



### EGCO 2023 Impact Valuation



### **Topics**

- 1. EGCO's Impact Valuation Methodology
- 2. Power Generation Stability & Capability
- 3. Climate Change & GHG Emission
- 4. <u>Waste Management</u>



### **Overview of EGCO's Impact Valuation Methodology**

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# Power Generation Stability & Capability

# **Power Generation Stability & Capability**

	\$1,491,1	113,239			
	(\$982,178,300)				
	Total revenue (USD)	■ External costs for various energy technologies (USD)			
Overview					
electricity ger - Thailand: Ov - Overseas:- T Associates	neration from 20 Pla vn Business, Subsidia 'hailand: Own Busine	nts ries ss, Subsidiaries, Joint Ventures, and			
Geneneratior	1				
Total electrici (kWh)	ty and steam genera	tion 24,911,000,000.00			
Total revenue	e (USD)	1,491,113,239.07			
Caal	Linth				
Coar	K VV N	3,472,000,000			
Hydro	kwh	17,927,000,000			
Wind	LIMA	2,879,000,000			
Selar DV		475,000,000			
Solar PV	KVVn	111,000,000			
Biomass	kWh	47,000,000			

#### External costs for various energy technologies

Impact		USD
Coal	Coal	\$ 288,176,000
Gas	Gas	\$ 681,226,000
Hydro	Hydro	\$ 9,212,800
Wind	Wind	\$ 1,520,000
Solar PV	Solar PV	\$ 699,300
Biomass	Biomass	\$ 1,344,200
Subtotal: annual externa	al impact	\$ 982,178,300

Material Topic	Power Generation Stability & Capability
Business Value Chain:	Operations, Products/ Services, Supply Chain
Activity Coverage	100%*
External stakeholder(s)/ impact area(s) evaluated	Environment, Society, Consumers/ end-users

#### Materiality of externalized impact on stakeholders assessed.

As Thailand's major electricity generation company, the vital role of EGCO Group is to generate electricity in alignment with electricity demands of its customers and electricity users. Power generation continuity is of importance to gain trust from customers and electricity users. It also contributes to energy stability of the country to meet the increasing demands in the future. Apart from responding to customers' and users' demands, operational excellence that covers operational readiness and efficient planning also contribute to the financial stability of EGCO Group.

\*Scope include: 20 Plants Thailand: Subsidiaries Overseas: Subsidiaries, JV and other investment

### **Power Generation Impact Valuation Approach**

### **Estimation Approach**

The impact of electricity generation, whether from renewable or non-renewable sources, can be assessed using various **quantitative** metrics.

#### **Natural Capital Protocol:**

- 1. This framework focuses on assessing the impact on **natural capital**, which includes resources like water, air, soil, and biodiversity.
- 2. Metrics could include the carbon footprint (measuring CO2 emissions), water usage, and land use associated with 1 MW of electricity generation.
- 3. Reference: https://naturalcapitalcoalition.org/protocol/

#### Social & Human Capital Protocol:

- 1. This approach considers the impact on social and human capital, including factors like health, education, and well-being.
- 2. Metrics might involve assessing job creation, health benefits, and community engagement resulting from energy projects.
- 3. <u>Reference: https://capitalscoalition.org/capitals-approach/social-human-capital-protocol/</u>

#### Social Value UK:

- 1. Social Value UK provides guidelines for valuing social outcomes.
- 2. Metrics could include **monetary valuation** of positive social impacts (e.g., improved health, reduced poverty) and negative impacts (e.g., pollution, displacement).
- 3. <u>Reference: https://www.socialvalueuk.org/app/uploads/2017/11/Discussion\_Paper\_on\_SVP\_NCP-FINAL-VERSION-2-1.pdf</u>

### **Power Generation Impact Valuation Approach**

### **Estimation Approach**

#### Business for Societal Impact (B4SI):

- 1. B4SI (formerly LBG) provides a framework for measuring societal impact.
- 2. Metrics could include **social return on investment (SROI)**, which quantifies the value created for stakeholders.
- 3. Reference: https://b4si.net/framework/

#### Impact Reporting & Investment Standards (IRIS):

- 1. IRIS offers a standardized set of metrics for assessing impact across various sectors.
- 2. Metrics cover areas like energy efficiency, renewable energy adoption, and community well-being.
- 3. Reference: https://iris.thegiin.org/

#### Impact Management Project:

- 1. This initiative focuses on impact measurement and management.
- 2. Metrics may include positive and negative externalities, resource use, and social outcomes.
- 3. Reference: . https://impactmanagementproject.com/

### **Power Generation Impact Identification**

### Framework



•Non-renewable resources: Fossil fuels like coal and natural gas are finite resources, raising concerns about longterm sustainability.

•Renewable resources: While some renewables like wind and solar have minimal resource depletion, others like geothermal and hydro may have localized impacts.

•Water usage: Cooling systems in thermal power plants can consume significant water resources, impacting water availability in water-stressed regions.



•Economic development: Reliable electricity access empowers communities, fuels economic activity, and improves living standards.

•Energy security: Dependence on domestic energy sources like renewables reduces reliance on foreign oil and gas imports.

•Innovation: Investments in clean energy technologies can drive innovation in other sectors, leading to wider societal benefits.



•Air pollution: Fossil fuel combustion (coal, natural gas) releases harmful pollutants like sulfur oxides, nitrogen oxides, and particulate matter, leading to respiratory issues, acid rain, and climate change.

•Water pollution: Thermal and chemical pollution from power plants can harm aquatic life and water.

•Land use: Large-scale hydropower projects may require dam construction and flooding, impacting ecosystems and displacing communities.

•Waste disposal: Power generates wastes such as fly ash, posing long-term storage challenges.



**Social Outcomes:** 



Impact

•Public health: Clean energy sources can improve air quality and reduce respiratory illnesses, leading to healthier communities.

•Job creation: The transition to clean energy can create new jobs in renewable energy sectors.

•Energy access: Expanding electricity access to underserved communities can improve education, healthcare, and economic opportunities.

### **Power Generation Impact Identification**

### Externalities of Electricity Generation

Impact	External Stakeholder	Description of Impact		
Air Pollution (Negative)	Residents, public health agencies	Emissions of pollutants like SOx, NOx, and PM contribute to respiratory issues, acid rain, and climate change.		
Water Pollution (Negative)	Communities, aquatic ecosystems	Thermal and chemical pollution from power plants harm water quality and aquatic life.		
Land Use (Negative) (Specific to Hydropower)	Local communities, indigenous populations	Dam construction and flooding displace communities and disrupt ecosystems.		
Waste Disposal (Negative) (Specific to Coal-fired Power Plants)	Future generations, local communities	Fly ash waste generation creates long-term storage challenges and potential environmental risks.		
Non-renewable Resource Depletion (Negative)	Future generations	Fossil fuels like coal and natural gas are finite resources, raising concerns about long-term sustainability.		
Renewable Resource Use (Mixed)	Local communities, environment	While some renewables have minimal resource depletion, others may have localized impacts (e.g., water usage for geothermal).		
Water Usage (Negative) (Specific to Thermal Power Plants)	Local communities, ecosystems	Cooling systems consume significant water resources, impacting availability in water- stressed regions.		

Impact	External Stakeholder	Description of Impact
Economic Development (Positive)	Communities, businesses	Reliable electricity access empowers communities, fuels economic activity, and improves living standards.
Energy Security (Positive)	National governments, consumers	Dependence on domestic energy sources like renewables reduces reliance on foreign oil and gas imports.
Innovation (Positive)	Society, technological sectors	Investments in clean energy drive innovation in other sectors, leading to wider societal benefits.
Public Health (Positive)	Communities, public health agencies	Clean energy sources improve air quality, reducing respiratory illnesses and leading to healthier communities.
Job Creation (Positive)	Workforce, local communities	The transition to clean energy creates new jobs in renewable energy sectors.
Energy Access (Positive)	Underserved communities, individuals	Expanding electricity access improves access to education, healthcare, and economic opportunities.

### **Power Generation Impact Valuation**

### Calculate Externalities of Electricity Generation

Quantitative Impact Metric	Quantitative Impact Calculati	on	Reference		
Externalities of Electricity Generation	Using the statistical analysis of	f external costs of various energ	*The analysis incorporated the estimation of external costs proxy: Human Health, Loss of Biodiversity, Local and Global Damage to Crops, Damage to Materials, and Climate Change		
	Generation Source	Gross generation 2023 own assets (kWh)	*Proxy external costs of various energy technology (US cent/kWh)	External costs of various energy technology (USD/kWh)	Proxy external cost (2002) is subject to 3% of yearly adjustment rate
	Coal	3,472,000,000	8.3	288,176,000	The externalities of energy production in the context of development of clean energy generation: http://search.proguest.com/openview/8349ae02af32d61844ed4bbcf016b
	Gas	17,927,000,000	3.8	681,226,000	563/1?pq-origsite=gscholar&cbl=54208
	Hydro	2,879,000,000	0.32	9,212,800	Impact Management Project: <u>https://impactmanagementproject.com</u>
	Wind	475,000,000	0.32	1,520,000	
	Biomass	47,000,000	2.86	1,344,200	



# **Climate Change & GHG Emission**

# EGCO Climate Change Impact Valuation

\$260,949,808

	Total annual societal c	osts incurred (er	nvironment) (USD)	tal annual societal costs avoided (environment) (USD)		
tal social neration	cost of annual impacts from electricity	\$	1,223,482,518	Total social cost of annual impacts avoided from electricity generation	™ \$	260,949,808
tput Gen	erated			Output Avoided		
	GHG Waste NOx	sox Wa	iter	GHG Waste NOx	SOX	Water
Output			Unit	Output		Unit
npact Gene	erated			Impact Avoided		
pact Gen	erated		USD	Impact Avoided		USD
pact Gen npact nnual so	erated cietal cost of GHG	\$	USD 1,223,482,518	Impact Avoided Impact Annual societal cost of GHG reduction	\$	<b>USD</b> 260,949,808

	Material Topic	Climate Change and GHG emissions
	Business Value Chain:	Operations, Products/ Services, Supply Chain
	Activity Coverage	100%*
•	External stakeholder(s)/ impact area(s) evaluated	Environment, Society, Consumers/ end-users

### Materiality of externalized impact on stakeholders assessed.

Climate change is important to the utility business because it directly impacts energy infrastructure and operations. More extreme weather events can damage facilities and disrupt energy supply. The industry's transition to cleaner energy sources also plays a role in addressing climate change, as utilities adapt to meet environmental regulations and ensure long-term sustainability.

\*Scope include: 20 Plants Thailand: Subsidiaries Overseas: Subsidiaries, JV and other investment



External Stakeholder	Description of Impact	Negative/Positive Externalities on Societal Stakeholders or Environment	Direct Environmental and/or Social Outputs Generated by Company's Business Activities	Quantitative Impact Metric
Renewable Energy Advocates	Adoption of renewable energy sources and green technology by utility companies to reduce emissions	Positive: Reduction in carbon footprint, promotion of sustainability	Investment in renewable energy sources like solar and wind	Percentage of energy generated from renewable sources
Regulatory Bodies	Compliance with environmental regulations and emission standards to mitigate climate change impacts	Positive: Reduced environmental degradation, improved regulatory compliance	Implementation of emission control technologies and policies	Level of compliance with emission standards
Future Generations         Long-term consequences of climate change affecting quality of life, resources, and opportunities for future generations		Negative: Limited access to resources, compromised living conditionsContinued reliance on fossil fuels renewable energy sources		Projected increase in temperature,
Society Reduction in greenhouse gas emissions (GHG) and impact is social cost of carbon		Positive: Mitigation of climate change impacts, reduction in social cost of carbon	Implementation of carbon reduction initiatives and green practices	Reduction in social cost of carbon, tons of GHG emissions reduced
Customers Opportunity to reduce emissions at customers (Scope 2) from switching to renewables and alternative fuels from process improvement and low carbon technologies.		Positive: Reduction in overall emissions, promotion of sustainable practices	Offering renewable energy options and promoting low carbon technologies	Reduction in emissions (Scope 2) at customer sites, percentage of customers using renewables
Supply Chain         Reduction of GHG in value chain (Scope 3)         Positive: Reduction in overall emission promotion of sustainable practices		Positive: Reduction in overall emissions, promotion of sustainable practices	Implementing supply chain sustainability practices	Reduction in emissions (Scope 3) along the value chain, percentage of suppliers using low carbon technologies
Consumers/End Users	Higher cost from alternative fuels and technology may impact consumers/end users	Negative: Financial burden, affordability concerns	Increased prices for energy or products due to green initiatives	Percentage increase in cost for consumers/end users, impact on consumer spending habits



### **Estimation Approach**

1. Define Scope and Emissions:

- Production process: Quantify the specific emissions from the production process (e.g., power generation, fuel use).
- Reduction projects: Specify the types of projects (e.g., renewable energy adoption, energy efficiency improvements) and forest management practices contributing to the Metric tonnes CO2 equivalent reduction.
- Specify the timeframe: 2024.

#### 2. Choose Proxy:

- The Social Cost of Carbon (SCC) represents the economic cost of emitting one additional tonne of CO2 to society due to climate change impacts. Several SCC estimates exist, each with its strengths and limitations. There are various sources for SCC estimates, including:
  - EPA Report on Social Cost of Greenhouse Gases: Provides SCC estimates for different policy scenarios and discount rates, the SCC for 2023 emissions is \$125/tonne of CO2 (Source EPA Social Cost of Carbon: <u>https://www.epa.gov/system/files/documents/2023-12/epa\_scghg\_2023\_report\_final.pdf</u>)
  - World Bank SCC Estimates: The World Bank offers SCC values based on different regions and income levels. For East Asia and Pacific (high-income), the SCC for 2020 emissions is \$140/tonne of CO2. (Source: <a href="https://openknowledge.worldbank.org/entities/publication/e917b047-3a48-5688-9804-0466417304fd">https://openknowledge.worldbank.org/entities/publication/e917b047-3a48-5688-9804-0466417304fd</a>)
  - US Interagency Working Group (IWG) SCC: This is the official SCC estimate used by the US government. It provides central and discount rate-adjusted values for different time periods. For 2024, the central value is \$51/tonne of CO2. (Source US Interagency Working Group on Social Cost of Greenhouse Gases: https://www.whitehouse.gov/wp-content/uploads/2021/02/TechnicalSupportDocument\_SocialCostofCarbonMethaneNitrousOxide.pdf)

### **Selected Climate Impact Valuation**

### Calculate Social Cost of Impact

Impact	External Stakeholder	Description of Impact	Quantitative Impact Metric	Quantitative Impact	Reference
Positive	Society	Reduction in greenhouse gas emissions (GHG) and impact is social cost of carbon	Reduction in social cost of carbon, tons of GHG emissions reduced	Greenhouse gas reduction: 2,087,598 Metric tonnes CO2 equivalent Social cost of carbon: \$125/Metric tonnes CO2 equivalent The avoided SCC = \$260,949,808	EPA Report on Social Cost of Greenhouse Gases Proxy value: for 2023, the central value is \$125/Metric tonnes CO2 equivalent Sourcehttps://www.epa.gov/system/files/documents/2023- 12/epa_scghg_2023_report_final.pdf
Negative	Society	Emission in greenhouse gas emissions (GHG) and impact is social cost of carbon	Increase in social cost of carbon from, tons of GHG emissions produced	Greenhouse gas emission from electricity generation: 9,787,860 tons CO2 Social cost of carbon: \$125/Metric tonnes CO2 equivalent The impact of SCC = \$1,223,482,518	



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## Waste Management

### **Waste Management Impact Valuation**

			\$2,987,474		
	(\$8,790,968)				
Total annual societal cos	ts incurred (environ	ment) (USD) Total ar	nnual societal costs avoided (environment) (USD)		
Total Impact			Total Impact Avoided		
Total social cost of annual impacts from electricity generation	\$	8,790,968	Total social cost of annual impacts avoided from electricity generation	\$	2,987,474
Output Generated			Output Avoided		
GHG Waste NOx S	SOX Wate	Unit	GHG Waste NOx	SOX	Water
Output			output		onic
Waste landfilled or incinerated (metric tonnes)		46,245	Waste diverted from disposal (metric tonnes)		26,279
Impact Generated			Impact Avoided		
Impact		USD	Impact		USD
Annual societal cost of waste	\$	8,790,968	Annual societal cost of waste diverted	\$	2,987,474
Subtotal: annual societal costs incurred	\$	8,790,968	Subtotal: annual societal costs avoided	\$	2,987,474

Material Topic	Waste Management
Business Value Chain:	Operations, Products/ Services, Supply Chain
Activity Coverage	100%*
External stakeholder(s)/ impact area(s) evaluated	Environment, Society

#### Materiality of externalized impact on stakeholders assessed.

EGCO Group recognizes the significant impact of waste generated from its power plants on the environment and communities within its value chain. Inadequate waste handling poses risks to external stakeholders, including environmental harm, health hazards, and community dissatisfaction. Embracing sustainable waste practices is essential for nurturing positive stakeholder relationships, promoting environmental stewardship, and ensuring the long-term viability of companies. To address this, EGCO has established waste management guidelines that align with relevant standards and regulations. These guidelines aim to ensure proper waste disposal and enhance operational eco-efficiency.



External Stakeholder	Description of Impact	Negative/Positive Externalities on Societal Stakeholders or Environment	Direct Environmental and/or Social Outputs Generated by Company's Business Activities	Quantitative Impact Metric
Local Communities	Pollution and health hazards caused by waste disposal.	Negative: Local communities bear the brunt of environmental       Environmental pollution, health risks.         degradation and health issues due to the utility company's waste       Environmental pollution, health risks.         disposal practices, resulting in negative externalities on their well-being       and quality of life.		Increased hospital admissions due to respiratory issues, higher rates of illnesses attributed to pollution.
Recycling Companies	Opportunity for waste recycling and resource recovery.	Positive: Recycling companies benefit from increased business opportunities and resource utilization, contributing positively to the economy and environmental sustainability.	cycling companies benefit from increased business s and resource utilization, contributing positively to the id environmental sustainability.	
Government Regulatory Bodies	Stricter regulations and penalties due to environmental pollution.	Negative: Government regulatory bodies impose stricter regulations and penalties on the utility company, which negatively affects its operations and financial performance while aiming to mitigate environmental harm.	Regulatory oversight, legal enforcement.	Increase in fines levied, number of regulatory violations reported.
Renewable Energy Companies	Potential for energy recovery from waste (e.g., through incineration).	Positive: Renewable energy companies capitalize on the utility company's waste by converting it into energy, creating positive externalities through sustainable energy production and resource optimization.	Renewable energy generation, resource utilization.	Megawatt-hours of energy generated from waste conversion.
Wildlife and Ecosystems	Habitat destruction and pollution from improper waste disposal.	Negative: Wildlife and ecosystems suffer negative externalities from habitat destruction and pollution caused by the utility company's waste disposal, leading to ecological imbalances and threats to biodiversity.	Loss of biodiversity, ecosystem degradation.	Decrease in biodiversity indices, habitat fragmentation metrics.
Society	Social cost of waste disposal includes healthcare expenses, environmental damage.	Negative: Society bears the negative externalities of waste disposal through increased healthcare costs and environmental damage, impacting overall well-being and quality of life.	Increased healthcare burden, environmental degradation.	Monetary value of healthcare expenses attributed to waste-related illnesses, environmental remediation costs.



### **Estimation Approach**

1. Define Scope:

<ul> <li>Total hazardous waste directed to disposal (landfill/incineration without heat recovery): <ul> <li>Hazardous waste landfilled:</li> <li>Hazardous waste incinerated without energy</li> <li>Ash and gypsum waste landfilled</li> </ul> </li> <li>Total non- hazardous waste directed to disposal (landfill/incineration without heat recovery): <ul> <li>Non-hazardous waste landfilled</li> <li>Non-hazardous waste incinerated without energy</li> </ul> </li> </ul>	<ul> <li>Total hazardous wastes diverted <ul> <li>Hazardous diverted from disposal (used/recycled/sold)</li> <li>Ash and gypsum waste composted, reused, recycled, or recovered</li> </ul> </li> <li>Total non-hazardous wastes diverted <ul> <li>Non-hazardous diverted from disposal (used/recycled/sold)</li> </ul> </li> </ul>
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• Specify the timeframe: 2024



### Estimation Approach (continued)

2. Choose Proxy:

- Determining the exact costs of landfill and incineration for waste from the utility sector is challenging due to several factors: Variations in location: Costs can vary significantly depending on the region, country, and even specific facility. Type of waste: Different types of utility waste (e.g., ash, hazardous materials, recyclables) may have different disposal costs. Market fluctuations: Landfill tipping fees and incineration processing charges can change over time.
- Cost Components:
  - System Capital Expenditures: These include the initial investment in equipment and infrastructure.
  - Annual Operating and Maintenance Costs: These ongoing costs cover day-to-day operations, maintenance, and other expenses.
  - Capital Recovery: Calculations related to recovering the initial capital investment.
- Hazardous Waste:
  - Landfill: Due to the stringent regulations and handling requirements, hazardous waste disposal in landfills generally comes at a significantly higher cost than non-hazardous waste. Estimates suggest a range of USD 100-500 per tonne ([Source: The World Bank, What a Waste 2.0, 2018]
  - Incineration: Similarly, specialized equipment and procedures are needed to handle hazardous waste through incineration, leading to higher costs. Estimates suggest a range of USD 300-1000 per tonne ([Source: Revised Estimation of Baseline Costs for Hazardous Waste Combustors for Final MACT Rule, EPA, 1999]).

Non-Hazardous Waste:

- Landfill: Costs vary significantly depending on location and specific facility, but generally fall within a range of USD 20-80 per tonne ([Source: The World Bank, What a Waste 2.0, 2018]).
- Incineration: While still higher than landfill, non-hazardous waste incineration tends to be less expensive than hazardous waste incineration. The estimated range is around USD 60-200 per tonne ([Source: The High Cost of Waste Incineration, no-burn.org, 2021]).
- Social costs for waste incineration amount to Euro 97 per tonne of waste compared with only Euro 58 per tonne of landfilled waste. ([Source: Burn or Bury? A Social Cost Comparison of Final Waste Disposal Methods, 2003)].



### Calculate Social Cost of Impact

Impact	External Stakebolder	Description of Impact	Quantitative Impact	Quantitative Impact	Reference
Positive	Society	Social cost reduction due to recycling includes resource conservation, pollution mitigation.	Monetary value of reduced social costs associated with landfilling and incineration	Waste diversion from landfill or incinerated with energy recovery: 26,279 metric tonnes Social cost of waste incineration: <b>euro 97/metric tonnes (2003) with</b> <b>3% yearly adjustment rate</b> Social cost of waste landfilled: <b>euro 58/metric tonnes (2003) with 3%</b> <b>yearly adjustment rate</b> The avoided social cost of waste = \$2,987,474	Social cost of wastes: https://www.econstor.eu/bitstream/10419/118076/1/NDL2003- 046.pdf The World Bank, What a Waste 2.0 (2018) provides a general range of global landfill costs: https://documents.worldbank.org/en/publication/documents- reports/documentdetail/302341468126264791/what-a-waste-a- global-review-of-solid-waste-management EPA report provides some insights into the range of baseline operating costs: https://www.epa.gov/stationary-sources-air- pollution/hazardous-waste-combustors-national-emission-
Negative	Society	Social cost of landfilling and incineration includes pollution, habitat destruction.	Monetary value of environmental damage, cost of habitat restoration efforts.	Waste diversion sent to landfill or incinerated without energy recovery: 46,245 metric tonnes Social cost of waste incineration: <b>euro 97/metric tonnes (2003) with</b> <b>3% yearly adjustment rate</b> Social cost of waste landfilled: <b>euro 58/metric tonnes (2003) with 3%</b> <b>yearly adjustment rate</b> The avoided social cost of waste = \$8,790,968	standards-nazardous Revised Estimation of Baseline Costs for Hazardous Waste Combustors for Final MACT Rule, EPA (1999): https://archive.epa.gov/epawaste/hazard/tsd/td/web/pdf/app-b.pdf The High Cost of Waste Incineration, no-burn.org, 2021: https://www.no-burn.org/incineration/ https://www.xe.com/ 1 EURO to 1.08523 USD (10 April 2024)