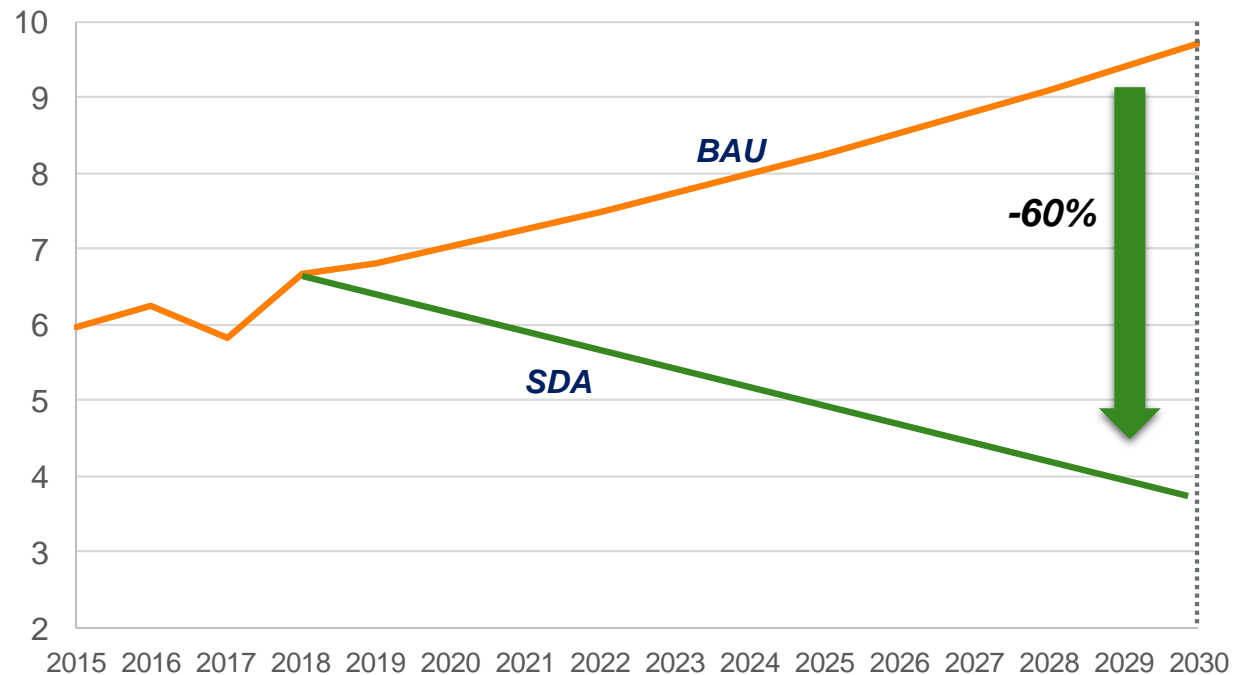
Absolute GHG Emissions - **55%** Reduction

GHG Intensity **0.22** tCO₂e/MWh

Climate-Related Scenarios (6/7)

6. Sectoral Decarbonization Approach (SDA)

The Sectoral Decarbonization Approach (SDA) is a scientifically-informed method for companies to set GHG reduction targets necessary to stay within a 2°C temperature rise above preindustrial levels. The method is based on IEA 2DS but is more specific to the particular industrial sectors.



Assumption

A gradually decline of carbon emissions is expected until 2050. In this scenario, the pathway for electricity generation sector is recommended to reduce intensity must decline steadily by 95% in 2050.

In 2030

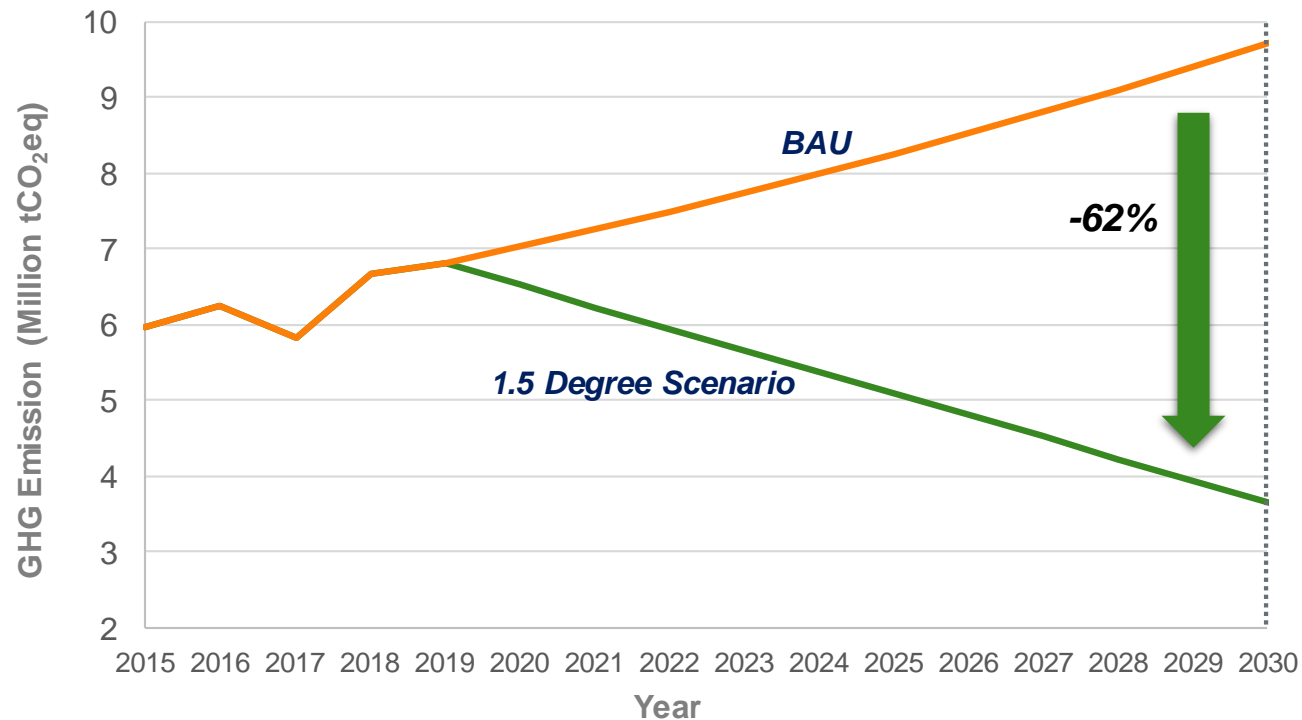
Absolute GHG Emissions - **60%** Reduction

GHG Intensity **0.19** tCO₂e/MWh

Climate-Related Scenarios (7/7)

7. 1.5 Degree Scenario

1.5 Degree Scenario outlines a more intensive GHG reduction with frame a mitigation pathways consistent with limiting global temperature to lower than 1.5 above pre-industrial levels in 2100. The scenario requires to strongly cut absolute emissions in an annual linear basis.



Assumption

With a more intensive GHG reduction from 2DS, the Absolute Emissions Contraction approach required to reduce company absolute GHG emissions by -4.2% annual linear terms.

In 2030

Absolute GHG Emissions - **62%** Reduction

GHG Intensity **0.18** tCO₂e/MWh