Norfund investment analysis

Final report

August 21th, 2024

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Norfund’s experience and knowledge could secure highly competitive projects, which would achieve 50 mt of annual avoided emissions with investments of 1.07 BUSD (11.2 mrd. NOK)

Key takeaways	Description
1 **Indonesia, South Africa, Vietnam, India and the Philippines have high potential for emissions avoidance due to fossil sources dominating power generation and renewable growth projections of 30-480 GW per country by 2030**	• Five countries have been selected based on their fit with the Norfund's strategy and mandate, which is to maximize emissions avoidance in countries where its investments can be additional. The specific selection criteria were 1) current generation from fossil-based sources, 2) forecast renewable growth, and 3) access to capital, leading to the selection of Indonesia, South Africa, Vietnam, India, and the Philippines. • India has the highest renewable outlook, with renewable growth amounting to 480 GW between 2023 and 2030. However, all selected countries are expected to add 30-40 GW by 2030. This is expected to come from a high share of solar PV as all are located in the solar belt with high capacity factors and a high degree of predictability.
2 **Three portfolios with different exposure to geographical and technological risk have been selected to reach goal of 50 million tonnes in emissions avoidance through 2030 investments**	• Three portfolios have been selected based on differing risk profile related to geographical and technology risk exposure. Portfolio A allows for 40% geographical investment exposure per country within the forecast growth of renewables, while portfolio B is less risky with a geographical investment exposure of 25%. Portfolio C introduces new technologies compared to Norfund's current technology selection such as offshore wind. These technologies currently yields a low amount of avoided emissions per invested amount, but could provide more value in the long run. • Input parameters, including cost and capacity factors, are based on Rystad Energy in-house data covering data on existing projects in the selected countries. Portfolio A has also been tested with input data based on Norfund achieved cost and capacity factors.
3 **Portfolio A reaches the emissions avoidance target with the lowest investment requirement of 1.82 BUSD (19.1 mrd. NOK[1]) with a selection of solar projects in South Africa, India and Indonesia**	• Portfolio A yields the lowest investment cost per avoided emissions with investments in solar in South Africa, India and Indonesia. These three countries have a significant amount of emission-intensive coal in the power mix in 2030, leading to the highest emission factors. Furtmore, while solar in India has the lowest capex cost, the high capacity factors of solar in South Africa and Indonesia reduces the overall LCOE. • Reaching 50 million tonnes of annual avoided CO2 emissions from the new investments in 2030 requires investments of 1.82 BUSD (19.1 mrd. NOK) based on minimizing cost per avoided emissions, which is achieved in Portfolio A.
4 **If Norfund is able to utilize its experience and knowledge to secure competitive projects with lower-than-average project costs, required invesments could be reduced to 1.07 BUSD (11.2 mrd. NOK)**	• Norfund have been able to achieve lower project capex than the averages reported by Rystad Energy. This includes for Indian solar PV, where Norfund has in 2024 attained a capex around 0.5 MUSD/MW, compared to Rystad's observed average evel of ~0.7 MUSD/MW. • Portfolio A.2 assumes that Norfund will continue to secure highly competitive projects in 2030, leveraging its expertise in selected countries and technologies, in line with its strategic objectives. The portfolio uses Norfund achieved cost data and other project-specific inputs to evaluate the required investments in 2030. To achieve the target of 50 million tonnes of annual avoided CO2 emissions by 2030, the required investments are estimated to be 1.07 billion USD (11.2 billion NOK).

1) Exchange rate assumed to 10.5 NOK/USD
Source: Rystad Energy research and analysis

Rystad Energy has established an investment model to estimate investments required in 2030 to reach 50 mt of annually avoided CO_2 emissions

The Climate Investment Fund's 2030 investments can contribute to 50 mt of avoided CO2 emissions annually - matching Norway's total emissions

Norfund

It is possible to scale the Climate Investment Fund towards 2030 with the target for 2030 investments alone to contribute to 50 mt of annual avoided CO2 emissions to the portfolio. The investments can be counted as part of Norway's climate finance and must be in line with Norfund's Climate Investment Fund criteria described below.

1) **Climate impact** – The investments must contribute to reduced or avoided emissions, either directly or indirectly.
2) **Additionality** – The investments must be additional and only include projects that would not have been realized without Norfund's participation and where Norfund can be catalytic and add value through expertise and influence.
3) **Feasibility** – Norfund must be able to efficiently invest its capital given external and internal constraints.

The projects shall be profitable, and any revenue shall be reinvested. Norfund's participation shall not exceed 35%.

RystadEnergy

Rystad Energy has conducted an analysis to determine the investments required to reach 50 mt annually avoided CO2 emissions from investments carried out in 2030. The target of the analysis was to establish portfolios that minimize required investments to reach 50 mt CO2 avoidance in line with the Norfund mandate and strategy. The required investments were determined with two different datasets:

1) **Rystad Energy country-specific renewable project data:** Cost and other project parameters for 2030 are established based on historical project data from Rystad Energy research forecasted using NREL capex reduction rates and capacity factor improvements per technology.

2) **Norfund achieved results:** Cost and other project parameters are based on historical Norfund achieved results that are forecasted to 2030 based on NREL capex reduction rates and capacity factor improvements per technology. Norfund's strategy is to utilize its experience and knowledge within the relevant countries and technologies to ensure highly competitive projects, e.g. selecting low-cost technologies that are also able to achieve high capacity factors.

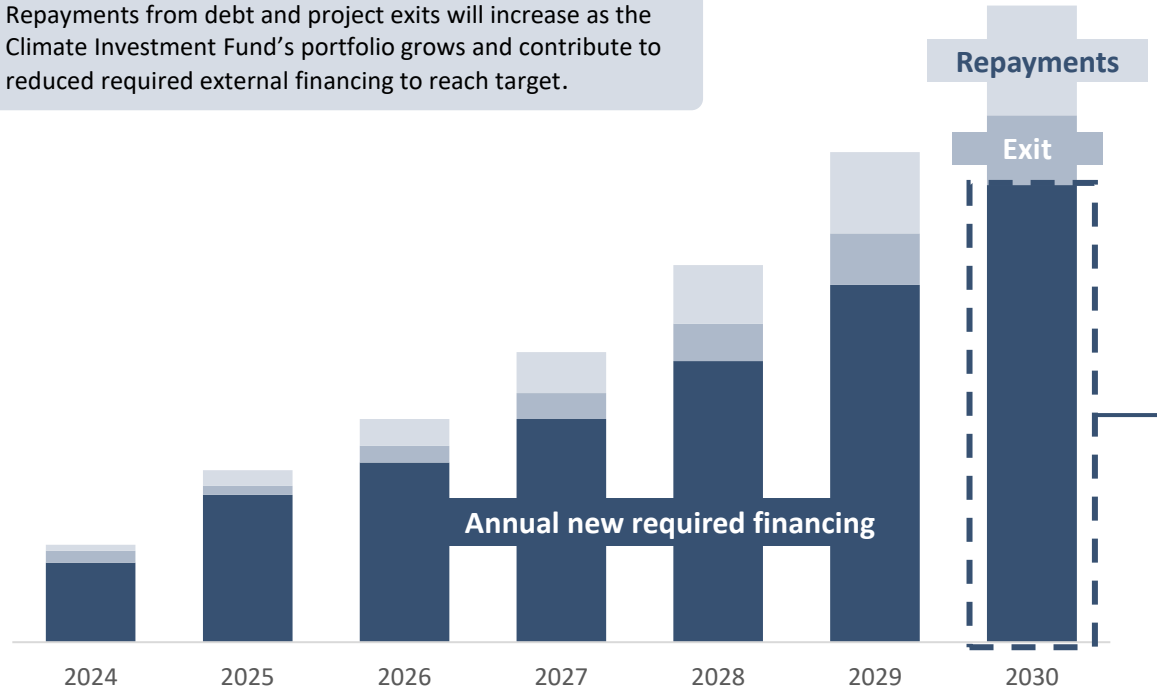
Sources: Rystad Energy research and analysis

The 2030 investments alone will add 50 mt avoided emissions annually to the Climate Investment Fund's portfolio

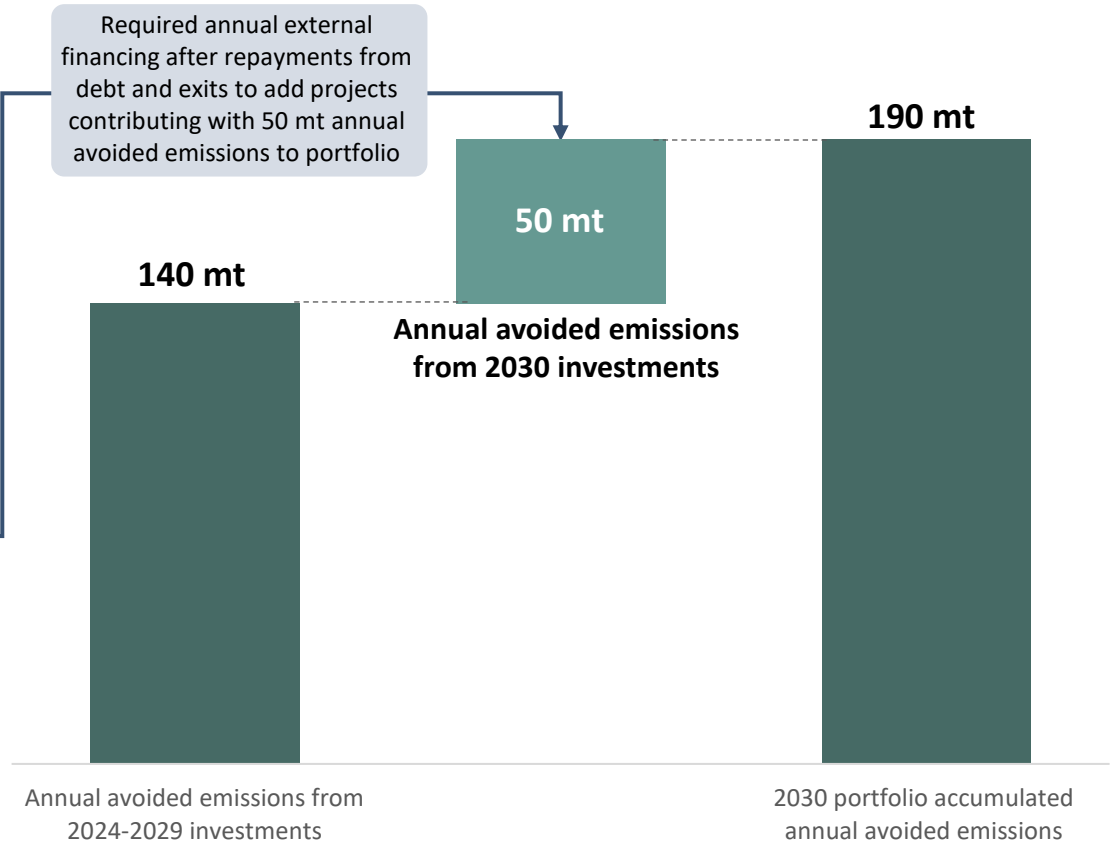
Annual investments required to reach 50 mt avoided emissions (conceptual)
MUSD

It is possible to scale the Climate Investment Fund towards 2030 to reach target of adding 50 mt of annual avoided emissions to portfolio with 2030 investments.

Repayments from debt and project exits will increase as the Climate Investment Fund's portfolio grows and contribute to reduced required external financing to reach target.



Annual avoided CO2 emissions from Norfund 2030 portfolio
Million tonnes



Total avoided emissions achieved from the Climate Investment Fund's portfolio will be much higher accumulated and can be established by summarizing the annual avoided emissions over the project's lifetime.
Sources: Rystad Energy research and analysis

RystadEnergy

Portfolio A reaches emission target with 1.82 BUSD and could reach 1.07 BUSD with Norfund costs

Portfolio selection: Reach 50 mt annual avoided CO2 emissions by minimizing investments per tonne CO2 avoided

A Portfolio A - High country exposure

Portfolio A illustrates how to minimize 2030 investments needed to reach 50 mt avoided CO2 emissions with country exposure limited to maximum 40%

Portfolio Constraints

- Max 40% country exposure
- Max 10 GW invested in generation[1]
- Selection on minimizing cost of 50 million tonnes of CO2 emission abatement

Country	Technology	2030 USD/t	Invested GW 2030	Exposure
South Africa	Solar	573 $/t	10.0 GW	40%
India	Solar	651 $/t	11.8 GW	40%
Indonesia	Solar	763 $/t	5.4 GW	20%

Required external financing[2]	1.82 BUSD
Emission abatement	50 Million tonnes CO_2

A.2 Portfolio A.2 - High country exposure with Norfund achieved results

Portfolio A.2 illustrates how to minimize 2030 investments needed to reach 50 mt avoided CO2 emissions with country exposure limited to maximum 40%, applying Norfund acheive project data

Portfolio Constraints

- Max 40% country exposure
- Max 10 GW invested in generation[1]
- Selection on minimizing cost of 50 million tonnes of CO2 emission abatement

Country	Technology	2030 USD/t	Invested GW 2030	Exposure
India	Solar	344 $/t	11.1 GW	40%
South Africa	Solar	388 $/t	9.3 GW	40%
Indonesia	Solar	475 $/t	4.9 GW	20%

Required external financing[2]	1.07 BUSD
Emission abatement	50 Million tonnes CO_2

1) Limitation does not apply to India as renewable growth projection from 2024-2030 is much higher than the other countries with 480 GW of expected new capacity, compared to 30-40 GW in South Africa, Indonesia, Vietnam and Philippines.
2) Assuming 8% equity and 8% debt participation, and that exits and debt repayments from existing portfolio will contribute to revenue and reduce the need for external financing. Source: Rystad Energy research and analysis

Increased exposure to additional technologies results in highest required investments of 2.36 BUSD

Portfolio selection: Reach 50 mt annual avoided CO2 emissions by minimizing investments per tonne CO2 avoided

B Portifolio B - Current strategy

Portfolio B illustrates how to minimize 2030 investments needed to reach 50 mt avoided CO2 emissions with country exposure limited to maximum 25%

Portfolio Constraints

- Max 25% country exposure
- Max 10 GW invested in generation[1]
- Selection on minimizing cost of 50 million tonnes of CO2 emission abatement

Country	Technology	2030 USD/t	Invested GW 2030	Exposure
South Africa	Solar	573 $/t	7.2 GW	25%
India	Solar	651 $/t	8.5 GW	25%
Indonesia	Solar	763 $/t	7.8 GW	25%
Vietnam	Solar	1193 $/t	8.6 GW	25%

Required external financing[2]	2.12 BUSD
Emission abatement	50 Million tonnes CO_2

C Porfolio C - New technology exposure

Portfolio C illustrates how to minimize 2030 investments needed to reach 50 mt avoided CO2 emissions with country exposure limited to maximum 25% and minimum 25% exposure to new technologies, offshore wind and solar + hydrogen

Portfolio Constraints

- Max 25% country exposure
- Min 25% new technologies
- Max 10 GW invested in generation[1]
- Selection on minimizing cost of 50 million tonnes of CO2 emission abatement

Country	Technology	2030 USD/t	Invested GW 2030	Exposure
South Africa	Solar	573 $/t	8.0 GW	25%
India	Solar	651 $/t	9.5 GW	25%
Indonesia	Solar	763 $/t	8.7 GW	25%
Philippines	Offshore Wind	3494 $/t	1.9 GW	25%

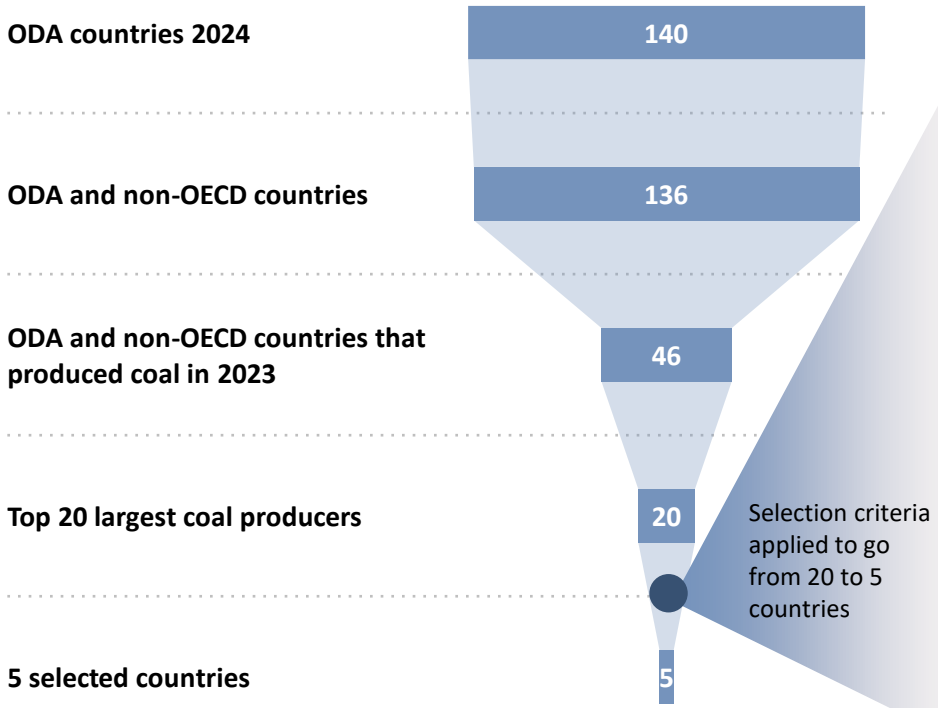
Required external financing[2]	2.36 BUSD
Emission abatement	50 Million tonnes CO_2

1) Limitation does not apply to India as renewable growth projection from 2024-2030 is much higher than the other countries with 480 GW of expected new capacity, compared to 30-40 GW in South Africa, Indonesia, Vietnam and Philippines
2) Assuming 8% equity and 8% debt participation, and that exits and debt repayments from existing portfolio will contribute to revenue and reduce the need for external financing. Source: Rystad Energy research and analysis

Climate and additionality impact determine the final selection of five target countries

Country selection to reach 50 mt in CO_2 emissions

Funnel for Norfund's climate fund



Country selection criteria

Climate impact		Fossil power generation	Total fossil generation in 2023 (TWh). Countries with large power production from fossil sources have higher need for renewable projects to avoid increasing emission levels. (Scoring: Higest value = 1, Lowest value = 20).
	%	Growth in generation from fossil sources	The growth in power generation from fossil fuel towards 2030 is an indication of the country's need for additional production from renewable energy (Scoring: Higest value = 1, Lowest value = 20).
		Renewable growth	Growth in renewable energy towards 2030 indicates the need for additional projects and illustrates the difference in installed renewable capacity between 2023 and 2030 in GW (Scoring: Highest value = 1, Lowest value = 20).
Additionality impact		GDP/Capita	Indicatative of the economic strength and potential for energy investments without foreign investments (Scoring: Lowest value = 1, Highest value = 20).
		FDI/GDP	Foreign Direct Investment as a percentage of GDP serves as a proxy for access to capital (Scoring: Lowest value = 1, Highest value = 20).
Overall score		Overall Score	Each country is ranked from 1-20 for each of the five metrics. The overall score is the average of these scores, which informs final recommendations and capital allocation.

Source: Rystad Energy research and analysis, PowerCube, Worldbank, UNCTAD

5 countries are selected due to significant fossil generation and large renewable growth projections

		Emission impact			Capital access			
Final ranking	Country[1]	Total Fossil Production 2023[2] (TWh)	Fossil Growth 2023-2030 (TWh)[2]	Renewable Growth 2023-2030 (GW)	GDP/capita[5]	FDI/GDP[4]	Overall score[3]	Comment
1	Indonesia	283	98	42	4580	2%	7	✓ Include as a selected country
2	South Africa	160	60	31	6780	2%	7	✓ Include as a selected country
3	Vietnam	195	54	42	4010	4%	7	✓ Include as a selected country
4	India	1491	51	472	2390	1%	7	✓ Include as a selected country
5	Bangladesh	100	49	9	2820	0%	7	
6	Iran	337	32	12	3980	0%	8	
7	Mongolia	23	22	1	4260	15%	9	
8	Myanmar	13	21	16	1270	2%	9	
9	Ukraine	33	20	16	4260	0%	9	
10	Iraq	101	17	8	5270	-1%	10	
11	Algeria	98	16	4	3920	0%	11	
12	Libya	38	16	1	7260	0%	11	
13	Venezuela	19	11	0	0	0%	11	
14	Kazakhstan	95	10	25	9620	2%	12	
15	Pakistan	74	9	31	1560	0%	12	
16	Philippines	93	8	42	3950	2%	13	✓ Include as a selected country
17	Cambodia	8	6	5	1690	12%	14	
18	Tanzania	3	6	16	1200	2%	14	
19	Mozambique	3	5	2	440	16%	15	
21	Nigeria	35	5	6	2160	-0%	16	

1) Only ODA countries included, 2) Only countries that included fossil fuels in their energy mix in 2023 are included and here measured in TWh. This list includes the top 20 largest producer, 3) Average of 1-20 ranking of the selected parameters, 4) Foreign Direct Investment/GDP, 5) Source Worldbank current US$ in BUSD Source: Rystad Energy research and analysis, PowerCube, Worldbank, UNCTAD

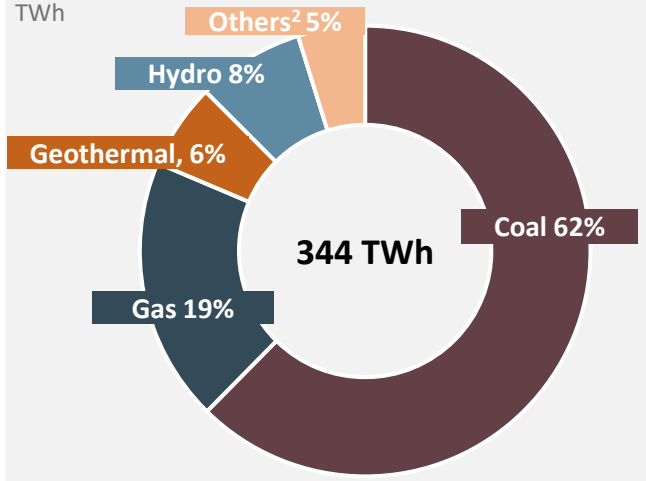
Coal
Gas
Liquids

Indonesia's power mix is dominated by coal and gas, and has had limited renewable growth

Current situation in Indonesia

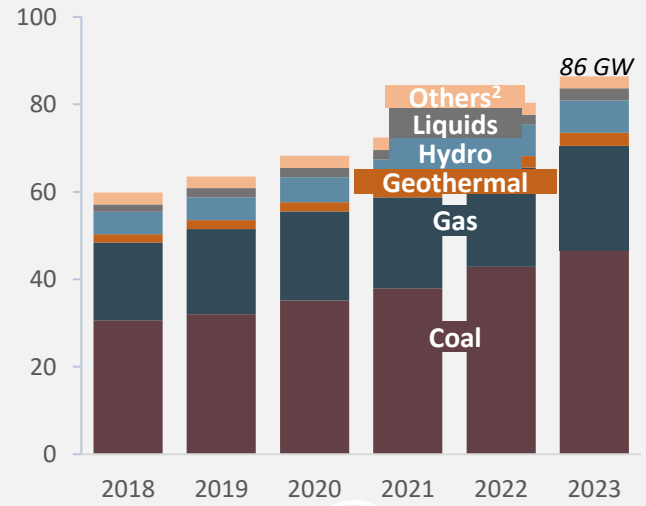
1 Indonesia's power mix is fossil driven with coal and gas being the largest

Power generation Indonesia in 2023
TWh



2 Installed capacity has increased the last 5 years, but no growth in renewables

Installed capacity Indonesia 2018-2023
GW



3 Low renewable share and FDI/GDP ratio is on the global average

Primary drives for selecting the country

Low renewable energy share in the power mix and (FDI)/GDP at 1.8%[1] indicates a need for more foreign investments

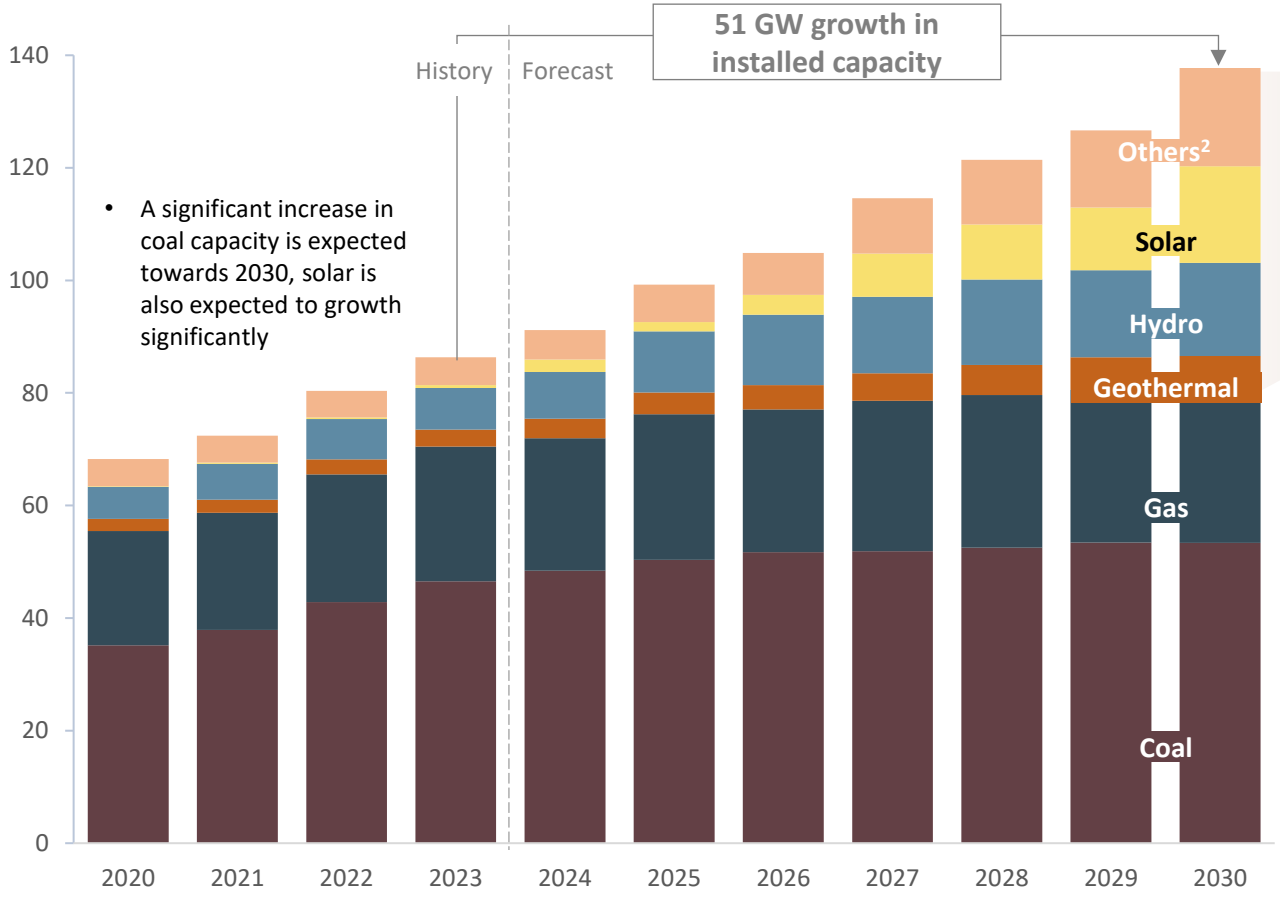
- **Indonesia's FDI to GDP ratio has been slightly above the global average of 1.8%** Indicating it is attracting foreign investment, but there is still a substantial need for more.
- **Strategic opportunities:** Indonesia offers substantial growth opportunities. Its lack of renewable energy in the power mix, combined with its expanding economy and significant potential for renewable energy investments, will drive a substantial increase in energy demand and investment opportunities.

Indonesia's power sector has increased coal and gas capacity over the past five years. There is significant potential to further expand renewable energy capacity in the country.

1) Foreign investment is based on 2022 numbers from UNCTAD and GDP is based on 2022 numbers from WorldBank, 2) Others include bioenergy, solar pv, onshore wind, liquids
Source: Rystad Energy research and analysis; Rystad Energy PowerCube; WorldBank

Indonesia is expected to add 51 GW over the next 6 years – Coal capacity anticipated to increase

Total installed power capacity per source, 2020-2030
GW



RES share and installed capacity in 2030

Renewable generation – 40% RES

Government target – 44% RES

Solar Rystad – 17 GW

Government target solar – 5 GW

Technology	Driver
Solar	**Substantial growth in solar power**: Solar capacity is expected to increase significantly from <1 GW to 17 GW by 2030.
Coal	**Gradual rise in coal capacity:** Coal capacity is projected to see a moderate increase from 46 GW to 54 GW, showing steady growth in the energy mix.
Wind	**Minimal onshore wind capacity in 2023:** Onshore wind capacity will grow from a minimal capacity to 3 GW in 2030, marking the beginnings of a new industry in Indonesia.

Source: Rystad Energy research and analysis; Rystad Energy PowerCube

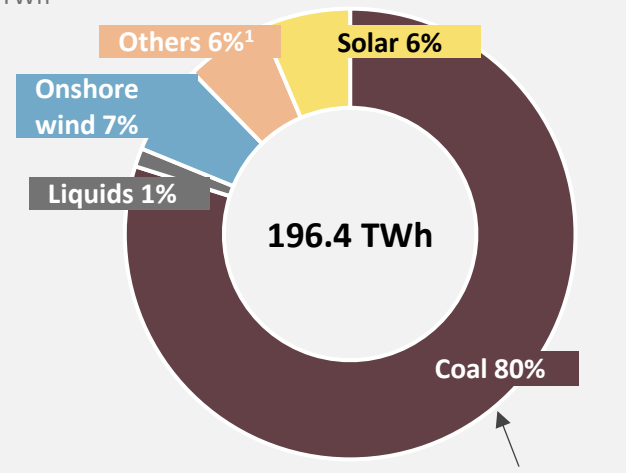
South Africa

Reliance on old coal plants leads to frequent breakdowns and unreliable power generation

Current situation in South Africa

1 Coal contributes to 80% of South Africa's power generation

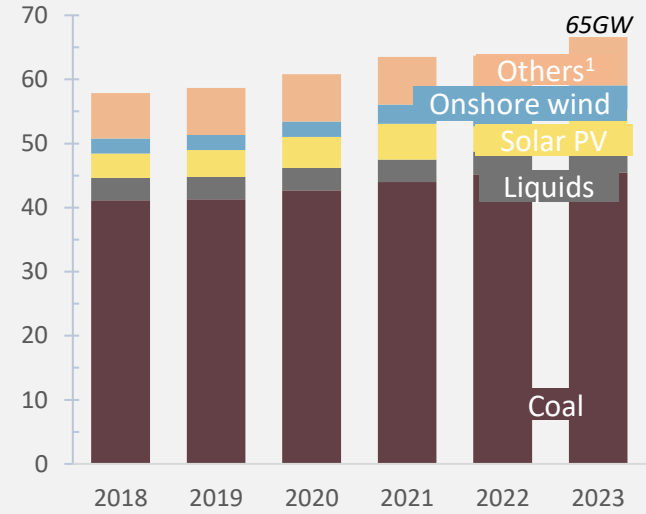
Power generation South Africa in 2023
TWh



Coal is the major driver for the power mix

2 Installed capacity has increased last 5 years, with coal and solar driving growth

Installed capacity South Africa 2018-2023
GW



3 Private investments in South Africa's energy sector remain low

Primary drives for selecting the country

South Africa has in recent years realized the need for foreign investment

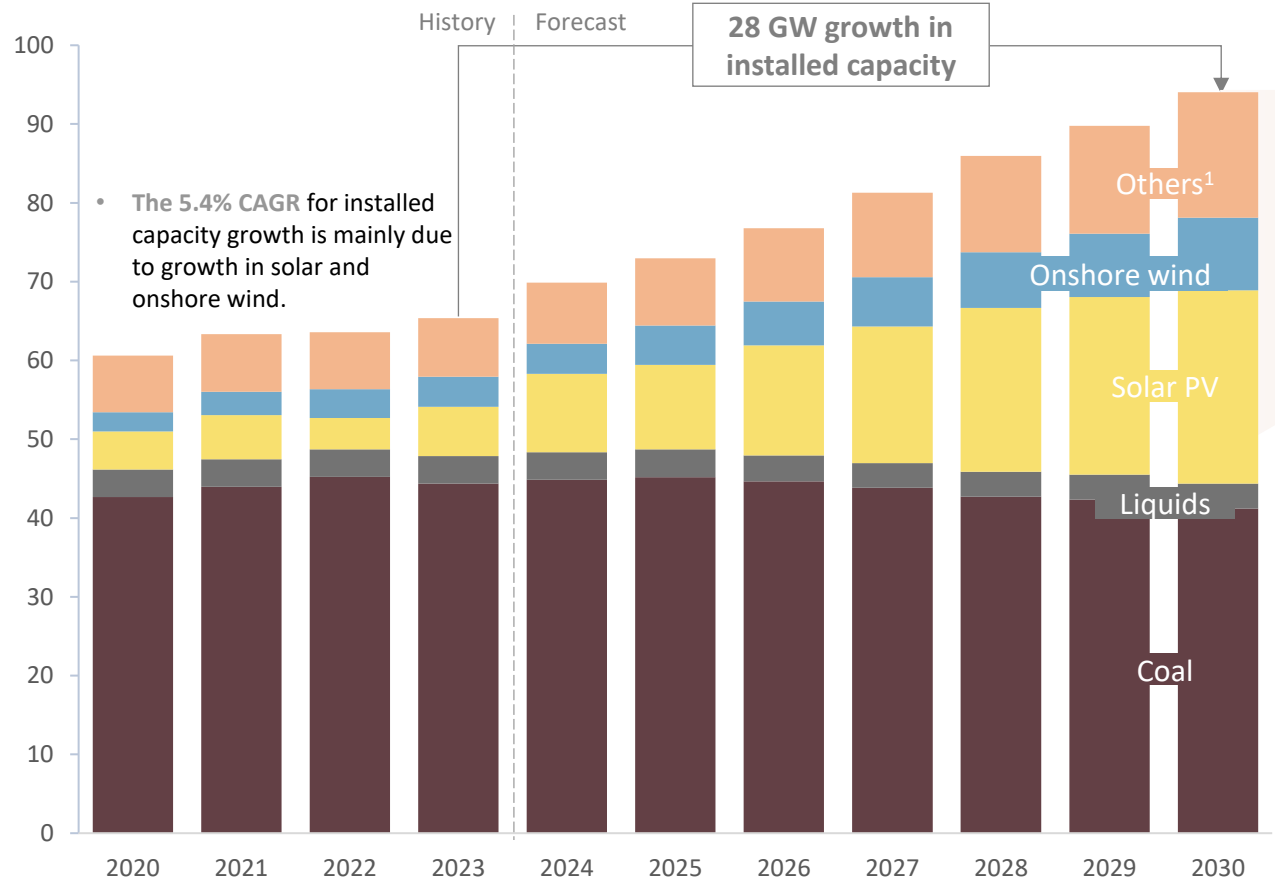
- **The Electricity Regulation Act 2021:** Allowed smaller producers to sell up to 100MW without license. In 2022 the private sector's regulations got lifted to promote private investments but has yet to realize significant investments due to unclear terms of investments and political stances.
- **Africa's largest economy**: South Africa offers substantial growth opportunities. It is Africa's largest economy, although their energy sector is failing to provide good accessibility to foster continued growth.

South Africa's power sector is currently dependent on old coal plants with frequent breakdowns – installing low-cost renewable energy sources such as solar and onshore wind can increase the reliability of the power supply

Source: Rystad Energy research and analysis
1. Others include gas, hydro, nuclear, bioenergy, pumped storage, battery, hydrogen, storage and solar thermal

South Africa will add 28 GW of power capacity over the next 6 years whereof 28 GW arerenewables

Total installed power capacity per source
GW



Installed capacity in 2030

- **Total power – 94 GW**
- **Governmental Target – 89 GW**
- **Solar Rystad – 24 GW**
- **Governmental Solar – 6 GW**

Technology	Driver
Solar	**Substantial solar growth:** The solar capacity is projected to grow from 6 GW to 24 GW, indicating a substantial growth in the solar segment.
Coal	**Coal upholds its position:** The coal capacity is expected to remain stable until the grid is improved and solar/wind projects are online to cover the demand.
Wind	**Moderate growth in wind:** The wind capacity is expected to grow from 4 GW to 9 GW. The large upfront capex requirement for wind dampens the growth compared to solar.

1. Others include gas, hydro, nuclear, bioenergy, pumped storage, battery, hydrogen, storage and solar thermal
Source: Rystad Energy research and analysis; Rystad Energy Power Cube; Integrated Resource Plan 2023

South Africa

Strong potential for solar in South Africa due to high capacity factor, and fast-track of projects

Overview of technological opportunities in South Africa

Sector	Technical	Regulatory	Market drivers	Norfund Fit
Solar	• The solar intensity in South Africa yields a very high capacity factor of close to 30%.	• South Africa fast-tracks solar projects by exempting some from environmental approvals (Solar Exclusion Norm by DFFE).	• South Africa's private sector and households are increasingly turning to off-grid solar power as a reliable source of energy, due to frequent load shedding. Projected growth from 6 GW to 24 GW.	
Onshore Wind	• Favorable constant wind speeds along the coastline makes onshore wind a suitable source for renewable energy, with an upcoming repowering market.	• Frequent load shedding disrupts development of larger projects: "SA Rejected bids for more than 4 GW of wind in its latest tender because it was unable to connect them to the grid."	• The onshore wind capacity is expected to grow from 4 GW in 2023 to 9 GW in 2030. The large upfront capex requirement for wind dampens the growth compared to solar.	
Offshore wind	• Offshore wind potential is ~900 GW, where 852 GW is floating due to deeper water levels. High wind speeds of more than 10 m/s is found along the whole coastline.	• Integrated Resource Plan for New Generation Capacity does not recognize procurement from offshore wind.	• The development of offshore wind power is expected to be limited, due to grid issues and required costly floating wind technology.	
Transmission Grid	• Has experienced energy availability factors as low as 55% in 2024. • Frequent stage 7 load shedding, meaning 7 GW of power shedding the last year.	• Eskom has been restructured to Generation, Transmission and Distribution for increasing focus to the improvement areas. • ERA Bill (2023) removes the need for grid licenses for small-scale renewable energy projects.	• Eskom's Transmission Development Plan, issued in 2022, comprises over 300 projects to improve the grid and reduce load shedding and limitation in the grid.	
Battery energy storage	• The need for BESS is not significant until the share of variable energy sources become dominant, but could be relevant for certain areas for security of supply.	• South Africa's current energy laws and regulations were designed for a fossil-fueled electricity system. They do not explicitly address or encourage the development of BESS.	• Close to 5 GW of BESS is forecast by 2030. A growing need if and when they are able to phase out coal.	

Source: Rystad Energy research and analysis

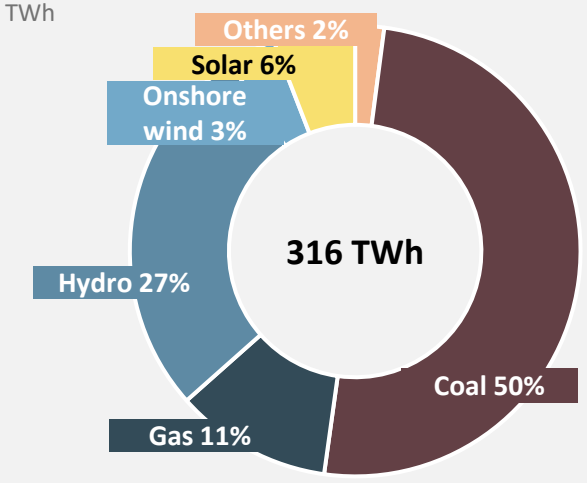
Vietnam

Renewable on the rise in Vietnam with 26 GW new capacity added the past 5 years

Current situation in Vietnam

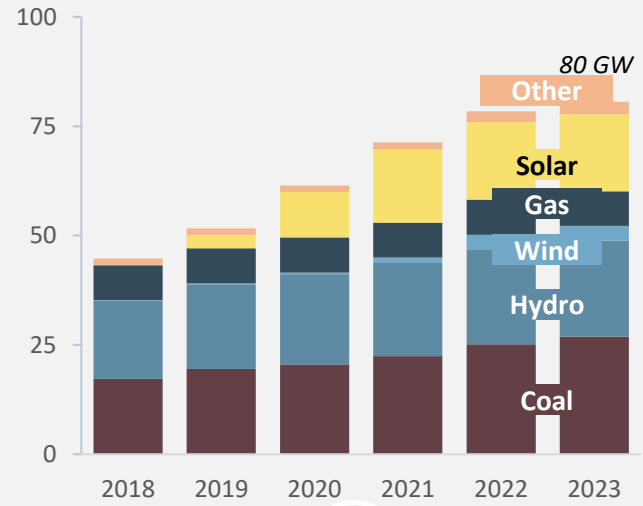
1 Vietnam's energy mix is primarily driven by coal and gas

Power generation Vietnam in 2023
TWh



2 Installed capacity has increased the last 5 years, with solar driving the growth

Installed capacity Vietnam 2018-2023
GW



3 FDI/GDP ratio is below the global average, indicating investment potential

Primary drives for selecting the country

Foreign Direct Investment (FDI)/GDP level at 4.4%[1] does not cover the need to renewable target.

- **The renewable share is increasing fast:** The installed capacity almost doubled the past 5 years, with renewables being the main driver of that growth with 26 GW increase.
- **High potential for wind:** Both onshore and offshore wind is expected to increase substantially in their power mix.

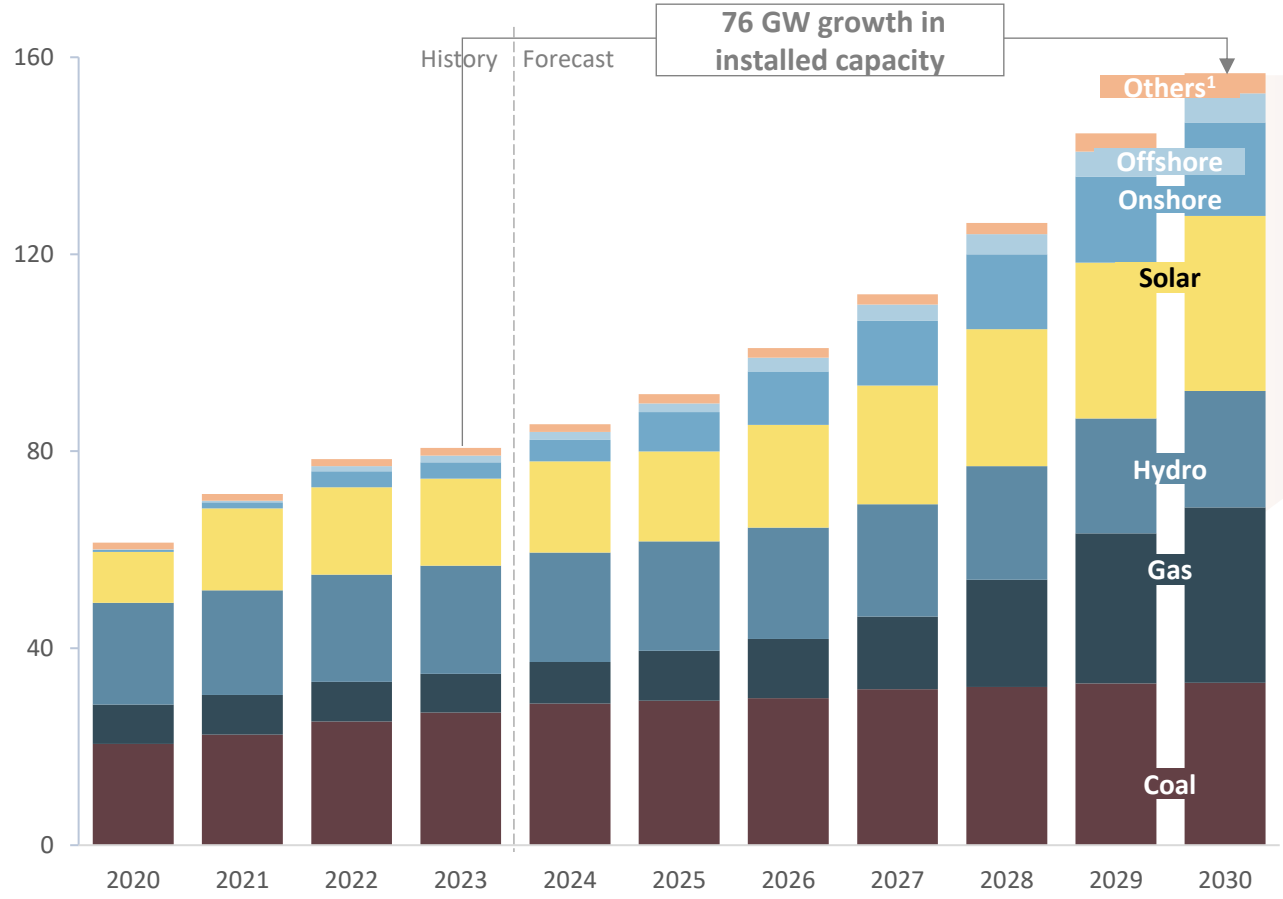
Vietnam's power sector is evolving with increased solar and wind capacity, a coal-dominant energy mix - significant growth potential and need for more foreign investments to decarbonize the power mix

1) Foreign investment is based on 2022 numbers from UNCTAD and GDP is based on 2022 numbers from WorldBank
Source: Rystad Energy research and analysis; Rystad Energy PowerCube; WorldBank

Vietnam

Vietnam expected to add 76 GW of energy over the next 6 years with solar and wind as

Total installed power capacity per source
GW



RES share and installed capacity in 2030

Renewable share – 55% RES

Government target – 39% RES

Solar Rystad – 35 GW

Government target solar – 21 GW

Technology	Driver
Solar	**Solar power's moderate growth**: Solar capacity will increase from 17 GW to 35 GW, showcasing a continious growth trajectory in the renewable energy sector.
Coal	**Stable capacity in coal**: Coal capacity is projected to rise slightly from 27 GW to 33 GW, demonstrating stability in the overall growth in the energy mix.
Wind	**Substantial growth in onshore wind**: Onshore wind capacity will grow from 3 GW to 19 GW, indicating significant growth in the region for wind.

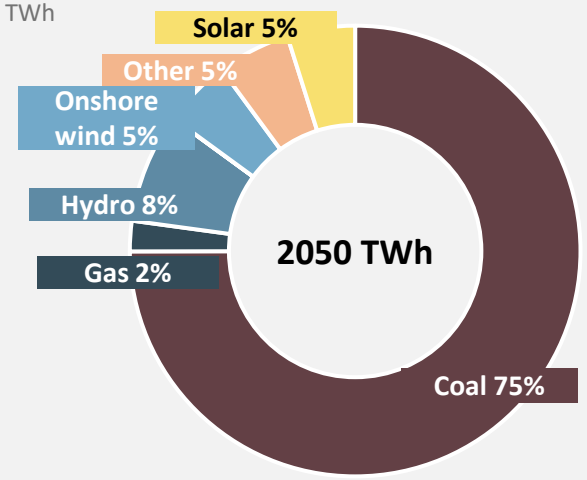
1) Others include liquids, battery, bioenergy, pumped storage and hydrogen
Source: Rystad Energy research and analysis; Rystad Energy PowerCube

India's power mix is dominated by coal, but solar capacity has grown significantly in recent years

Current situation in India

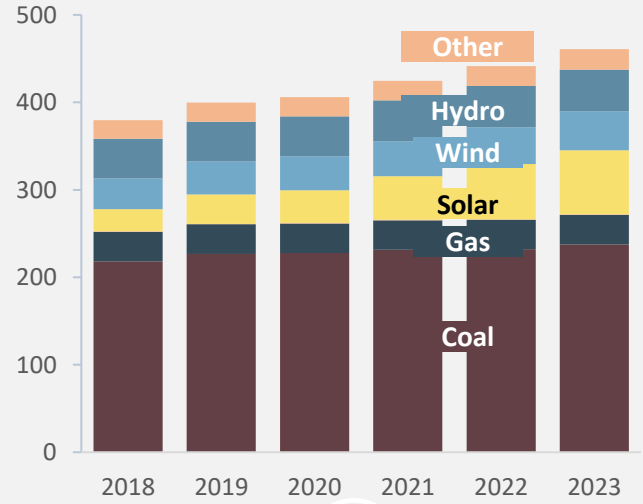
1 India's energy mix is primarily driven by coal

Power generation India in 2023
TWh



2 Installed capacity has increased the last 5 years, with solar driving the growth

Installed capacity India 2018-2023
GW



3 FDI/GDP ratio is below the global average, indicating investment potential

Primary drives for selecting the country

Foreign direct investment (FDI)/GDP at 1.4%[1] indicates a need for more foreign investments

- **India's FDI to GDP ratio has been consistently below the global average:** Ratio of 1.4% indicating it is not attracting as much foreign investment relative to its economic size compared to other countries
- **Scale of demand**: India offers substantial growth opportunities in a growing economy. Its large and young population, burgeoning middle class, and expanding digital economy will drive a significant increase in energy demand at a scale not found in the other selected countries.

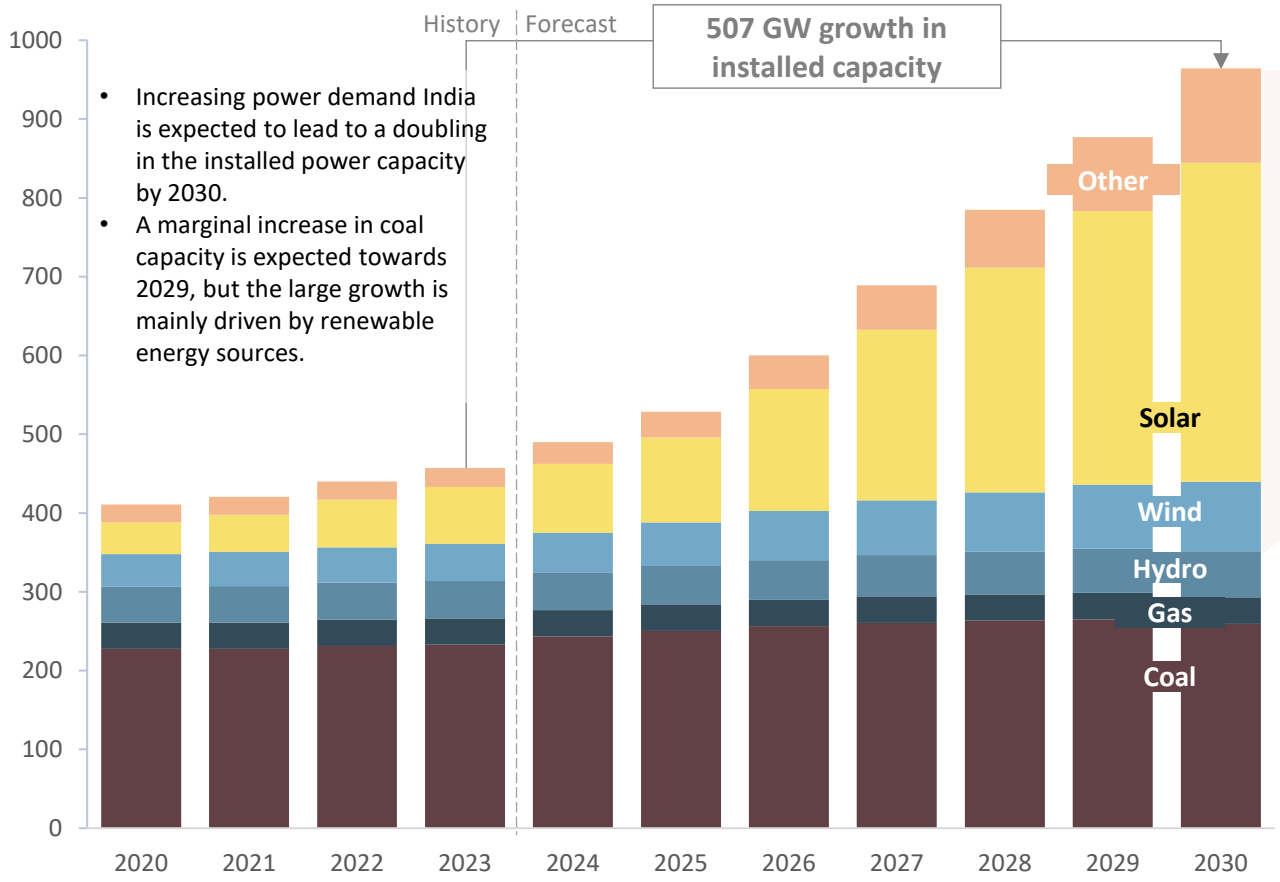
India's power sector is dominated by coal, but with significant growth in energy demand and investments expected going forward

1) Foreign investment is based on 2022 numbers from UNCTAD and GDP is based on 2022 numbers from WorldBank
Source: Rystad Energy research and analysis; Rystad Energy PowerCube; WorldBank

India expected to add 507 GW of energy over the next 6 years, with 481 GW from renewables

Total installed power capacity per source

GW



Installed capacity in 2030

- **Total Renewable energy – 671 GW**
- **Government target – 500 GW**
- **Solar Rystad – 405 GW**
- **Government target solar – 280 GW**

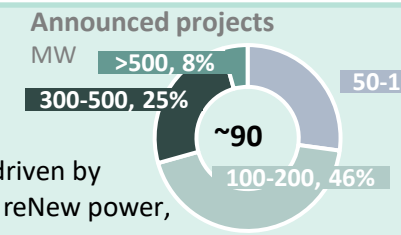
Technology	Driver
Solar	**Solar power's significant growth**: Solar capacity will increase from 73 GW to 405 GW, showcasing a substantial growth trajectory in the renewable energy sector.
Coal	**Stable capacity in coal**: Coal capacity is projected to rise slightly from 233 GW to 260 GW, demonstrating stability in the overall growth in the energy mix. Although fossil growth is only 27 GW compared to 481 GW renewables.
Wind	**Doubling of onshore wind**: Onshore wind capacity will grow from 47 GW to 88 GW, indicating moderate growth while remaining relatively stable.

Source: Rystad Energy research and analysis; Rystad Energy PowerCube

Typical project for solar and onshore wind is 200 MW - offshore wind in India is still in its infancy

Overview of projects in India

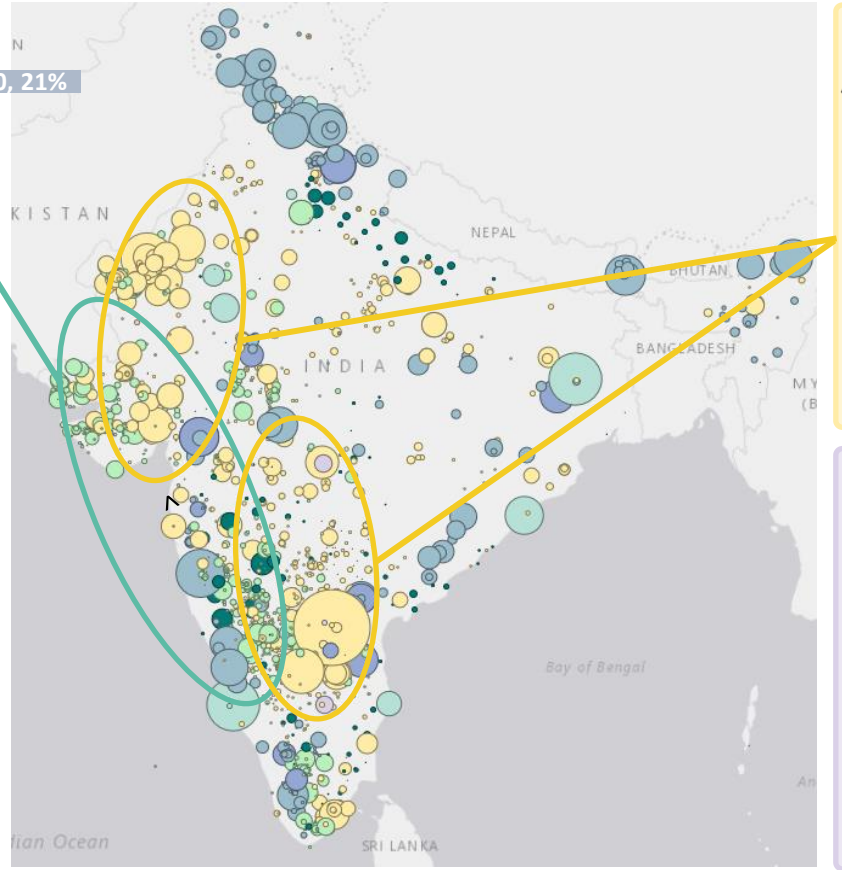
Onshore wind



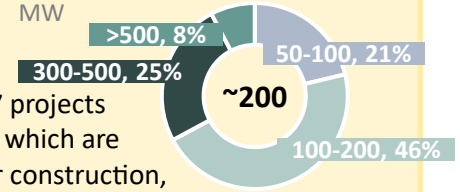
- Onshore wind power is driven by three larges developers, reNew power, Greenko and Adani.
- India has around 90 wind projects in various stages of development, including operational, under construction, in application, or approved.
- The majority of these projects are between 100 and 300 MW, suggesting that the average wind project size in India is around 200 MW.

Offshore wind

- India aims to achieve 30 GW of installed offshore wind capacity by 2030.
- The government intends to auction around 37 GW of offshore wind capacity by 2030
- However, there are currently no projects under development.



Solar



- There are currently 207 projects in the pipeline in India, which are either operating, under construction, in application, or approved.
- Among these, the vast majority are projects between 100 and 300 MW, with 95 projects falling in this range.
- This indicates that the typical solar project in India is approximately 200 MW.

Battery

- India has a robust pipeline of battery energy storage system projects, with more than 15 projects in various stages of development. These include 2 operating projects, 3 under construction, 4 in the financial close stage, 5 approved, and 2 in the application phase.
- Key players like Greenko, ReNew Power, and Tata Power are prominent, primarily using lithium batteries and grid connection

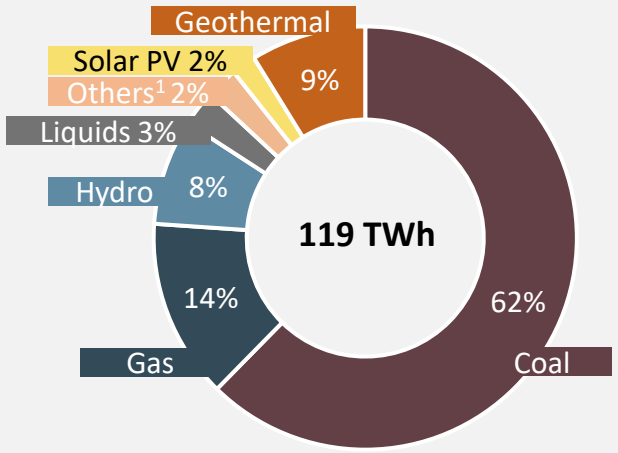
1) Projects under 50 MW are not considered in these projections since they are not relevant for Norfund
Source: Rystad Energy research and analysis

High electricity prices and expected growth in energy usage creates organic growth towards 2030

Current situation in the Philippines

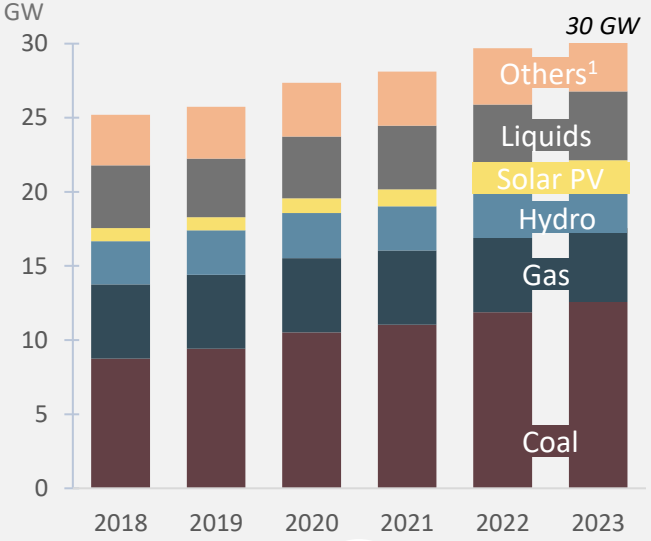
1 Philippines's energy mix is coal dominant

Power generation Philippines in 2023
TWh



2 Installed capacity has increased last 5 years, with solar and coal driving growth

Installed capacity Philippines 2018-2023
GW



3 Economic growth and high electricity prices drives need for renewables

Primary drives for country selection

Expected economic growth and high electricity prices drives need for renewable energy sources

- **Low energy use per capita:** Growth in renewable capacity is backed by an expected increase in power consumption by 2030 as a result of economic growth. The current consumption per capita is at 5192 kWh/capita. This is more than half of what neighboring country Vietnam use, with 13 744 kWh/capita.
- **High electricity prices**: The Philippines currently pay one of the highest energy prices in Asia, the opportunity space for low-cost renewables

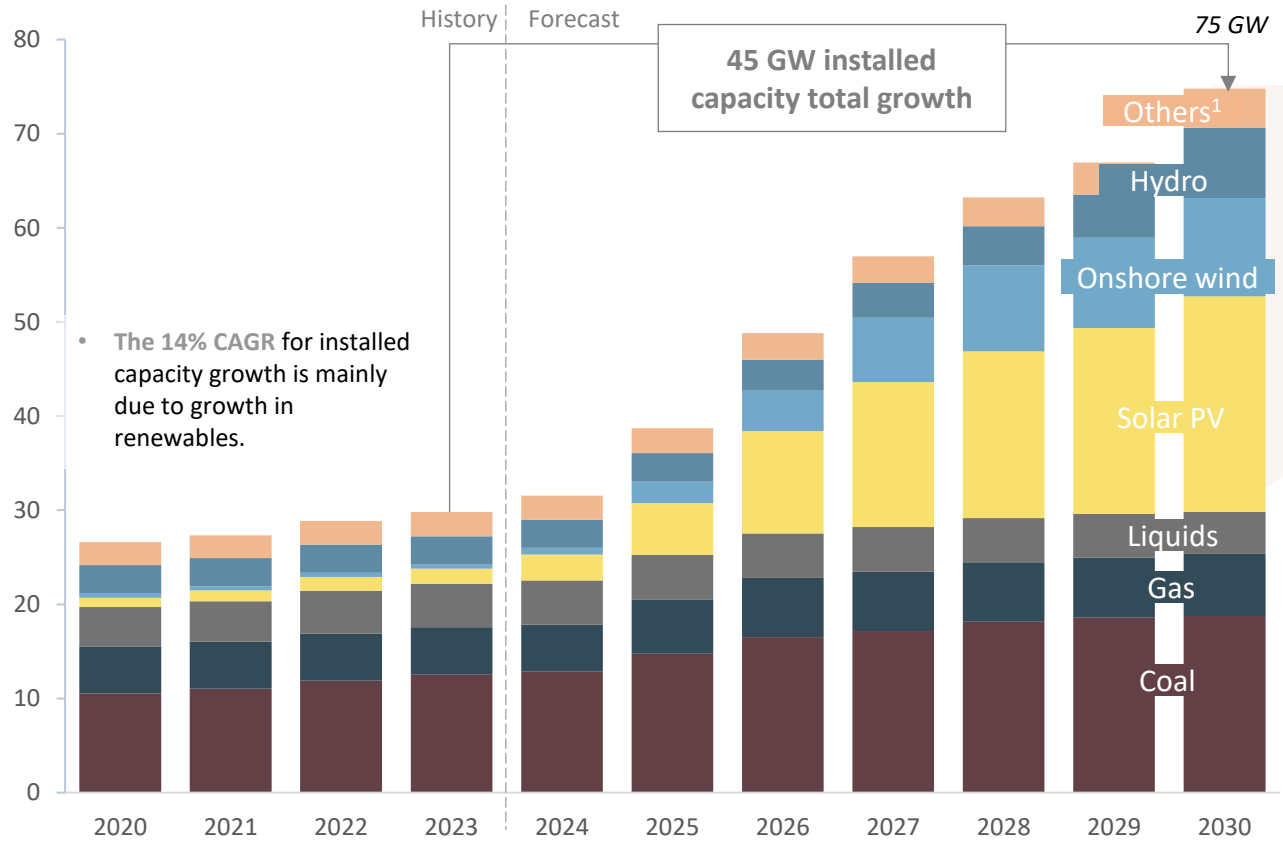
Philippines' power sector is dominated heavily by coal and gas – expected economic growth and increase in power consumption drives need for low-cost renewables in their power mix

Source: Rystad Energy research and analysis

Philippines

The Philippines will add 45 GW of energy over the next 6 years, mainly attributed to renewables

Total installed power capacity per source
GW



RES share and installed capacity in 2030

- **Renewable Generation – 50%**
- **Renewable Generation – 35%**
- **Solar Rystad – 23 GW**
- **Solar Target – 20 GW**

Technology	Driver
Solar	**Substantial solar growth**: The solar capacity is projected to grow from <1 GW to 23 GW, indicating an immense growth in the solar segment.
Coal	**Slight growth in Coal:** The coal capacity is expected to grow from 13 GW to 19 GW due to increased demand.
Wind	**Substantial growth in wind:** The wind capacity is expected to grow from <1 GW to 10 GW. This growth is attributed to the large coastal potential for wind and repowering.

1) Others include nuclear, bioenergy, pumped storage, battery, hydrogen, storage and solar thermal
Source: Rystad Energy research and analysis; Rystad Energy Power Cube; NREP 2020-2040

Philippines

Large renewable growth coupled with clear grid plans offer opportunities for foreign investment

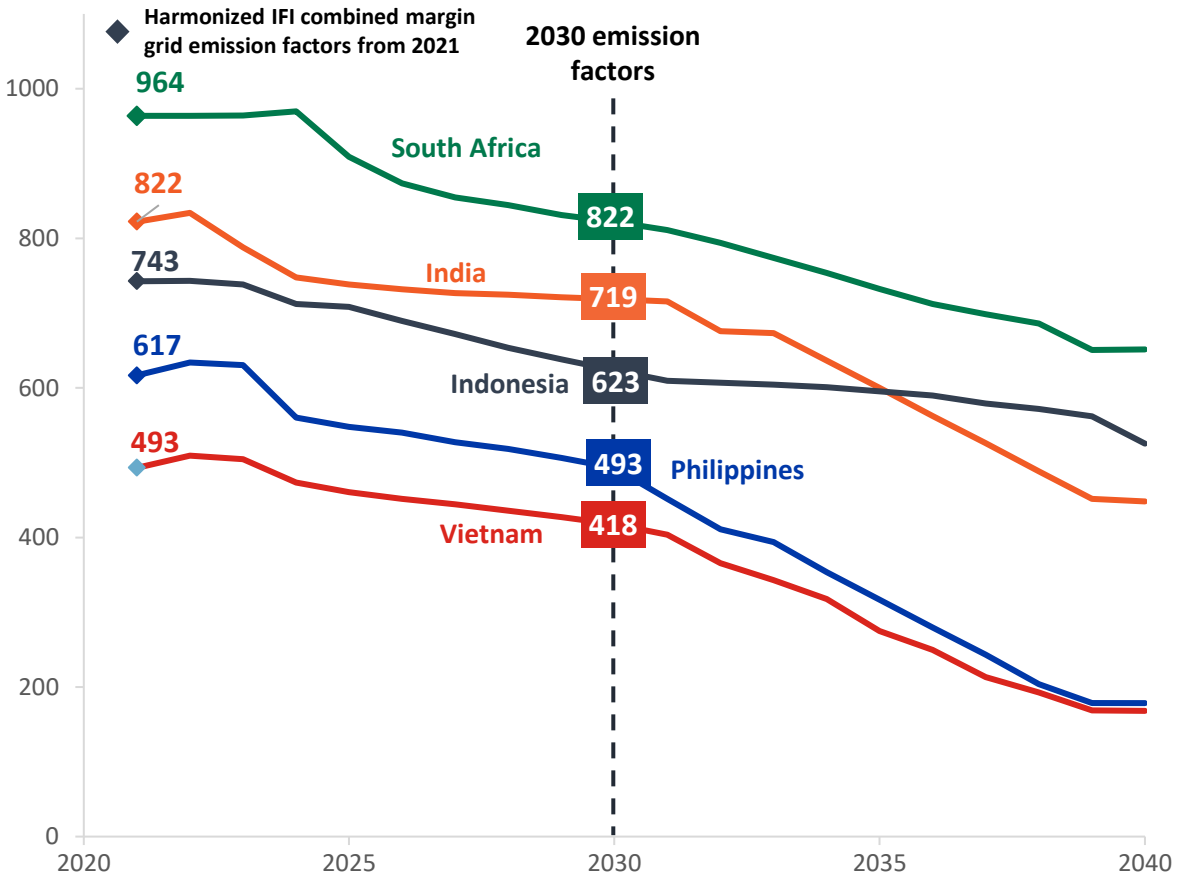
Overview of technological opportunities in Philippines

Sector	Technical	Regulatory	Market drivers	Norfund Fit
Solar	• Domestic capacity factor for solar PV at around 25%, with the recent growth attributed the high cost of electricity, creating organic growth in the segment due to solar's low LCOE.	• Feed-in-tariffs and GEAP tariffs are in place for solar PV projects. • Private owners of solar PV have reduced the risk through a flat rate of net-metering back into the grid.	• The government target of 20 GW of solar PV is aligned with Rystad research, and will be a significant driver of renewable growth.In November 2022, the Philippines opened renewable energy projects to 100% foreign ownership.	
Onshore Wind	• The capacity factor hovers around 40%, as onshore wind projects make use of the coastal winds. Potential for increased capacity, however, due to high land costs there is an incentive to grow through repowering.	• The Renewable Energy Act (2008) sets the momentum for increase renewable energy, including land-based wind power.	• Onshore wind projections show substantial growth from <1 GW in 2023 to 10 GW by 2030. Repowering land areas with high capacity factors and utilizing the western coast line yields a high potential for growth.	
Offshore wind	• High cost of electricity paired with strong coastal winds, provides a good potential for offshore wind. However, the deep waters call for floating wind turbines.	• One of few countries that has a clear Offshore wind roadmap towards 2040. • DOE plans to hold the Green Energy Auction (GEA) for offshore wind in 2025.	• Roadmap outlines a potential of ~180 GW, with only 18 GW as bottom-fixed. National 2030 roadmap presents a low growth scenario of 3 GW and high growth scenario at 21 GW. Technical uncertainty sets Rystad's forecast to 1 GW.	
Transmission Grid	• A joint study by the PDOE and USAID found the Philippines' 2030 power grid plans can handle a 50% renewable energy target, including significant solar and wind power.	• NGCP has proposed a clear roadmap for the transmission upgrades needed to accommodate 35% renewable grid generation by 2030.	• TDP for 2040 clearly states required improvements and project pipeline for milestones such as 2025, 2030, 2035 and 2040. These projects are dependent on foreign investments.	
Battery energy storage	• Grid improvement include microgrids as an essential way to reach a stable grid by 2030. BESS will play a crucial role securing baseload for these RES grids.	• Announced the "Policy for Energy Storage System in the Electric Power Industry" in 2023, providing guidelines for the use of energy storage.	• Projected installed BESS of 5 GW by 2030, driven by large energy companies, including San Miguel, Aboitiz and Ayala groups.	

Source: Rystad Energy research and analysis

Highest potential for emission reduction in South Africa, with India and Indonesia next on the list

Rystad Energy combined margin emission factor (CM EF) forecast (for variable renewable energy)
gCO2/kWh

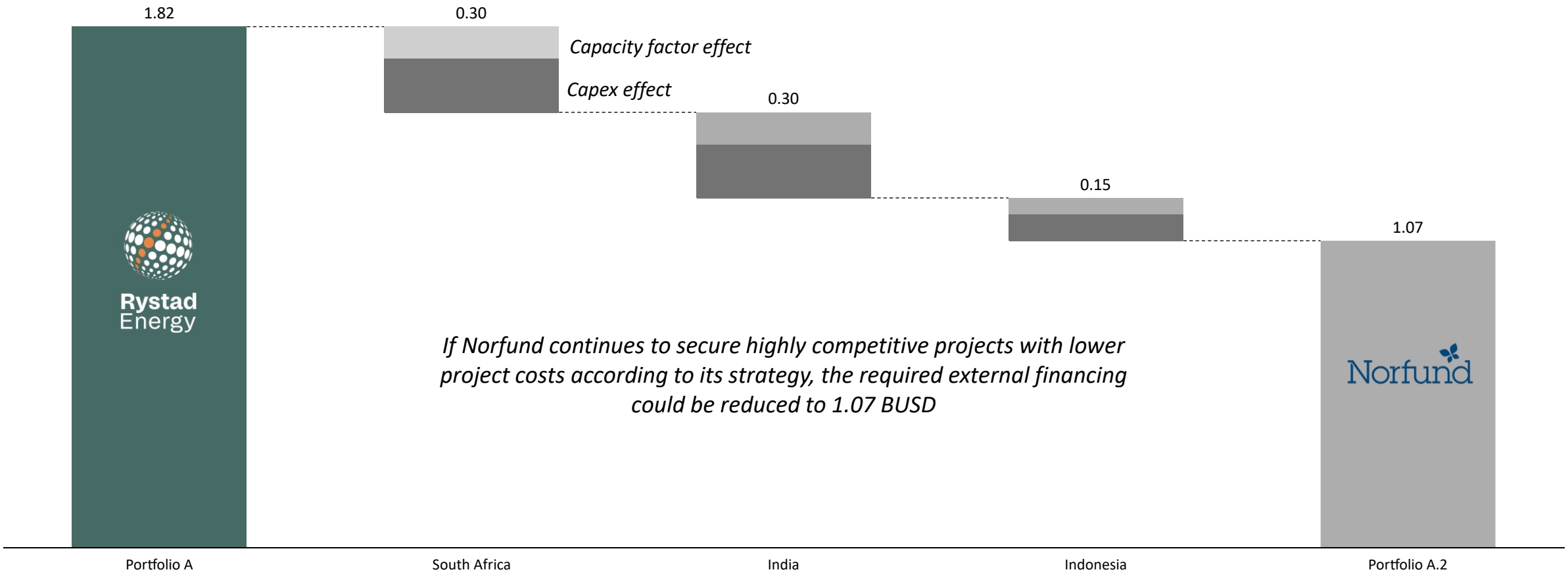


1	**South Africa**	• Generation from fossil sources expected to account for more than 50% until 2039 • Generation from coal is dominating the power mix and is expected to remain at stable levels until 2035, before it is expected to decline.
2	**India**	• Second largest grid emission factor until 2035 driven by stable levels of power generation from coal. • India is expected to reach 50% share of generation from renewables in 2032, leading to decreasning grid emission factor towards 2040.
3	**Indonesia**	• Coal and gas is dominating the power generation and is expected to remain stable until 2040 • Increased capacity from coal going forward which affects the Build Margin and leads to Indonesia surpassing India's combined margin emission factor in 2035
4	**Philippines**	• Large share of power generation from gas and liquids, in addition to coal. This drives the emission factor down compared to the other countries as gas and liquids have lower emission intensity and generation from these sources is assumed to be displaced before coal due to the higher marginal cost
5	**Vietnam**	• Vietnam reaches 50% generation from renewable sources in 2032, leading to a rapid decrease in emission factor as renewables enter the marginal • In addition, Vietnam is expected to increase its gas capacity towards 2040.

Sources: Rystad Energy research and analysis; Rystad Energy PowerCube; UNFCCC

Norfund’s capacity factors and capex estimates could lower the required external financing

Difference in required external financing for Portfolio A and A.2 with Norfund input parameters[1]
BUSD



1) Assume exit and debt repayments from existing portfolios can be used, hence reducing the need for external financing.
Source: Rystad Energy research and analysis; Rystad Energy PowerCube