Theory of Change for the Climate Investment Mandate

Background note

Last updated: 2024

Contents

1. Introduction

In 2022 Norfund was tasked with the management of the Climate Investment Fund.

The objective of the Climate Investment Fund is to contribute to reducing or avoiding emissions of greenhouse gases by investing in renewable energy in developing countries with extensive emissions from coal power and other fossil fuel-based power production. The investment shall lead to economic development in these countries being based to the greatest extent possible on renewable energy.

This document describes how investments in renewable energy in emerging markets is contributing to climate change mitigation and economic growth. The document describes the hypothesis of change, the rationale for investment, some of the literature within this field, assumptions related to the theory and impact risks that should be considered.

2. The Theory of Change framework

Box 1: Theory of change concept

A theory of change is a comprehensive framework that outlines how and why a desired change is expected to happen in a particular context.

The theory starts with a clear problem statement, identifying the specific issue or challenge that needs to be addressed. Inputs are then detailed, which include the resources, activities, and interventions necessary to address the problem, that Norfund is providing. These inputs might consist of funding, staff, partnerships, and specific actions or programs designed to drive change.

The theory of change then maps out the sequence leading from inputs to outputs, outcomes in the short and longer term, and finally, the desired impact. Outputs are the direct results of the activities and inputs provided by Norfund, such as the increase in staff or increased payment of taxes and fees by the investee.

Outcomes refer to the short- and medium-term changes that result from these outputs, such as expansion of firms in the supply chain or establishment of new firms and increased household consumption and resilience. Finally, the impact is the long-term, sustained change that the investment aims to achieve, such as job creation, economic growth and improved living standards.

This pathway is mapped out in a theory of change, and helps organizations and stakeholders understand the process of change, measure progress, and refine strategies to ensure the desired impact is achieved.

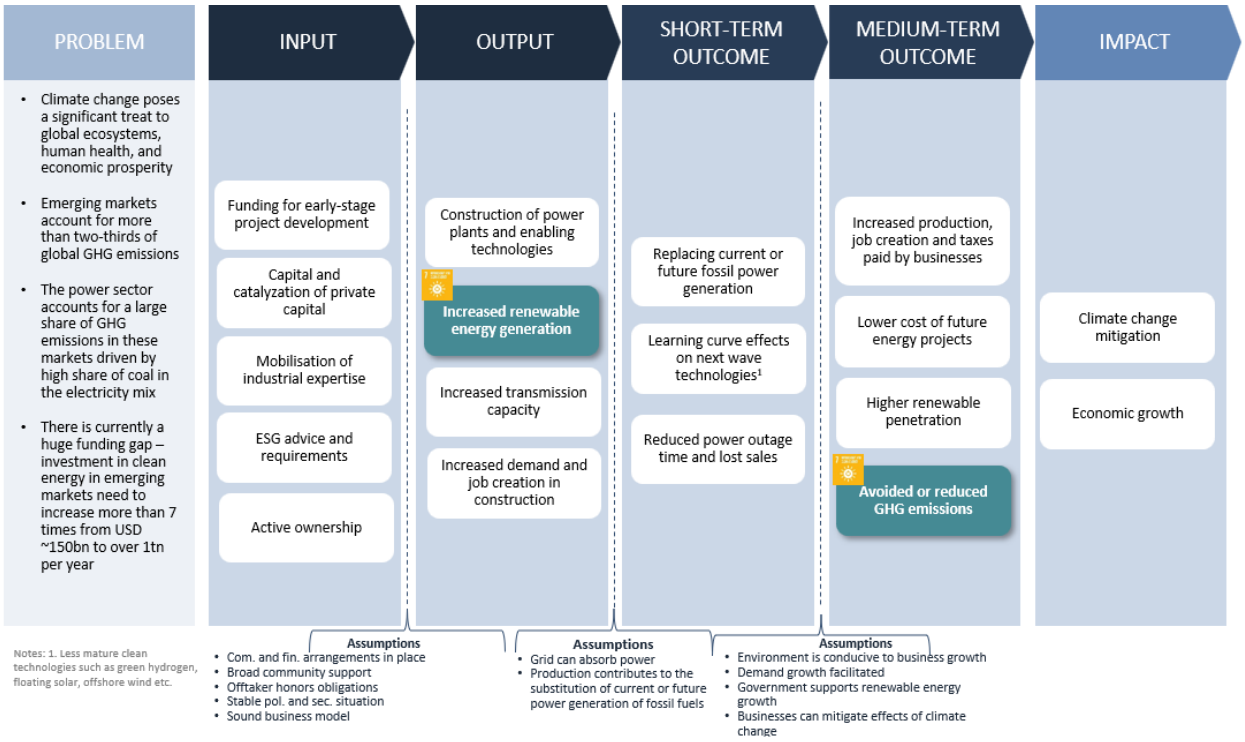
Based on literature and current knowledge of renewable energy Norfund has developed a Theory of Change (ToC) for how change happens through our investments in renewable energy. The ToC consists of

a framework of input, output, short- and medium-term outcomes and impact goals, as described in box 1.

The input is what Norfund provides as an investor, while the outputs are monitored during annual reporting. The outcomes are generally measured through case studies and other in-depth analysis on a case-to-case basis. The expected long-term outcomes and impacts are demonstrated through literature.

The elements visualized in the ToC are those that are probable based on literature and knowledge of the sector. However, we do not claim that these pathways happen in all cases. Central to being able to move from input and through the steps, all the way to the final impact goals are the assumptions we have described in section **Error! Reference source not found.** of this document. If these assumptions do not hold, some or all the steps in the ToC might not be realized.

2.1 The theory of change for renewable energy – CIM



3. The Hypothesis of Change

This part of the document explains how our inputs translate through to outputs, outcomes and impact.

3.1 Input

Norfund provides funding to support the development of new, or expansion of existing, renewable energy power projects in emerging markets. Sometimes Norfund also partly finances early-stage project development, such as feasibility studies, commercial structuring and environmental impact assessments.

We invest equity, debt or guarantees in power projects depending on their financing needs and mobilize technical expertise and other financers. Norfund provides advice and requirements to ensure environmental and social risks are properly identified and mitigated prior to construction and during operation. Often, we engage in active ownership of the projects to ensure standards are upheld throughout the project.

3.2 Output

After financial close is reached, the project enters the construction, business development or expansion phase. Construction activity creates temporary construction jobs and demand for goods and services from suppliers. The construction or expansion of the project also has the potential of creating jobs in operations and maintenance upon finalization.

The expertise and requirements provided by Norfund help to ensure that the project operates with high technical quality and in compliance with the International Finance Corporation´s Performance Standards on Environmental and Social Sustainability. Resulting operations within the power production segment provide increased renewable energy generation. For projects related to transmission lines, the resulting operations should yield increased transmission capacity.

3.3 Outcome

In the short-term, investing in renewable energy projects, including transmission lines and storage technologies such as batteries, yields higher grid capacity, replaces current or future fossil fuel power generation and reduces the occurrence of power outages in contexts where lack of generation capacity and/or stable grid solutions are prevalent issues. More reliable access to renewable energy reduces the amount of lost sales and revenues due to power outages.

In the medium term these changes contribute to increased production, job creation and taxes paid to the government, from the businesses that receive increased or more stable access to renewable energy.

Furthermore, the initiation and construction of power plants can also contribute to lower costs of future energy projects, by demonstrating its viability and available technologies. This contributes to higher penetration of renewable energy projects. Increasing the access to renewable energy sources contributes to avoiding or reducing greenhouse gas emissions. In growing economies, with a growing need for energy, new renewable capacity will most likely avoid future emissions by substituting fossil fuel energy projects that would have otherwise been initiated.

3.4 Impact

From the outcome section we note that increased access to renewable energy reduces the dependence on pollutive energy sources, and by that contributes to avoiding emissions. This contributes to avoiding the adverse effects of climate change. Better transmission capacity and storage solutions provide a more

stable source of energy, enables the grid to absorb more variable renewable energy and yield predictability for businesses and households, and thereby increasing profitability and production capacity. This should contribute to economic growth and further job creation in the economy.

4. Rationale for investment

Climate change poses a significant threat to global ecosystems, human health, and economic prosperity. It exacerbates natural disasters, leads to unpredictable weather patterns worldwide, and thereby threatens food security by affecting crop yields. Moreover, climate change disproportionately affects the most vulnerable populations, exacerbating the already existing issues of inequality and social injustice. The interconnection of tackling climate change, reducing poverty and protecting the most vulnerable populations highlights the need for a holistic approach to this issue.

Investing in renewable energy in emerging markets has the potential to limit greenhouse gas emissions (GHG) and at the same time ensuring a just transition by creating jobs in vulnerable and low-income communities.

The trends in global GHG emissions over the past years emphasize the urgency of addressing climate change. Despite increasing awareness and efforts, global GHG emissions have continued to rise, with carbon dioxide (CO2) emissions from fossil fuels and industry being large contributors (IPCC, 2023). This increase in emissions has led to a worrying rise in global temperatures, pushing the planet closer to critical thresholds that will trigger irreversible changes in the climate system.

The Intergovernmental Panel on Climate Change (IPCC) has warned that limiting global warming to 1.5 degrees Celsius above pre-industrial levels requires rapid and far-reaching transitions in just about every country and sector there is (IPCC, 2023). Reaching the target of 1,5 degrees heating seems more and more unlikely, meaning it is even more crucial to work towards limiting the most catastrophic impacts of climate change. In a world with increasing energy needs, renewable energy sources need to be scaled up significantly for a reduction in GHG emissions to be possible.

Addressing climate change is not only an environmental imperative but also an opportunity to foster businesses that drive innovation. Transitioning to a low-carbon economy presents opportunities for economic growth through the development of new technologies and industries, such as renewable energy and energy efficient solutions. This transition can create jobs, improve public health by reducing local air pollution, and enhance energy security. Furthermore, investing in climate adaptation and resilience can protect communities and infrastructure from the adverse effects of climate change that are already experienced widely.

Knowing the urgency in mitigating climate change and the immense adverse effects it will have if we fail to do so, it seems imperative to address emissions where they are most likely to increase, and where they are most cost effective, meaning where we get the most reduction in GHG emissions per unit investment. Emerging markets account for 34% of global GHG emissions (excl. China) and their share is expected to rise going forward due to population- and economic growth (International Energy Agency,

2021). Therefore, it is essential to ensure the growth in energy needs and demands of these markets are met by renewable energy options, to limit the potential corresponding rise in GHG emissions.

To limit the adverse effects of climate change, many commitments have been made to achieve net zero by 2050[1]. In a net zero scenario, all human-caused greenhouse gas emissions are counterbalanced by removing an equivalent amount of these gases from the atmosphere, resulting in net zero emissions. It is estimated that emerging markets will need more than one trillion USD annually to be invested by 2030 to achieve net zero by 2050 (International Energy Agency, 2023). This is more than seven times the current investments in these markets (International Energy Agency, 2021). Therefore, massive mobilization of private and public finance will be required to meet the remaining investment gap. Investments and mobilization of other financing enabled by the Climate Investment Fund are therefore contributing to closing some of this gap.

An issue faced when considering how to close the investment gap is that the cost of capital can be significantly higher in developing- and emerging economies compared to that of developed countries, especially driven by high country risk premiums (International Energy Agency, 2021). This limits the competitiveness of renewable energy projects, as the upfront capital expense typically is higher than for fossil projects. This highlights the importance of realizing investments through the Climate Investment Fund, that can mobilize further investments. Without such investments, it will not be possible to achieve the phenomenal scale up of investments into the renewable sector that is required to deliver on global climate goals.

5. Rationale for the steps outlined in the Theory of Change

The relationship between access to energy, climate change mitigation and economic growth has been extensively studied. Literature suggests that access to renewable and reliable energy sources is a fundamental driver of economic development, contributing to mitigation of climate change and impacting various aspects of society and industry.

As the main objective of the Climate Investment Fund is to contribute to reducing or avoiding emissions of greenhouse gases by investing in renewable energy in developing countries, this part of the note will first describe how our investments contribute to that end. Then the note will describe some of the other effects expected to occur as a result of investments in renewable energy in these markets, namely the link between renewable energy generation and economic development, reduction in costs and productivity growth for firms. Lastly in this chapter we will describe how these investments can reduce the costs of future projects of similar nature.

5.1 Future avoided emissions

The Climate Investment Fund invests in countries that are growing, and that rely extensively on fossil fuel for electricity consumption. Given that a country or region with growing energy needs would have met this demand by scaling up fossil fuel energy sources, introducing renewable energy into the energy mix will avoid emissions.

Several studies have calculated the need for renewable energy in the energy mix to limit global warming to 1.5 degrees Celsius. IRENA states that renewable energy sources need to make up 77 % of the energy

[1] Norfund has committed to transitioning our portfolio to net zero GHG emissions by 2050.

mix by 2050 if this target is to be reached[2] (IRENA, 2023). Considering that renewable energy currently makes up about 20 % of the energy mix, large investments in these technologies are needed.

Considering literature, the overall findings suggest that the additional energy provided by renewable energy sources does reduce the amount of GHG emissions that would have otherwise been emitted. However, the extent of this varies depending on context. A report from the UN found that internationally supported renewable energy and energy efficiency projects implemented in developing countries between 2005 and 2016 are projected to reduce greenhouse gas emissions by 0.6 Gigatons of carbon dioxide annually in 2020. When scaled up using international climate financing commitments, these efforts could deliver 1.4 GtCO2 in annual reductions by 2020 (Hsu & Angel, 2017). Considering this together with the advancements that have been made over the last years it is evident that scaling up renewable energy has tremendous potential in avoiding emissions.

There are several methods for calculating avoided emissions, but most methods consider the difference between the emissions from the project activity and a reference or baseline scenario over a defined period. Norfund´s methodology for estimating avoided emissions considers the current grid emission factor, the future plans of the country, and how integrating new renewable capacity will affect the various sources of fossil fuel, including considerations of price and baseload capacity. The methodology calculates avoided emissions based on the electricity production we contribute to through our investments, using both sector and country intensities to account for the context in which we are invested. In 2023, the operational power plants Norfund had invested in under the climate investment mandate were estimated to have avoided 2.2 million tons CO2e. Furthermore, Norfund financed five new projects under the climate mandate that, when operational, are estimated to avoid 8.5 million tons of CO2e emissions annually. This corresponds to approximately 17% of Norway's total emissions of CO2e in 2022, making it evident that these investments are highly effective in avoiding emissions.

5.2 Reduced emissions

To demonstrate contribution to the reduction in emissions, one must demonstrate that the fossil fuel power production has been substituted by renewable energy sources. This could for instance be the case if a coal plant was shut down due to the construction of a hydro or solar power plants. However, in growing economies with increasing demand for energy, this is scenario will rarely be realized, although over longer term most fossil fuel plants need to be decommissioned and replaced by renewables to reach net zero targets.

The role of prices

As consumers generally choose the more affordable energy option, the lower cost of renewable energy compared to fossil fuels can significantly reduce fossil fuel usage. When renewable energy options are competitively priced, they offer an effective means of lowering emissions.

In many parts of the world, renewable energy is already cheaper than fossil fuel options in the operational phase (IRENA, 2023). However, renewable energy projects often require high costs up front, in the construction phase, before production can start. At the same time, several fossil fuel options, such as the use of diesel generators, have higher variable costs.

[2] Depending on a range of preconditions and assumptions regarding the other energy sources in the mix

A study from China, that considers 50 years of energy prices, evaluates the relationship between fossil and renewable energy sources. The study finds that rising prices of oil, coal, and natural gas lead to increased renewable energy consumption in the long run, demonstrating the possibility of substitution between the two options (Ben-Salha, Hakim, Zaghdoudi, Soltani, & Nsaibi, 2022). The study finds no effect on prices in the short run. This can be explained by barriers in the market that means it takes time for a new market equilibrium to be realized.

Direct reduction in emissions – project example

We have several examples from our own portfolio companies, where the expansion of renewable energy sources has contributed to reduction in emissions on site. One example of this is a project in Madagascar that was conducted with CrossBoundary Energy. The company, Rio Tinto, approached CrossBoundary to provide a low-carbon energy solution for their mining activities, and ultimately build a "sustainable mine". The operation has implemented a range of initiatives, using wind and solar energy, as well as battery storage solutions, to minimize the companies carbon footprint. Examples like this illustrate that the companies in our portfolio directly contribute to reducing emissions.

Even though we have such examples we know that barriers in the market, and growing demand for energy makes the nature of the relationship between increased access to renewable energy sources and the use of fossil fuel sources vary from case to case.

5.3 Economic growth

Access to energy is critical for economic advancement, being the primary input into many economic activities, across sectors and for households. Increased availability of electricity is found to correlate with economic growth, as theory would suggest (Burke, Stern, & Bruns, 2018). However, there are few methodological strong studies that have been able to establish a causal relationship between the two sizes. Economic growth requires that energy is available, but the nature of relationship is ambiguous.

Wolde-Rufael examined the relationship between energy consumption and economic growth in 17 African countries from 1971 to 2001, in two studies from 2006 and 2009 (Wolde-Rufael & Yemane, 2006 & 2009). The first study found that increased electricity consumption has a positive, causal effect on economic growth in three countries, while the reverse effect, economic growth leading to increased consumption and economic growth, is found in six countries. This means that it is somewhat ambiguous what comes first, increased electricity consumption or economic growth.

However, the later study from Wolde-Rufael from 2009 uses the same data to reexamine the hypotheses. The central finding from this study is that energy influences economic growth, but that the availability of capital and labor are highly important to facilitate sustained economic growth.

Further, Eggoh et al. examined the same relationship using data from 21 African countries between 1970 and 2006 (Eggoh, Bangake, & Rault, 2011). The study finds that a change in energy consumption has an impact on economic growth, and equally a change in economic growth has an impact on energy consumption.

The outcomes of these studies of course depend on the country, context and time period in which they are performed. However, it seems evident that while access to energy undoubtedly is an important

prerequisite for improved business productivity and household welfare, the casual link is difficult to establish with certainty. This is mainly due to reversed causality and the difficulty of controlling for all other factors that play an important role in transitioning from increased access to renewable energy through to economic growth.

5.4 Reduction in costs and productivity growth for firms

Part of the theory of change describes how increased access to energy contributes to reduction in costs and productivity growth of firms, allowing them to increase their demand for labor. This is part of the chain of events that are expected to contribute to economic growth, as described above.

Considering the effect of increased access to electricity on business productivity, literature and reports highlight how investments in the power sector reduce power outages and reliance on expensive backup solutions. This enables businesses to operate more efficiently, lowering costs, and increasing output and government revenue through higher taxes (Eberhard & Dyson, 2020). This is particularly crucial for industries heavily reliant on power, such as transport, trade, and manufacturing services. Reducing power outages enhances business productivity and the competitiveness of firms by reducing costs related to downtime (Onuonhga, 2020; Akinlo, 2009; Bathia & Angelou, 2015).

Reducing power outages, both by increasing the supply of energy to the grid and by improving grid capacity, has great potential as an enabler of increased productivity in businesses. Andersen and Dalgaard (2013) assessed the effect of power outages on economic growth in Sub-Saharan Africa from 1995-2007 and found a substantial negative effect on economic growth due to power outages, indicating that limiting such occurrences positively impacts firm productivity (Andersen & Dalgaard, 2013). The effects of unreliable power supply, however, differ between countries and contexts, depending on businesses' ability to adapt to unreliable supply by using generators or purchasing less power-intensive products. For instance, a study from Senegal finds that power outages significantly negatively affect SMEs, while larger businesses that can afford generators are not impacted (Cissokho, 2019). Nevertheless, investing in power producers that contribute to the reliability of supply by increasing the supply to the grid undoubtedly has positive productivity effects for firms.

5.5 Lower costs of future projects

An important, positive effect of investing in renewable energy projects is the effect it has on the cost of future, similar projects. By paving the way for new technologies, demonstrating their usage and benefits, is likely to facilitate uptake and reduce prices in the longer run. Reducing the price of projects is likely to contribute to more use of renewable energy sources.

Solar technology is a good example of where this development is observed. For more than four decades, the price of solar panels declined by 20% with each doubling of global cumulative capacity, demonstrating the effect of the learning curve and making the technology available (Roser, 2023).

By investing in renewable energy Norfund is contributing to this catalyzing effect, facilitating even higher renewable energy penetration. Thus, the initial investment into a solar or hydro plant can contribute to even more such investments taking place, by lowering the barriers for uptake with other investors.

In conclusion, there are many ways in which access to electricity affects individuals, households and the economy. This Theory of Change points out what we see as most plausible and important to highlight as steps to reach the desired outcomes and impacts, based on available knowledge and literature describing the sector, its challenges and its possibilities.

6. Assumptions

Investing in renewable energy is important to achieve climate change mitigation and economic growth, but for our inputs to translate to outputs, further to outcomes and in the end the desired impact there are many elements that should be in place. This section outlines the assumptions we have underpinning the theory of change.

It is important to note that not all the assumptions must hold for the investment to be realized and be successful. We acknowledge that several of the outlined assumptions are difficult to achieve in the markets Norfund operates in. However, if the desired outcomes and impacts of an investment are not realized, the lack of one or several of the elements mapped out here might be part of the reason.

6.1 From inputs to outputs

The key assumptions in order to be able to transition from our inputs to our desired outputs include:

- There are robust commercial and financial arrangements in place
- The project has broad community support
- The political and security situation is stable
- The offtaker honors its obligations
- The business model is sound

Having **robust commercial and financial agreements** in place is important for the outputs to be realized. In the context of developing countries, this often involves navigating complex legal frameworks, managing currency risks, and ensuring that the agreements are resilient to local economic fluctuations and shocks.

Gaining the acceptance and backing of the local communities is vital in assuring the success of the investee. In order to obtain **broad community support** we must understand and show respect to local cultures, traditions, and needs. Ensuring broad community support can mean the difference between the success and failure of an investment, as local communities play a key role in the operations and sustainability of the projects. This is one of the reasons why Norfund´s local presence through regional offices and use of local consultants is important.

All investments, and particularly those in emerging markets must account for the possible **political and security risks**. A stable political environment ensures the continuity of policies and regulations, which is essential for the viability of long-term projects. Additionally, a secure environment is crucial for the safety of the investment, the workers, and the project's assets. Political instability or security issues can lead to project delays, increased costs, or even failure of the project.

In the context of investments, offtakes are the entities (often local or regional companies or governments) who agree to purchase the energy that is generated through the project. It is crucial that

the **offtakers** are reliable and have a track record of **honoring their contractual obligations,** so that the supplier is not left with nowhere to sell the power that is produced.

Lastly, but not exhaustively, having a **sound business model** means the project is more likely to be economically viable, sustainable, and capable of delivering the expected returns both financially and in terms of the impact we would like to achieve. To ensure this, we conduct thorough market research, try to understand local regulations, adaptions to local market conditions, and we plan for contingencies. A sound business model is adaptable to the challenges that may arise in the emerging markets context, such as fluctuating market demands or changes in regulatory frameworks.

6.2 From outputs to short-term outcomes

For the outputs to result in the desired short-term outcomes:

- The grid must be able to absorb the power generated by the IPP
- Production contributes to the substitution of current or future power generation of fossil fuels

The capacity of the electrical grid to integrate and distribute the generated power is a critical factor. Often, the markets in which we operate have grids that are underdeveloped or strained by existing demands. For successful implementation, it is essential to ensure that the grid can handle the additional load without frequent outages or stability issues. This might involve grid upgrades or the development of localized, off-grid solutions where grid connectivity is not feasible. We also make investments in transmission lines and storage solutions to mitigate this issue. However, when a power producer is contracted to provide power into the grid, the evacuation of power is always planned for.

To achieve avoidance or reduction of greenhouse gas emissions, it is essential that the **production contributes to the substitution of current or future power generation of fossil fuels**. This involves not only increasing the capacity of renewable energy sources but also working to ensure that these sources are reliable and consistent enough to reduce dependence on fossil fuels. This is a significant challenge in emerging markets where fossil fuel-based power generation is often the most established source. This is especially an issue for variable renewable energy sources such as solar energy, which is dependent on the weather conditions to deliver enough power. We do however assume the introduction of renewable energy will contribute most to reducing future emissions, as reducing dependence on current solutions would require the market to have sufficient power to meet demand already. As this is unlikely to be the case in markets where power needs are increasing, we assume we are contributing to avoiding emissions by replacing future GHG emissions from pollutive energy sources, that would have otherwise been used to meet energy needs. In addition, over the longer-term developing countries must replace their fossil fuel power plants with renewable energy to achieve net zero.

6.3 From short-term outcomes to medium-term outcomes

For the short-term outcomes to be transitioned to medium term outcome:

- The environment is conducive to business growth
- The demand growth facilitated by renewable energy
- The government supports renewable energy growth
- The businesses are capable of- and able to mitigate the adverse effects of climate change

The success of businesses that receive better access to electricity is dependent on external factors that allow them to increase productivity, employment and taxes. For this to happen, as a result of the increase in access to energy and the reduced losses due to less power outages, the **environment** in which they operate should be **conducive to business growth**. This includes predictable government policies, access to financing, market stability, and supportive infrastructure. A conducive environment encourages investment, innovation, and expansion of businesses, which is essential for growth, and eventually the impact goals we envision.

The assumption of the **growth in demand being facilitated by renewable energy** sources is paramount to achieve avoidance or reduction in GHG emissions. In emerging markets, the transition to renewable energy should align with the increasing energy demands driven by economic growth, urbanization, and population growth. This assumption is crucial because if the demand for energy in these markets is growing, it creates a substantial opportunity for renewable energy solutions to replace more carbon-intensive energy sources, as already described. By meeting this rising demand with renewable options, rather than pollutive fossil fuel solutions, a significant amount of GHG emissions can be avoided. In addition, over the longer-term developing countries must replace their fossil fuel power plants with renewable energy to achieve net zero.

Government support for growth in the renewable energy sector is a critical assumption that must be met in order for these projects to be successful. Government policies and incentives play a pivotal role in shaping the energy landscape of emerging markets. Support can come in various forms, such as financial incentives, regulatory frameworks, and investment in infrastructure, which are essential for fostering a conducive environment for renewable energy projects. Moreover, government support can also aid in attracting other private investors, and help foster public-private partnerships, all of which will be necessary for the large-scale implementation of renewable energy solutions needed if we are to avoid reaching crucial thresholds of global warming.

Lastly under this section, the firms involved in energy production and the businesses who receive better access to energy need to **be capable of reducing the negative impacts of climate change**, for longer term outcomes to be realized. This involves designing and implementing solutions in the business that are resilient to extreme weather events and changing climate conditions. As climate change can lead to more frequent and severe weather events, energy systems and other business activities that are affected by weather must be robust enough to withstand these challenges. This is to ensure consistent energy production and access, as well as the viability of businesses. Building resilient businesses, whether it's through robust physical infrastructure or flexible operational strategies, is critical to ensure that the businesses can withstand and quickly recover from such events. This resilience is key to achieving the set goals and ensuring maintained productivity in the face of climate change.

7. Impact risks

The transition to renewable energy, while beneficial and needed in the long run, carries some immediate risks. Job displacement is a concern given that the industry evolves away from traditional energy sectors jobs to less labor-intensive power plants. If the renewable projects displace jobs in the traditional sector, this raises economic and social challenges that necessitate strategic planning to avoid regional unemployment issues.

Skill mismatch is another risk that should be considered. The renewable sector demands a unique set of skills that might differ from those found in the fossil fuel industry. Significant investment in retraining and education might be required to bridge this gap and ensure a smooth transition to new kinds of jobs.

Initially, renewable energy can be expensive, potentially leading to higher energy costs that could burden low-income households and challenge the competitiveness of small businesses. But this would only happen if the energy supplied offsets production in fossil fuel companies. If the energy production is already sufficient to meet demand, prices should decrease as a result of higher supply.

Intermittency issues with renewable sources like solar and wind power can lead to reliability challenges, necessitating investments in energy storage and advanced grid infrastructure to maintain a stable supply. To mitigate some of this risk, we also perform investments in transmission and storage solutions, to enhance the stability of the grids.

There are also environmental considerations that need to be accounted for. While renewable energy sources are better for the climate, they are not entirely without adverse effects. For example, the production of solar panels and wind turbines produce emissions, and land use for these projects can create conflicts, particularly if conducted over agricultural or indigenous lands. In considering placement of investments these aspects are important to consider.

From a macroeconomic perspective, overreliance on any single sector, including renewables, can create vulnerabilities. Diversification of energy sources is essential to mitigate the risks associated with economic downturns. Here, geopolitical risks are also a factor as the supply chain for the minerals used in renewable technologies is concentrated in a few countries, which could lead to new dependencies and risks. This is important to be aware of when we invest in large scale renewable projects.

Obsolescence of technology is an inherent risk in any rapidly advancing field, and renewable energy generation is no exception. Infrastructure installed today may become outdated rather quickly, requiring additional investment and could potentially lead to economic losses.

Another consideration when investing in renewable energy is the importance of a just transition. Ensuring a just transition to renewable energy in emerging markets requires an approach that balances environmental considerations with social equity and that considers the historic context. A successful approach would emphasize protecting vulnerable communities and workers in traditional energy sectors jobs. It would also have to consider how to best ensure that the access and benefits of renewable energy are distributed well among different parts of the society.

In conclusion, while the shift towards renewable energy is critical for avoiding and reducing GHG emissions, to ensure long-term sustainability, it requires careful planning and risk management to ensure that the transition is possible and equitable. This involves preparing the workforce for new opportunities, ensuring that the initial costs do not lead to economic issues, and planning for an energy future that benefits all. With a proactive approach, the potential risks can be managed, and the transition to renewable energy can be realized, leading to job creation, economic growth and improved standard of living while reducing or avoiding GHG emissions.

References

Akinlo, A. (2009). Electricity consumption and economic growth in Nigeria: Evidence from cointegration and co-feature analysis. *Journal of Policy Modeling* , 681-693.

Andersen, T., & Dalgaard, C.-J. (2013). *Power outages and economic growth in Africa.* Energy Economics.

Bathia, M., & Angelou, N. (2015). *Beyond Connections: Energy Access Redefined .* World Bank.

Ben-Salha, O., Hakim, A., Zaghdoudi, T., Soltani, H., & Nsaibi, M. (2022). *Assessing the Impact of Fossil Fuel Prices on Renewable Energy in China Using the Novel Dynamic ARDL Simulations Approach.* Sustainability.

Burke, P., Stern, D., & Bruns, S. (2018). The Impact of Electricity on Economic Development: A Macroeconomic Perspective. *International Review of Environmental and Resource Economics*, 85-127.

CDC. (2020). *What is the impact of investing in power?* CDC.

Cissokho, L. (2019, August). The productivity cost of power outages for manufacturing small and medium enterprises in Senegal. *Economia e Politica Industriale*, pp. 1-23.

Eberhard, A., & Dyson, G. (2020). *What is the impact of investing in power.* British International Investment.

Eggoh, J., Bangake, C., & Rault, C. (2011, November). Energy consumption and economic growth revisited in African countries. *Energy Policy*, pp. 7408-7421.

Falchetta, G. (2021). *Energy access investment, agricultural profitability, and rural development: time for an integrated approach.* Environmental Research.

Hsu, & Angel. (2017). *Renewable Energy and Energy Efficiency in Developing Countries: Contributions to reducing global emissions.* The 1 Gigaton Coalition .

International Energy Agency . (2023). *World Energy Outlook 2023.*

International Energy Agency. (2021). *Financing clean energy transitions in emerging and developing economies.* IEA.

International Energy Agency. (2021). *Global Energy Review: CO2 Emissions in 2021.* IEA.

International Energy Agency. (2021, December 17). *The cost of capital in clean energy transitions*. Retrieved from IEA: https://www.iea.org/articles/the-cost-of-capital-in-clean-energy-transitions

International Energy Agency. (2023, September 15). *Access to electricity improves slightly in 2023, but still far from the pace needed to meet SDG7*. Retrieved from IEA: https://www.iea.org/commentaries/access-to-electricity-improves-slightly-in-2023-but-still-far-from-the-pace-needed-to-meet-sdg7

International Energy Agency. (2023). *Scaling Up Private Finance for Clean Energy in Emerging and Developing Economies.*

IPCC. (2023). *Climate Change 2023: Synthesis Report.* IPCC.

IRENA. (2023). *World Energy Transitions Outlook .*

Jaber, J., Marahleh, G., & Dalabeeh, A. (2019). *Emissions Reduction Resulting from Renewable Energy Projects in Jordan.* Journal of Energy Technologies and Policy.

Jack, K. (2022, March 31). *How much do we know about the development impacts of energy infrastructure?* Retrieved from emLab: https://emlab.ucsb.edu/blog/how-much-do-we-know-about-development-impacts-energy-infrastructure

Luciane, L., Munyehirwe, A., Peters, J., & Sievert, M. (2017). Does Large-Scale Infrastructure Investment Alleviate Poverty? Impacts of Rwanda's Electricity Access Roll-Out Program. *World Development 89*.

Norfund. (2023). *Norfund Annual Report 2023.*

Onuonhga, S. (2020). *Economic Growth, Electricity Access, and Remittances in Kenya.* Management and Economics Research Journal.

Roser, M. (2023, April 18). *Learning curves: What does it mean for a technology to follow Wright's Law?* Retrieved from Our World in Data: https://ourworldindata.org/learning-curve

Rubinson, Claude, M, J., Watkins, R., Butscher, J., & Noureddine, B. (2022). *Qualitative Comparative: Analysis Exploring Causal Links for Scaling Up Investments in Renewable Energy .*

Scott, A., Darko, E., Seth, P., & Rud, J.-P. (2013). *Job Creation Impact Study: Bugoye Hydropower Plant, Uganda.*

World Investment Report. (2023). *World Investment Report 2023, Investing in sustainable energy for all .* United Nations.