EVALUATION OF THE SWEDISH PROGRAMME FOR INTERNATIONAL CLIMATE CHANGE MITIGATION WITHIN THE KYOTO PROTOCOL

FINAL REPORT

SWECO

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SUMMARY

This evaluation concerns the Swedish Programme for International Climate Change Mitigation within the Kyoto protocol. The focus of the evaluation is to analyse programme impact, as well as provide an overview of the programme's project portfolio.

The programme

The Swedish programme was launched in 2002 and will run until 2025. The programme was founded as a framework for the Swedish Energy Agency (SEA) to obtain Certified Emission Reductions (CERs) and Emission Reduction Units (ERUs) through two types of flexible, market-based mechanisms: The Clean Development Mechanism (CDM) and Joint Implementation (JI).[1] The Swedish programme has had three key objectives. The first objective concerns Sweden's national climate targets for the two commitment periods of the Kyoto protocol, ending in 2012 and 2020 respectively. The second objective is for the programme to contribute to the development of the flexible mechanisms of the Kyoto Protocol (and future regimes). Finally, the programme is expected to contribute to sustainable development in project host countries.

The project portfolio

As of 2021, SEA had signed contracts for buying a total of 35 million CERs (equivalent to 35 million tonnes of CO_2) from 275 projects worldwide, thereby creating the sixth largest project portfolio globally, counting number of projects. The project portfolio is dominated by projects in Asian host countries which are expected to deliver approximately half of the CERs in the programme, with projects in African host countries expected to deliver a quarter of CERs, and 19 percent of CERs from Latin America and the Caribbean. Finally, five percent of the projected total CERs come from European projects (JI).

Programme impact

This evaluation finds that the Swedish programme clearly contributes to reduced emissions, certainly through the purchase and delivery of CERs. The Swedish programme had, up until 2020, resulted in 31.4 million delivered CERs. Of these, 22.3 million CERs have so far been cancelled, further contributing to the overall objective of reduced emissions. Approximately three million CERs are expected in total for the years 2021-2025, taking the total of delivered emission reductions to 34.5 million. This number represents a significant contribution to emission reduction, certainly from a Swedish perspective, with Swedish territorial emissions amounting to 46.3 million tCO_2e in 2020 (down nine percent from 2019).[2] In other words, the programme's impact on emissions over the total programme period represents about 75 percent of Sweden's territorial emissions for one year.

The purchase of CERs also contributes to the transfer of technology as well as knowledge crucial to limiting emissions and the use of fossil fuels in energy production. These types of co-benefits have been found in renewable energy projects, methane gas capture projects as well as projects aimed at

[1] Within the Clean Development Mechanism (CDM) the term CER is used. In the Joint Implementation mechanism (JI) the term ERU is standard. To simplify matters, and since CDM projects make up the vast majority of projects, the term CER will be used when referring to both CERs and ERUs in this report, unless otherwise noted.

[2] Naturvårdsverket (2021) Territoriella utsläpp och upptag av växthusgaser: https://www.naturvardsverket.se/data-och-statistik/klimat/vaxthusgaser-territoriella-utslapp-och-upptag

affecting energy consumption through increased energy efficiency. The purchase of CERs has also been found to be a cost-effective way to contribute to reduced global emissions.

Another important objective of the Swedish programme is to be involved in, and contribute to, the development of mechanisms for emissions trading. This evaluation finds that the Swedish programme has been both pioneering and consistently active in development efforts, contributing to long-term sustainability and credibility of the various mechanisms used. The development of PoAs (Programme of Activity) has been crucial to making the CDM mechanism more accessible to projects in least developed countries (LDCs). The Swedish programme has, through its expertise, contributed to the development of this tool through participation in UN and EU-level negotiations.

A further objective, added later during the programme period, concerns the programme and its projects' contribution to sustainability in project host countries. While the conditions for evaluating this type of impact are challenging – a lack of systematic reporting and documentation is the main reason for this – this evaluation still finds evidence to support this type of impact. At the project level the case studies, along with the results of previous evaluations and studies, project follow-up and impact analyses, suggests that many of the projects have contributed to, or have a clear potential to contribute to, sustainability-related impacts. These include economic, social as well as environmental impacts.

1. Introduction

Sweco has been commissioned by The Swedish Energy Agency (SEA) to summarise and evaluate the Swedish programme for international climate change mitigation. The programme was initiated in 2002 and will run until 2025.[3] The main purpose of the programme is to contribute to reduced emissions of greenhouse gases globally, primarily through the purchase of Certified Emission Reductions (CERs) and Emission Reduction Units (ERUs).[4] The programme objectives are further detailed in chapter two.

1.1 The evaluation

The purpose of this evaluation is to analyse programme impact, as well as provide an overview of the programme's project portfolio. The following evaluation questions have been the basis for the evaluation:

- What are the total verified emission reductions of the programme?
- What can be said of the project portfolio regarding price per ton, geographical distribution, type of project or technology used?
- What are the additional impacts, for example contribution to sustainable development in project host countries, possible negative or other impact?
- Can any transformative impact be identified and how likely is it that the projects have contributed to lasting impact?

To provide answers to these questions Sweco is relying on multiple data sources and analyses. Data on the programme project portfolio (for example including project-related data on funding mechanism, project type, technology used, host country and region, CER payments, CERs delivered and projected) have been gathered from SEAs own database as well as from the UNFCCC database. The project database supplied by SEA contains data updated until September 2021.[5]

Earlier commissioned evaluations and studies on the programme and the CDM/JI mechanisms, as well as yearly programme progress reports have provided additional important data to the evaluation team, in particular regarding programme development and implementation, earlier output and impact, as well as lessons learned. The mid-term evaluation of the programme carried out in 2018 has been a particularly important source.

[3] The final payment to projects will be in 2022. However, projects will continue to deliver CERs until 2025.
[4] Within the Clean Development Mechanism (CDM) the term CER is used. In the Joint Implementation mechanism (JI) the term ERU is standard. To simplify matters, and since CDM projects make up the vast majority of projects, the term CER will be used when referring to both CERs and ERUs in this report, unless otherwise noted.
[5] With one exception: The aggregated data on delivered and projected CERs used in Figure 9 is from December 2021.

Interviews with current and previous programme representatives and experts at SEA have been carried out to further the evaluators understanding of the programme, its development and its possible impacts. Regular meetings and conversations have taken place between the evaluation team and a selected team of SEA experts in order to further evaluation efforts and provide practical assistance.

A selected number of interpretive case studies, six in total, have been carried out to provide further evidence regarding additional impacts other than emission reductions, such as co-benefits, contribution to sustainable development in project host countries, as well as possible transformative impacts. The case studies have not been selected on the assumption that they will be representative of the project portfolio. Instead, the main purpose of the case studies has been to provide an understanding of how different impacts have and can be achieved, or how potential negative impacts can be avoided. The cases have been selected mainly based on project type and technology used, the success or failure to deliver CERs, as well as geographical location. In each case study, project documentation from UNFCCC and SEA has been an important source and includes Emissions reduction purchase agreements (ERPAs), project design documents (PDDs), progress reports. In addition, in some cases investor reports and impact analyses carried out by other parties have been utilized. Furthermore, interviews with project and partner representatives have been carried out.

The preliminary findings of this evaluation were presented during an interpretation seminar with SEA on 13 October 2021. This report represents the final report of the evaluation.

1.2 Report structure

After this first chapter, the introduction, chapter two provides a brief overview of the programme and its development over time. In chapter three, the focus is on the project portfolio. Chapter four centres on programme impact, including emission reductions as well as additional impacts. Finally, in chapter five, the evaluation relates programme impact to the objectives set out in the programme.

2. The programme and its development

This chapter provides a brief overview of The Swedish Programme for International Climate Change Mitigation[6] (the programme) and its development. The sources for this chapter are mainly made up of SEAs yearly reports on the programme, government instructions to SEA regarding the programme, the UNFCCC CDM website[7] and interviews with SEA staff past and present.

The Swedish programme was launched in 2002. From the start, it has been managed by the Swedish Energy Agency (SEA) on behalf of the Swedish government. The programme will run until 2025. The programme was founded as a framework for SEA to obtain carbon credits as set out in the Kyoto Protocol through two types of flexible, market-based mechanisms: The Clean Development Mechanism (CDM) and Joint Implementation (JI). These mechanisms were set up to create a carbon trading market and encourage private sector engagement in the efforts to reduce global greenhouse gas emissions. While CDM focuses on projects in developing countries, JI focuses on developed countries.[8]

The Swedish programme has had three key objectives. The first objective concerns Sweden's national climate targets for the two commitment periods of the Kyoto protocol, ending in 2012 and 2020 respectively. The second objective is for the programme to contribute to the development of the flexible mechanisms of the Kyoto Protocol (and future regimes). Finally, the programme is expected to contribute to sustainable development in project host countries.

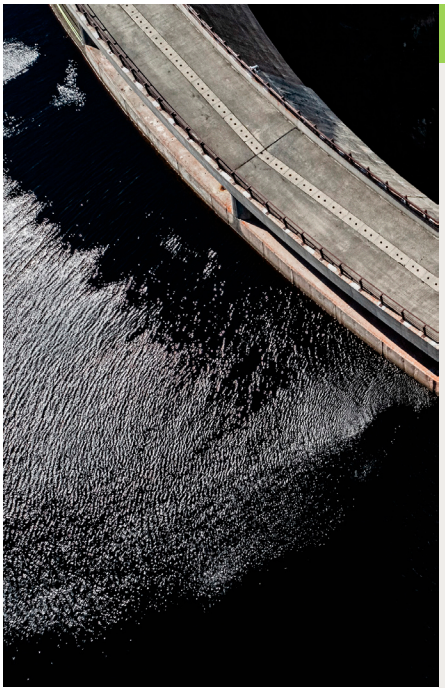
As of 2021, SEA had signed contracts – Emission reduction purchase agreements (ERPAs) – for buying a total of 34.5 million CERs (equivalent to 34.5 million tonnes of CO_2) from 275 projects worldwide, thereby creating the sixth largest project portfolio globally, counting number of projects.[9] The portfolio consists of both bilateral projects and multilateral fund projects within the CDM and JI mechanisms. The 34.5 million tCO_2e (tonne CO_2-equivalent) can be compared with Sweden's yearly territorial emissions which amounted to 46.3 million tCO_2e in 2020.[10]

The main purpose of the programme has remained unchanged since 2002 – supporting climate change mitigation initiatives in developing countries[11] by creating financial incentives for governments and private sector companies, helping them to overcome barriers like capital scarcity, weak institutions and other uncertainties that may hamper such projects. Second, the programme's

[6] Formerly The Swedish International Climate Investment Programme (SICLIP)
[7] https://cdm.unfccc.int/
[8] UNFCCC. Mechanisms under the Kyoto protocol: https://unfccc.int/process/the-kyoto-protocol/mechanisms
[9] GreenStream (2018). Lessons learned from the Swedish Programme for International Climate Change Mitigation. Final report.
[10] Naturvårdsverket (2021). Territoriella utsläpp och upptag av växthusgaser: https://www.naturvardsverket.se/data-och-statistik/klimat/vaxthusgaser-territoriella-utslapp-och-upptag
[11] Early on, this included developed countries in eastern Europe, through JI.

project portfolio has always included projects with different technical focus, including green energy production and landfill gas flaring.

Starting out, there was an explicit priority to achieve coordination between emission reduction-projects in the Baltic states and Eastern Europe – many of which had been inherited by SEA from earlier climate programmes such as the Activities implemented jointly (AIJ) – and Swedish aid initiatives under the framework of SIDA. The JI mechanism, with a focus on eastern Europe and Russia, and where both countries commit to emission reductions, was used alongside CDM initially. But JI was dropped in favour of CDM early on as the Swedish programme sought to focus on funding emission reduction-activities in developing countries. In 2005 another objective was added to the programme, namely supporting Swedish companies that wanted to engage in the market-based mechanisms of the Kyoto protocol, later extended to promoting Swedish technology exports in general. At the end of the first commitment period, the portfolio was tilting heavily towards projects in India, Brazil and China: Three big, high-growth developing economies with a high institutional readiness for initiatives in wind power, hydro power, biogas and landfill gas capture – common topics in CDM projects from which SEA purchased CERs until 2011.



Programme of activities (PoA)

PoAs were introduced to the CDM and JI mechanisms in 2009 as an alternative to regular project activities. They are a programmatic approach to coordinate an unlimited number of emission reduction-projects. These are called component project activities (CPAs), that individually do not need to go through the full CDM project cycle.

PoAs were introduced to enable LDCs to participate in the flexible mechanisms of the Kyoto protocol to a larger extent. PoAs provide certain benefits, such as reduced transaction costs and investment risks, a simplified approval process, as well as enabling small-scale projects and supporting household activities not eligible as regular projects.

In the second commitment period, the programme underwent a change of strategy, according to government directives. Earlier in the programming period, a target of 40 million emission reductions was one of the main drivers in the selection of new projects. This target was dropped to enable more projects from least-developed countries (LDCs) in the programme portfolio, where relatively few projects had been hosted in the first period, and where the volume of CERs from each individual project was generally lower.[12] SEA shifted the geographical focus of new projects accordingly. The shift meant SEA would henceforth focus more on countries in areas like Sub-

[12] As early as 2010 the SEA was instructed, by government directive, to recruit more projects from LDCs. Furthermore, new EU ETS regulations in international credits for phase 3 (2013-2020) required CERs to originate from projects in LDC host countries: https://ec.europa.eu/clima/eu-action/eu-emissions-trading-system-eu-ets/use-international-credits_sv

Saharan Africa, on new tools such as PoAs and on household activities. Projects focusing on improving domestic energy efficiency became more common. Considering the relative lack of institutional readiness compared to countries like India and China, new projects in LDCs inevitably carried more risk in general, including delays or failed deliveries of CERs.

This shift also coincided with the 2012 crash of the global carbon credit market when CER prices plunged to record lows and the future of the CDM as a functioning mechanism for green investment promotion was under threat. Suddenly there was a massive global supply of CERs and little demand. The Swedish programme stayed active in the market despite this, with SEA continuing its CER purchases. A major factor behind this according to SEA, was to maintain credibility as a funding partner by honouring long-term contracts, and to stay engaged in CDM – a mechanism that SEA and the Swedish government believed in.

SEA also increased its monitoring of project impact. During 2014-15 project lead partners were asked to fill out a sustainable development questionnaire (SDQ) with standardised questions on the expected impact of project activities on environmental, social and economic development in host countries, including both co-benefits and possible negative effects. In 2017, the International Finance Corporation's performance standards on environmental and social sustainability (IFC PS) was used for similar purposes, although with more of a focus on assessing risk. The aim of these follow-up measures was to provide data on programme contribution to sustainable development in the project host countries.

3. The project portfolio

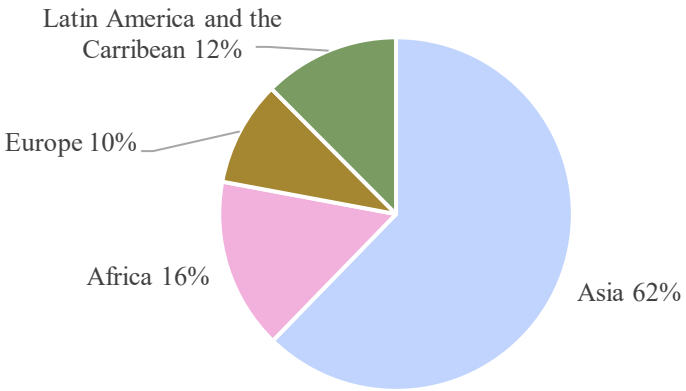
This chapter aims to provide an overview of the project portfolio that SEA has compiled over the programme period. The overview is guided mainly by the three parameters defined in the second evaluation question: the cost of CERs, the geographical distribution, the type of project and technology used.

The purpose of the portfolio overview is to provide a better understanding of the projects contained in the SEA portfolio and its potential impact. The overview describes the project portfolio mainly through quantitative measures and relies heavily on the SEA Agresso database with classifications of projects according to variables such as technology used, geographical location and mechanism. There are certain limitations associated with the data used. For example, yearly data is only available from 2011 onwards, due to changes in the administrative system at SEA. However, these limitations have not impacted the overview presented in this chapter adversely.

3.1 Geographical distribution

The overall project portfolio (including both bilateral and fund projects) has financed activities in 60 countries with a total of 275 projects so far delivering CERs.[13] Overall the balance of the portfolio leans heavily towards Asia with a total of 173 projects (68 %). India (64), China (38) and Thailand (20) stand out in terms of number of projects. India´s leading position is partly explained by a long history of CDM engagement in the region. One of the first CDM projects was initiated here in 2002, the same year as Sweden officially launched its programme. Asia, and in particular India and China, were also in a better starting position in terms of financial and institutional readiness for hosting CDM projects.

Figure 1: Regional distribution of the Swedish programme portfolio, share of projects.[14]



Source: SEA

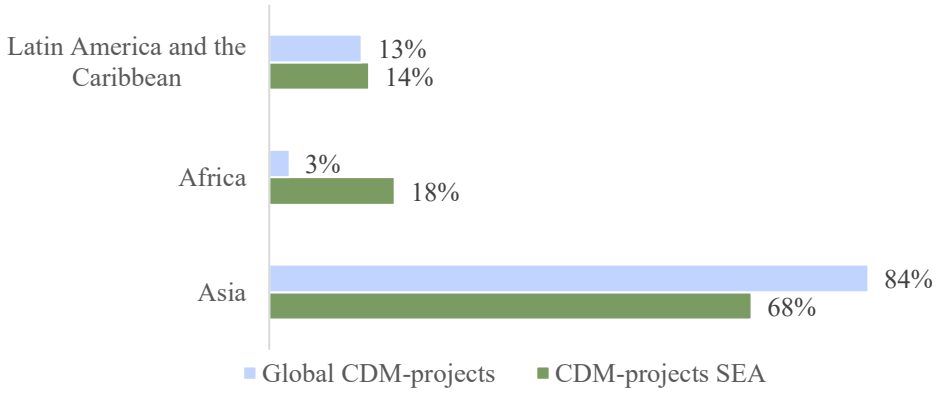
[13] Source: SEA database. Not including projects from Pilot Auction Facility (PAF) where project level data is missing.

[14] In this report, the following regional/continental groupings are used: Africa, Asia, Europe, Latin America and the Caribbean, the latter group including Central and South America. One project in Oceania is included in the portfolio but is not included in the regional figures for illustrative purposes. In addition, all figures in this report include both JI and CDM bilateral and fund project data, unless otherwise noted.

Looking outside the Swedish programme, the global CDM portfolio in total is unevenly distributed geographically. Asia, with India and China in the lead, stand out, representing 84 percent of all hosted projects. By comparison, African countries have hosted a very small share of projects – three percent of the global total. While the CDM was originally set up to support climate-mitigating efforts in developing countries in general, the failure to involve Africa and the LDCs of the world to a larger extent, can be regarded as a failure of CDM. In LDCs, the need for external financing and expertise in order to reach climate-mitigation objectives is great, as is the potential for technology transfer towards renewable energy and other co-benefits.[15] However, several structural disadvantages partly explain low CDM project registration in Africa. These include issues such as high investment risks (due in part to a perceived, higher risk of corruption), a lack of technical expertise and generally lower emission intensity.[16] Issues related to mobilising the resources and infrastructure needed to host CDM projects have also been raised previously.[17]

Comparing the global and Swedish project portfolios (Figure 2), both portfolios are dominated by projects in Asia, although the region's share in the Swedish portfolio is significantly smaller by comparison. Almost a fifth of all Swedish CDM projects have African host countries. Starting in 2013, only CERs from projects based in LDCs could be registered in the EU ETS.[18] This fact, in combination with a focus on PoAs in Africa in the Swedish programme, are major explanations for this difference.

Figure 2: The Swedish and the global CDM portfolios compared, regional share of projects (JI projects excluded).



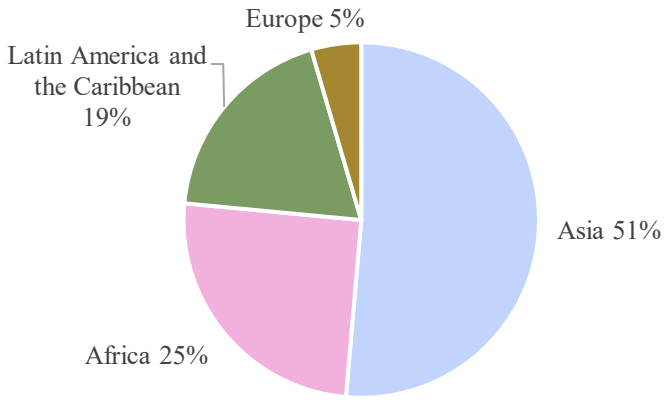
Source: SEA and UNFCCC.

As a share of total projected emission reductions in the Swedish programme, CERs from projects in Africa represent an even larger share of the total, in comparison to the share of projects: CERs from Africa represent a quarter of all emission reductions, as seen in Figure 3. This is explained by a comparatively larger average project size in Africa, in terms of projected CERs. The PoA tool and its capacity to coordinate and include a large number of CPAs has been important in this regard. Many of these PoAs consist of household activities and technologies such as cookstoves. The projects in

[15] Desanker (2005). The Kyoto Protocol and the CDM in Africa: a good idea but.. Unasylva, Food and Agriculture association of the UN, Vol. 56 2005/3.
[16] An Update on the CDM in Africa in Times of Market Crisis, Nicolas Kreibich, Lukas Hermwille, Carsten Warnecke, Christof Arens. Climate and Development, 9 (2017), 2, 178-190 2
[17] Rahman, Dinar, Larson (2016). The incidence and extent of the CDM across developing countries. Environment and Development Economics, Vol21:4/2016.
[18] European Commission (2021). Use of international credits in EU ETS: https://ec.europa.eu/clima/eu-action/eu-emissions-trading-system-eu-ets/use-international-credits_sv#ecl-inpage-1352

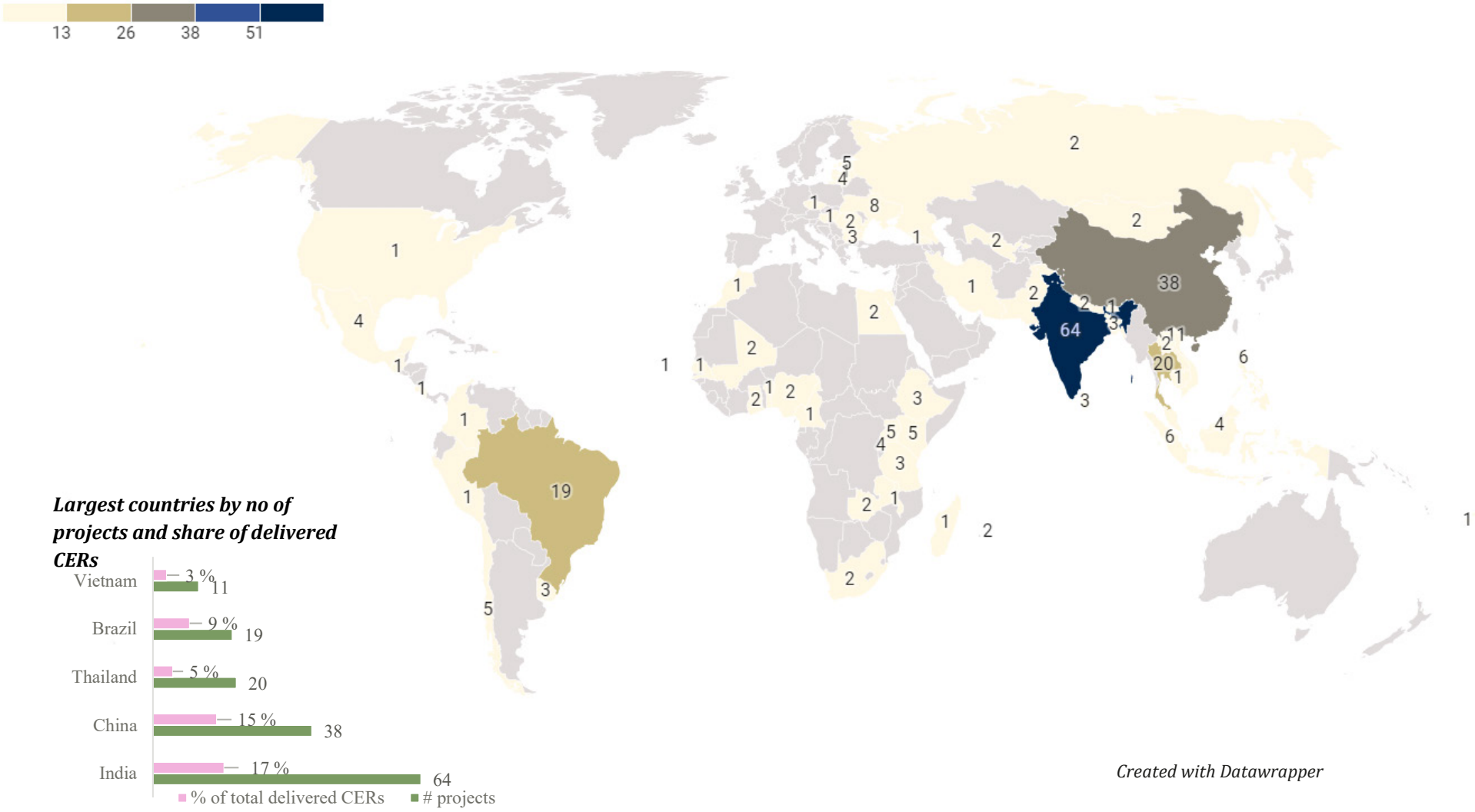
Latin America and the Caribbean also have a large average size in terms of CERs, which is a result of several large-scale landfill gas projects.

Figure 3: Projected total share of CERs in the Swedish programme by region.



Source: SEA

Figure 4: Geographical distribution by number of projects, and share of delivered CERs in top five countries by number of projects.

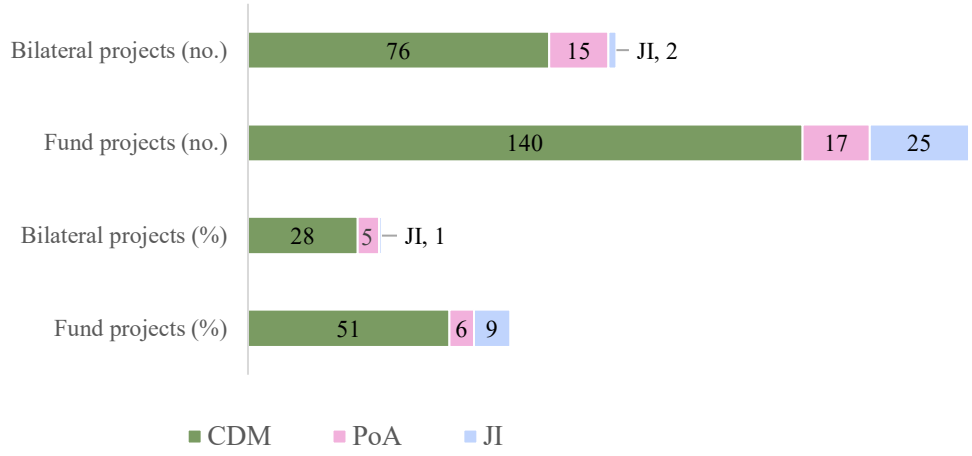


3.2 Type of project and technology

This section aims to provide an overview of the portfolio by project type, defined here as either bilateral projects or multilateral fund projects, as well as the technology used for emission reductions. The PoAs are treated separately in some cases, to provide further detail.

As shown in Figure 5, bilateral projects (including PoAs) make up a third of the programme portfolio and the rest are projects within one of the many multilateral funds within the CDM and JI mechanisms. It is also clear that CDM projects dominate the portfolio, unsurprising given that the JI mechanism was dropped in favour of CDM early on.

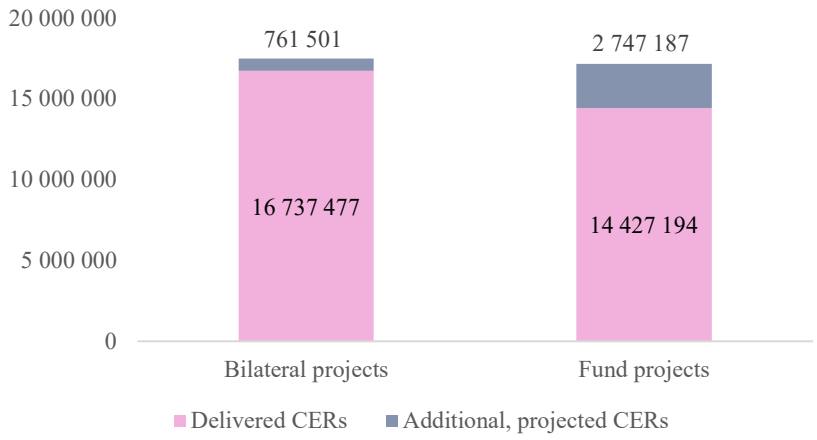
Figure 5: Number and share of projects by project type and mechanism.



Source: UNFCCC and SEA

Figure 6 shows the CERs that have been delivered so far, as well as the CERs that are still expected, from bilateral and fund projects in the portfolio. The share of total projected CERs is roughly equal between bilateral and fund projects, although fund projects make up a much larger share of the total number of projects.

Figure 6: Number of delivered and projected CERs by project type.



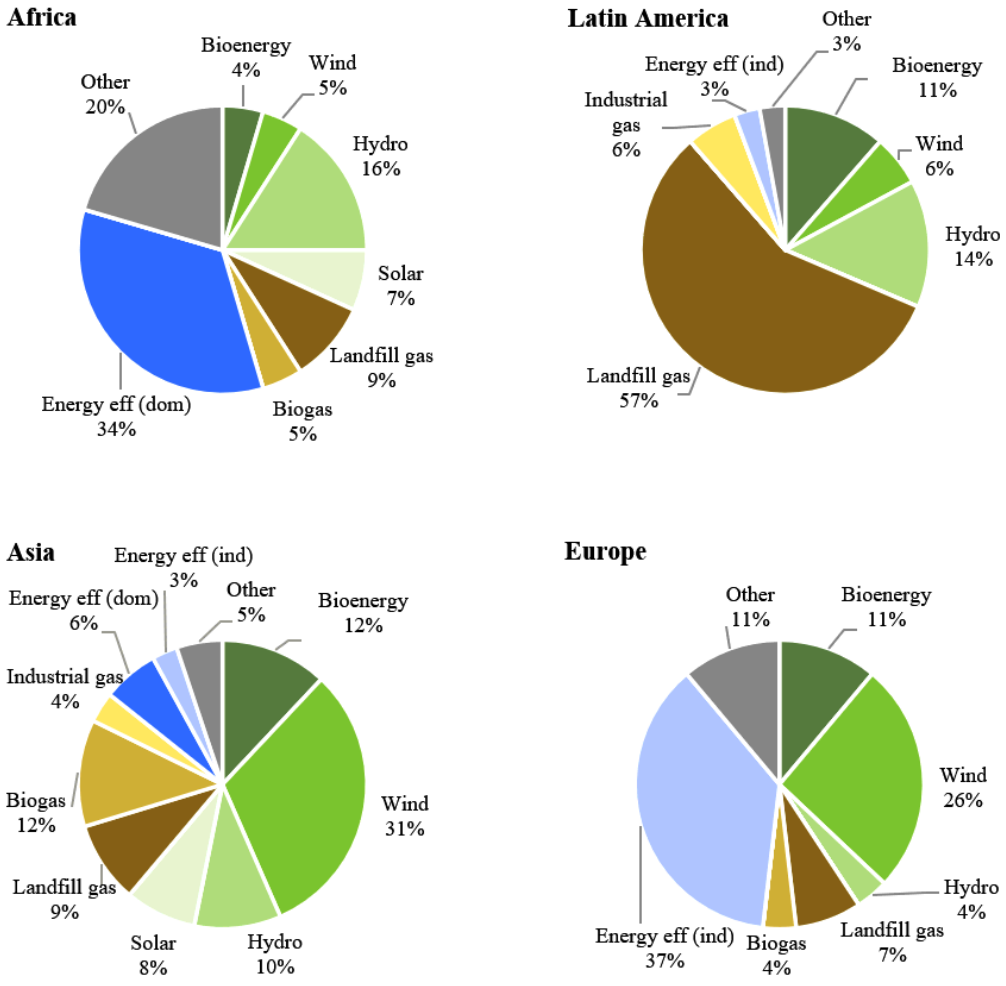
Source: SEA

Twelve percent (43 in number) of the total financed projects are PoAs. These have so far delivered only four percent of the total delivered CERs in the programme. Six PoAs have yet to deliver any CERs, and more than half are expected to deliver more CERs in the coming years. At the time of writing, 16 percent of the projected CERs from PoAs had been delivered, with severe delays in many cases.

When analysing the issuance of CERs by technology, as illustrated in Figure 7, there is a high variance between technology used and location:

- Europe (only JI): Projects were predominantly focused on industrial energy efficiency and wind.
- Latin America: Landfill gas followed by hydro and bioenergy were most frequent.
- Africa: Domestic energy efficiency projects (mostly cookstove projects) represent over a third of all projects, followed by hydro.
- Asia: Wind was by far the most frequent technology with almost a third of all projects. Biogas, bioenergy, landfill gas and hydro also represented a large share of projects.

Figure 7: Share of projects by technology and region.



Source: SEA

3.3 Average cost of emission reduction in the programme

The calculations regarding average cost of CERs in this evaluation are based on the contracted purchase price of CERs (ERPAs) from all projects included in the programme portfolio at the time of writing this report[19], both bilateral and fund projects. Table 1 shows the average price of CERs in the Swedish programme, when combining the average contracted CER cost.

Table 1. Average costs for CERs in the Swedish programme[20]

Average cost per CER in ERPAs (real prices[21])	60 SEK
Average SEA administrative cost per CER	7 SEK
Average total cost per CER	**67 SEK**

Source: SEA and Statistics Sweden.

Previously, SEA has calculated an average nominal price of 70 SEK per CER, when only looking at projects active during 2019-2022.[22] While the real price calculations in this evaluation takes inflation into account, it does not consider changes in currency exchange rates (ERPAs are signed in USD or EUR) and changes in the market price for carbon credits, which can both affect the actual price paid for CERs in most of the projects within the Swedish programme. The reason for this is that a majority of projects in the programme were signed with ERPAs that included some flexibility in the actual price paid for CERs in each individual project over time, to allow for some price variation according to shifts in market price and other factors. These ERPAs also had a minimum and a maximum price specified. The minimum was set in order to ensure that the price paid would not sink too low, for example following dramatic market price dips.[23] However, since 2012-13, most ERPAs in the Swedish programme were signed with a fixed price for CERs. This change was made in response to the carbon credit market crash of 2011-12 and ensured that project-related costs could be reasonably covered over the course of the ERPA.[24]

In addition, and in close dialogue with SEA, an effort has been made to estimate the average administrative cost per CER in the programme, including staff costs associated with programme management, programme-related activities and project support, but excluding property costs. The total sum of administrative costs amounts to 245 million SEK over the programme period. Divided by the total number of projected CERs in the programme (34.5 million) we arrive at a programme cost of 7 SEK per CER over the course of the programme period. This puts the average cost of CERs in the Swedish programme at 67 SEK (real prices).

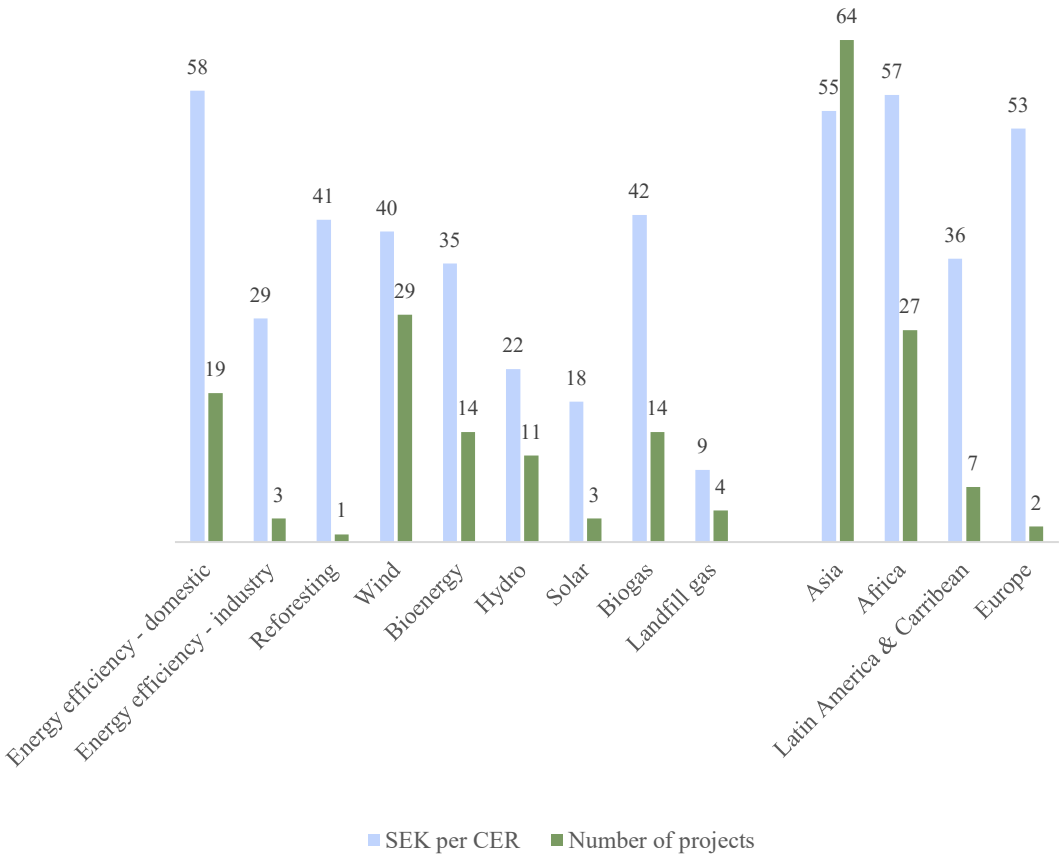
[19] Data up until September 2021 (SEA).
[20] Prices based on ERPAs, including all contracted CERs.
[21] Price adjusted for inflation, source: Statistics Sweden (SCB). At nominal prices, the average cost per CER is 55 SEK.
[22] SEA (2021). Årsrapport 2020 för Sveriges program för internationella klimatinsatser.
[23] Almost all prices bottomed out at minimum after 2012. Source: SEA interview.
[24] SEA interview.

3.3.1 Cost comparisons

Initially, it is important to bear in mind that SEA project financing decisions have not been strictly based on cost-effectiveness and seeking out projects which would have generated the maximum volume of CERs at the lowest possible price. The programme strategy is dictated by climate policy and government directives, and an earlier volume target of 40 million CERs was dropped in order to focus on other objectives. An example that has been mentioned earlier in this report (see chapter 2) is the efforts made since 2010 in increasing the recruitment of projects in LDCs, where the risk of delays or failures in the delivery of CERs is considerably higher, but where the potential co-benefits may be higher.

With that being said, when looking at CER costs in further detail, the average cost of CERs in the types of projects financed under CDM and JI show a negative correlation between average cost and project size (in terms of CERs). In other words, the bigger the project, the lower the cost per CER, in general. This demonstrates economies-of-scale impact. It suggests that purchasing CERs through projects with a small total of projected CERs, as a rule, can be relatively expensive – in other words, less cost-effective.

Figure 8: Average cost of CERs per continent and technology (fund projects not included).



Source: SEA.

The average price calculations show significant variations in the costs of CERs by technology and region (Figure 8). For example, the lowest average costs per CER are found in Latin America and the Caribbean, but comparatively few projects were financed there. The low cost is largely due to a number of sizeable landfill gas projects with very low cost per CER.

Africa has the highest average cost per CER, but only marginally higher than CERs from projects in Asia and Europe. The most expensive technology in terms of average cost of CERs is domestic energy efficiency projects, mainly cookstove projects. Since these are mainly hosted by partners in African countries, this can partly explain the high average cost of CERs in the region. Furthermore, the use of PoAs has likely contributed to a lower average cost per CER in these projects than would be possible to achieve in regular bilateral projects.

The cookstove/African example illustrates the limitations of the CER cost analysis, and the difficulties in drawing perfect conclusions regarding price comparisons over time (due to shifts in the supply and demand of carbon credits) between technologies and regions. Costs are clearly influenced by the following and other factors:

- Project type (bilateral, fund and regular projects or PoAs),
- the type of technology used,
- specific regional transaction costs,
- under what market conditions the purchase agreement for CERs was signed (supply and demand).

In addition, there are many potential co-benefits that are not captured in this type of cost analysis. Other positive (as well as negative) impacts are potentially generated by projects. More on that in the next chapter.

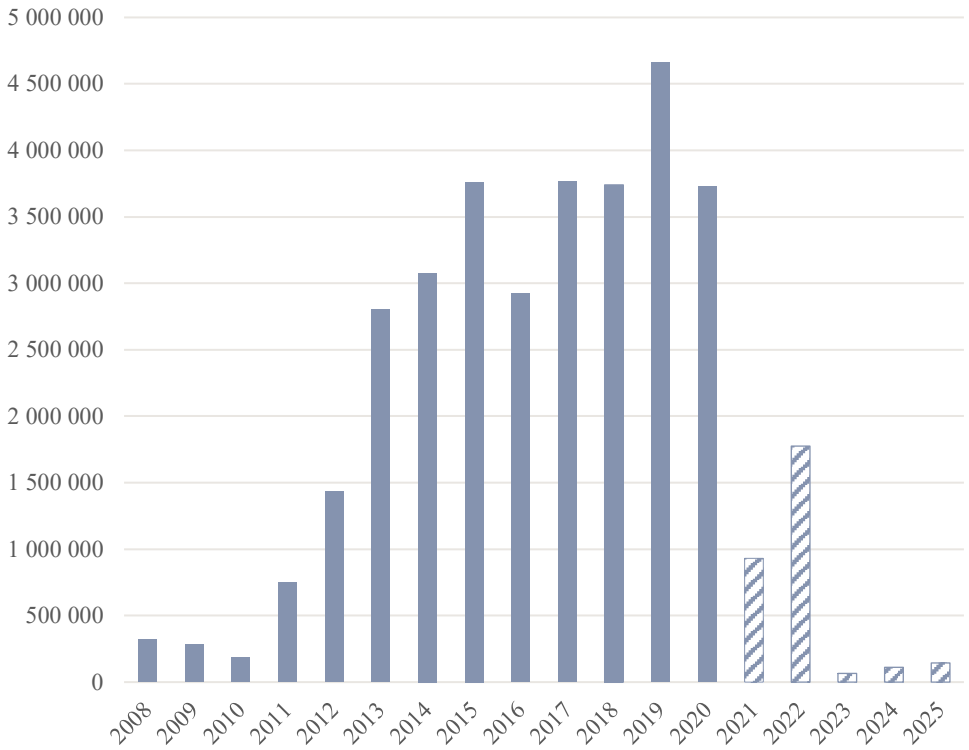
4. Programme impact

This chapter analyses the impacts of the Swedish programme for international climate change mitigation, including emission reductions, co-benefits such as contribution to other SDGs beyond climate change, negative impacts as well as transformative impacts.

4.1 Emission reduction

The Swedish programme for climate change mitigation had, up until 2020, resulted in 31.4 million delivered CERs. As Figure 9 shows, the investment in projects really started paying off in the form of delivered CERs from 2013 onwards, rising to a high of 4.7 million units in 2019. The number of delivered CERs is expected to decrease dramatically in 2021 onwards, mainly due to a decreasing number of active projects still to deliver CERs, with a small number of additional CERs expected in 2023-2025 from fund projects. Approximately three million CERs are expected in total for the years 2021-2025, taking the total of delivered emission reductions to 34.5 million.[25]

Figure 9: Delivered (2008-2020) and projected (2021-2025) CERs per year.

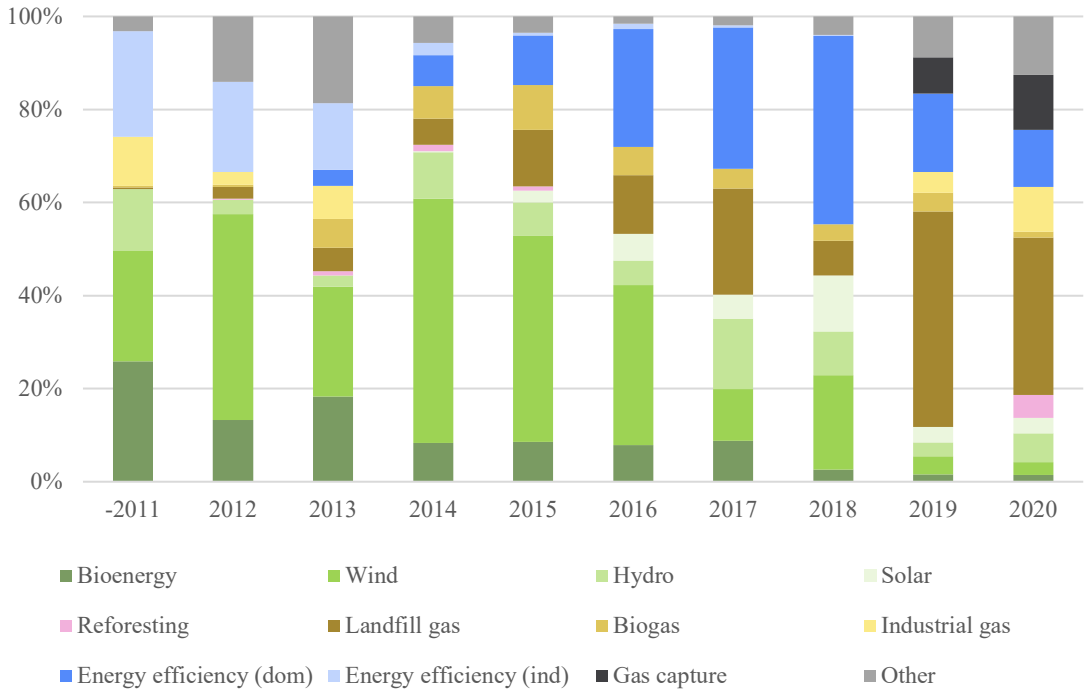


Source: SEA

[25] SEA database and interviews.

Figure 10 shows the total number of CERs delivered in the programme on a year-by-year basis, divided by technology share. The figure clearly demonstrates the previously established (see section 3.2) early domination of renewable energy projects and industrial energy efficiency projects (mostly JI projects in Europe), being slowly replaced by gas-related projects (especially landfill gas projects) and household energy efficiency projects.

Figure 10: Delivered CERs over time, by technology share of CERs.[26]

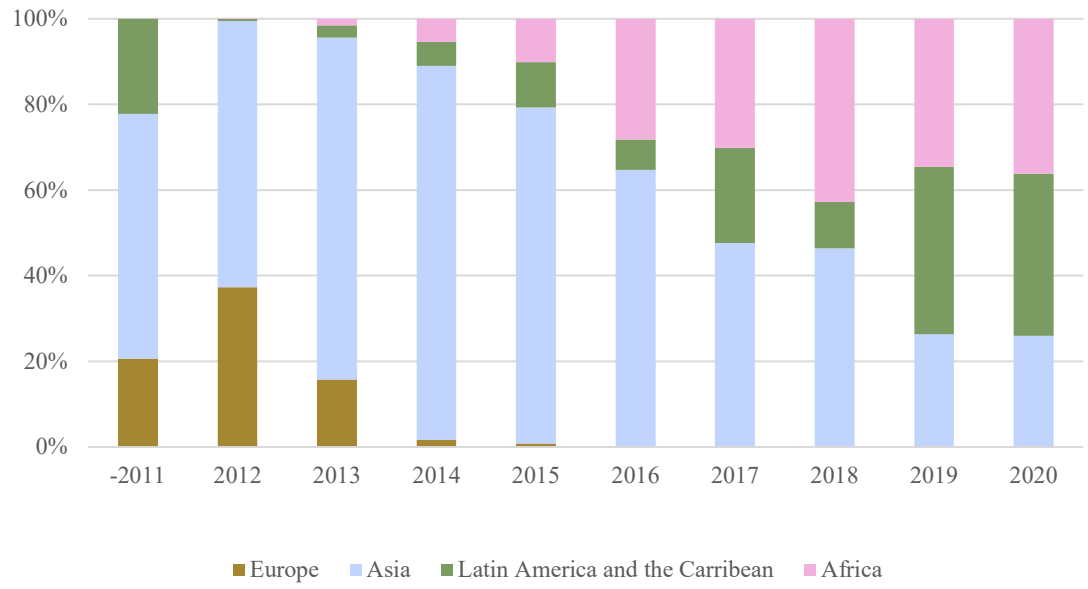


Source: SEA.

Figure 11 shows the regional origin of the yearly delivered CERs in the programme. The early involvement in JI meant that ERUs (the term for emissions reduction used in JI) were delivered from projects based in Europe up until 2015, although the numbers for 2014 and 2015 are just slightly over 30 000 ERUs per year. The very limited registration of projects in African countries during the programme's early years is also clearly illustrated in this figure. But CERs delivered from projects in Africa as well as Latin America and the Caribbean make up a growing share of the total number of delivered CERs later in the programme period. They represent the majority share from 2017 onwards. The figure also illustrates the dominance of CERs from projects in Asia throughout, with CERs from this region making up just over half the total delivered and projected CERs.

[26] The column for -2011 includes CERs delivered up to and including 2011.

Figure 11. Delivered CERs over time, by regional share of CERs..



Source: SEA

4.1.1 Cost-effective emission reduction

As previously discussed in section 3.3.1 Cost comparisons an analysis of cost-effectiveness is not easy to do for the Swedish programme, especially since some project impacts are difficult or almost impossible to quantify. In addition, the scope of this evaluation does not include an extensive analysis on cost-effectiveness. However, since one of the initial incentives for the programme was to contribute to cost-effective emission reduction and bearing in mind this is also a key idea behind the CDM in general, it is relevant to touch on briefly.

The 34.5 million CERs projected in the Swedish programme is a significant contribution to emission reduction, certainly from a Swedish perspective, with Swedish territorial emissions amounting to 46.3 million tCO_2e in 2020 (down nine percent from 2019).[27] In other words, the programme's impact on emissions during the whole programme period represents about 75 percent of Sweden's territorial emissions for one year. This is very much in line with one of the programme's main objectives, to contribute to the national climate objective limited climate impact.[28] Bearing in mind that the cost of these 34.5 million CERs is approximately 67 SEK per CER, and that the tax on one ton of CO_2 is 1 200 SEK in Sweden, the programme looks to be a highly cost-effective option for reducing emissions. In addition, the cost of emission reduction within Klimatklivet[29], where costs range from 1 000 – 4 000 SEK per tCO_2e (depending on the type of action/investment), is also much higher compared to the programme.[30] Earlier studies have also shown that the programme is cost-

[27] Naturvårdsverket (2021) Territoriella utsläpp och upptag av växthusgaser: https://www.naturvardsverket.se/data-och-statistik/klimat/vaxthusgaser-territoriella-utslapp-och-upptag
[28] Sveriges miljömål. Begränsad klimatpåverkan, https://www.sverigesmiljomal.se/miljomalen/begransad-klimatpaverkan/
[29] Klimatklivet is a government initiative aimed at supporting local climate investments in Sweden: https://www.naturvardsverket.se/bidrag/klimatklivet/
[30] Riksrevisionen (2019). Klimatklivet – stöd till lokala klimatinvesteringar (RiR 2019:1).

efficient, both when comparing to short-term measures to reduce emissions in Sweden, or when comparing with other carbon market options.[31]

4.2 Co-benefits of projects

Emission reductions, avoidance or removal projects often generate other benefits than the contribution to climate change mitigation (Sustainable Development Goal (SDG) 13). However, these co-benefits are not easily verifiable in the case of CDM or JI projects[32].

The CDM has always included sustainable development criteria as part of the basic requirements for registering new projects. Early on however, it was up to the project host country to assess the likelihood of this type of impact. Unfortunately, limited follow-up on this type of impact was ever made. Starting in 2009-2012, a more systematic and objective approach regarding sustainability, co-benefits and transformative impact of funded projects was developed, to enable systematic project-level reporting and documentation of these aspects. Since the Swedish programme had been running for about ten years at this point, there is a lack of data on co-benefits in most projects within the portfolio.

Within the CDM, the Sustainable Development co-benefits tool was developed to make co-benefits and other impacts more visible. However, the tool was created relatively late (the first project-level report done with the tool is from 2013), so it has not been used by many projects. Of the over 8 200 CDM projects registered globally, only 76 (less than 1 %) have reported their SDG benefits with this tool.[33] The SEA has been partly involved in the development of the SD tool by giving feedback to the draft questionnaire format. Of the Swedish programme's bilateral projects, four have reported their SDG benefits through the tool. However, the lack of any "do no harm" aspects in the tool contributed to SEA developing their own SDG questionnaire in 2014, which in addition to co-benefits, included questions on potential negative impacts.[34] However, questionnaires like these have certain limitations, especially since they rely on responses regarding project output and impact from people involved in the projects. In other words, there is a risk of positive bias.

Even though there has been a lack of systematic reporting of easily quantifiable data, qualitative information of co-benefits has been used in this evaluation, such as information found in Project Design Documents (PDDs), data from interviews made in this evaluation, examples in the project-level case studies, and other relevant documentation such as the programme's mid-term evaluation and the lessons learned reports.

4.2.1 Project-level co-benefits found in the case studies

The case studies performed in this evaluation has been an important source material to highlight co-benefits from individual projects. It is important to note that the case studies take a learning approach first and foremost – they have been designed and selected to provide information on co-benefits, transformative impact and possible negative impact in particular circumstances, such as regional location, technology used and project type. The selection is not meant to be representative of the programme as a whole. Rather, projects for case studies have been selected where the

[31] For example, see Riksrevisionen (2011) Klimatinsatser utomlands – statens köp av utsläppskrediter (RiR 2011:8)
[32] In some other standards, such as Gold Standard, the impact of the project towards other SDGs is measured and verified. This is not systematically done in CDM and JI.
[33] https://www4.unfccc.int/sites/sdcmicrosite/Pages/SD-Tool.aspx
[34] The results of the SEA questionnaire have been summarized in a report called *De svenska, internationella klimatinsatsernas bidrag till de globala målen enligt Agenda 2030*

available information (for example, the availability of project representatives was a factor in the selection) and the likelihood of various impacts other than CERs was expected to be high. The selection was made together with SEA, due to the agency's prior knowledge about these and other projects in the portfolio.

The **Cabeolica wind power project** (Cape Verde) has had a significant positive environmental impact from fuel switch from fossil to renewable energy and from technology transfer. Before the wind farms became operational, almost all electrical power generated on the Cape Verde islands originated from fossil fuel-powered thermal generators. The project has thus directly contributed to a reduced dependence on fuel imports, replacing an estimated 22 percent of imported fuel. The project has contributed to a more reliable power supply and helped reduce power outages in the islands by an approximated 60 percent. The project has also contributed to 10 direct and 52 indirect jobs locally.[35]

Assessment of the SDGs impacted by the project:

The **Bokpoort Concentrated Solar Power (CSP) project** (South Africa) is, according to case study evidence, one of the major drivers of technology transfer towards renewable energy in South Africa, with its 50 MW production at peak capacity. The plant's 1 300 MWh thermal energy storage capacity means it has among the largest energy storage facilities of all CSP plants in South Africa. The power generated serves approximately 21 000 households. On a local level, the project appears to contribute to transformative impact: Just under two percent of revenue goes toward economic and social development activities as per the conditions of the power purchase agreement, which has resulted in a host of community improvements such as training, bursaries and empowerment of women. Almost 42 percent of the total project costs are directed to local civil works, contributing to local job opportunities.

Assessment of the SDGs impacted by the project:

The **MicroEnergy Credits – Microfinance for Clean Energy Product Lines** (Mongolia, PoA) is a micro-lending scheme aimed at poorer households, who are offered subsidised loans at approximately ten percentage points lower interest rates. The loans are supplied in order to facilitate the purchase of fuel-efficient heating stoves and insulation for homes. The PoA is estimated to have generated several co-benefits, even though regional regulatory constraints limited the potential impact, including co-benefits. The main co-benefits observed include cleaner indoor air in households due to the use of cleaner heating products, with a reduction in particulate matter emissions, and associated positive health impact.

The PoA has also generated or supported local jobs by hiring staff, using local distributors, technicians and other service providers to effectively market the clean energy products to

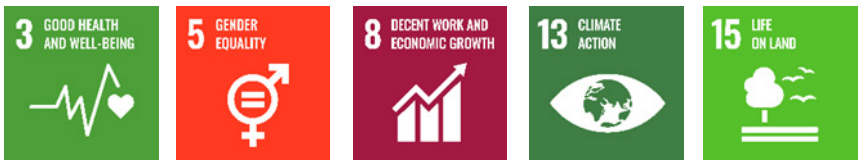
[35] Cabeolica impact study (2018) and Cabeolica Sustainability Report (2017).

households. Other co-benefits include lower fuel (firewood) needs at the household level, which in turn has the potential to affect local deforestation. The reduction in household fuel expenditures observed in the PoA resulted in more disposable income for poorer families. The project has contributed to expanding the MicroEnergy Credit (MEC) operations in Mongolia beyond the PoA-specific activities: The operators have later received larger loans from the Green Climate Fund for the scale-up of activities. This was made possible because of the example set by the project.

Assessment of the SDGs impacted by the PoA:

The **Fuel-Efficient Stoves in Zambia** (Zambia, PoA) set several targets relating to co-benefits, including gender related benefits such as limiting time spent by female household members gathering firewood, thereby freeing up time for other economic activities. Another target was to decrease stove-users exposure to smoke indoors when cooking, prevent burn injuries (especially among children) by providing a safer method for combusting biomass, as well as providing jobs to the local communities through stove installations and monitoring activities. Also, local deforestation is potentially reduced when less firewood is needed to produce necessary heating. In the end, the project did not fully meet its targets – neither for stove distribution nor for CER deliveries. Still, 41 968 stoves were installed in households which have generated benefits beyond reduced emissions. Recipient households clearly preferred the new stoves over the older three-stone fireplaces. User satisfaction was high. For women, cooking was made both cleaner and safer (less smoke, fewer burn injuries). Valuable time was also freed up for young women (who are usually the ones collecting firewood), thereby enabling many to work or attend school. The PoA also contributed to local jobs. Even though some of the stoves broke down earlier than expected, a later follow-up in 2018 by 3 Rocks limited[36] indicate many stoves were still being used several years after the end of their supposed lifespan.[37]

Assessment of the SDGs impacted by the PoA:



[36] 3 Rocks ltd is a UK based CDM-project developer, part of the Clean Cooking Alliance (CCA).
[37] Case study interviews of project proponents. See case study in the Annex of the report.

The **Nkolfoulou Landfill Gas Recovery Project** (Cameroon) has contributed to systemic changes in the local waste management practices. Given the financial constraints on waste management in Cameroon, and the fact that the system for capturing and flaring landfill gas at Nkolfoulou remains in operation, the project has clearly contributed to systemic change. Because of the project, living conditions have improved around Nkolfoulou. Air pollutants (NMVOCs, H_2S) and odours have been reduced, benefitting people living in the vicinity. Landfill gas can cause major damage to crops, plants, and animals, and these risks have been reduced because of the gas capture and flaring activities. Visual improvements have also been made to the waste deposit sites. The project's greatest co-benefit may be that it is used as a reference project in a Sub-Saharan context, with technology transfer co-benefits to the surrounding region. In many Sub-Saharan African countries, there are still no local or regional strategies or concrete measures to control landfill gas emissions, so this project demonstrates one way to achieve results.[38]

Assessment of the SDGs impacted by the project:

The **CDM Sustainable Energy Programme** (Zambia and Senegal, PoA) involves two main activities: 1) selling portable, fuel-efficient cookstoves to households, and 2) the production and distribution of refined biofuel (charcoal). The case study concerns the Zambian component project activities (CPA) only, since those were the ones affiliated with the SEA ERPA. The original targets of the PoA concerning co-benefits included slowing deforestation and limiting the time spent by female household members gathering firewood, potentially freeing up time for work or studies. Other targeted co-benefits were health benefits from less smoke-inducing stoves and thus cleaner indoor air, as well as contributing to over 100 short-term jobs and more than 20 long-term jobs (especially for local women), and reducing household expenditures on cooking fuel.

As the PoA has not reached its targets in terms of stove distribution or CER sales – 8 890 stoves were distributed in Zambia, which represents 57 percent of the targeted amount – the PoA has not generated as much co-benefits as originally targeted. In 2019, researchers belonging to the energy programme EPPSA surveyed Zambian households participating in the PoA in question. The researchers found that there were some co-benefits related to reduced household expenditures and health impacts from better indoor air. The PoA also contributed to some local jobs, reduced the time spent by women for gathering firewood, and potentially contributed to slowed local deforestation to some extent.

Assessment of the SDGs impacted by the PoA:

[38] Case study interviews of project proponents. See case study in the Annex of the report.

4.2.2 Earlier studies on co-benefits

As the case studies demonstrate, the co-benefits can vary depending on factors such as the technology in focus, local or regional conditions and the type of activities included in the projects. In this section we summarise findings on co-benefits from earlier studies on the Swedish programme (The mid-term evaluation and the lessons learned report in particular), SEAs own follow-up on bilateral projects' contributions to the SDGs and SEAs yearly reports on the programme.

The bilateral projects have, in total, contributed to an estimated 1 245 MW of installed renewable energy production capacity in host countries. In addition, they have also contributed to an estimated 650 new jobs.[39] Below, we summarise further findings on co-benefits, based on project technology.

Renewable energy and energy efficiency projects have generally contributed to a more reliable and secure power supply, improved health and reduced environmental impact, as well as increased climate awareness in the host countries. They also tend to contribute to a reduced dependency on fossil fuels.

In addition to the 1 245 MW renewable energy production capacity mentioned earlier, the energy efficiency projects aimed at industry have contributed to an increased 25 MW of electricity generation capacity through more efficient heat use in industrial processes. Energy efficiency projects at the household-level are estimated to have reduced electricity consumption by around 200 000 MWh per year.

Bioenergy projects have contributed to technological development in the host countries, most notably the bioenergy projects in China. Biogas projects also tend to result in new jobs, knowledge and technology transfer and reduced emissions of hazardous substances. Biogas projects have also contributed to increased income for fuel suppliers such as farmers, for example through an increased demand of cassava root as a fuel. Furthermore, the biogas projects have contributed to a more reliable power supply and reduced fire risk. Associated irrigation activities have also contributed to increased access to clean water through improvement in sewage treatment and increased ground water protection.

Solar energy projects have created new jobs and reduced the emissions of hazardous substances. At least two of these projects have contributed to knowledge and technology transfer: A project in Thailand (Solar Power Project by Bangkok Solar Power Co Ltd) was, at the time of launch, the first CDM-project concerning large-scale electricity generation based on solar cells in the country. And a similarly ambitious project in South Africa (Bokpoort CSP, analysed above) partly contributed to the introduction of solar power in the country.

Hydropower projects have contributed to job creation, a more reliable power supply, knowledge and technology transfer and reduced emissions of hazardous substances. Unlike other project types, the hydropower projects have also contributed to rural electrification to a significant extent, which has, in turn, contributed to household-level impacts, for example a reduced need for firewood.

Wind power projects have generally resulted in new jobs, more reliable power supply in the regions, technological development, reduced emissions of hazardous substances, as well as knowledge and technology transfer. The Swedish programme's wind power project in Mongolia

[39] The Swedish Energy Agency (2020). De svenska, internationella klimatinsatsernas bidrag till de globala målen enligt Agenda 2030.

was the first privately funded project of its kind in the region, paving the way for other projects and partners to follow suit.

The **household-level** projects**,** such as cookstove and lightbulb projects, have in general led to some of the more direct co-benefits to the health and well-being of the local population. Household projects are estimated to have contributed to reducing emissions of hazardous substances and reducing the risk of fires, especially in the cases where energy efficient lightbulbs replace kerosene lanterns. The cookstove projects have contributed to a reduced need for firewood, which in turn increases time available for working or school activities. They have also contributed to improved indoor air and reduced household expenditure. The household projects also tend to result in new job opportunities for the local population, among others in production and distribution of cookstoves, as well as knowledge and technology transfer. However, up-front costs of the stove projects are high (project partners risk making financial losses) and there is a risk that results are temporary.

Other project types

In addition to the above-mentioned project types, other technology and methodology have been in focus, such as **forestry (afforestation or reforestation)** projects. These projects can also contribute to a number of co-benefits. The PCF (Prototype Carbon Fund) project Reforestation as Renewable Source of Wood Supplies for Industrial Use in Brazil, contributed to several job opportunities locally, mainly through the hiring of more than a thousand workers in the growing and planting of sprouts, 70 percent of whom are women.[40] However, the long-term impact in terms of job creation is unclear. Another PCF afforestation project in Romania has estimated the following co-benefits: Enhancing biological diversity by turning impoverished agricultural land into forests and increasing diversity in bird species nesting in the area.[41] The Kachung forestry project in Uganda aimed to improve soil quality through the control of soil erosion by reducing water runoff during the rainy season. The Kachung project also contributed to 15 full time workers as technical staff, and 300 workers in peak season, as well as 250 off-peak season workers through the year.[42]

4.3 Negative project-level impacts

Even though the Swedish programme has generated many positive impacts regarding emission reductions and co-benefits relating to the SDGs, there have also been some negative impacts reported from the projects. Some of the projects funded through CDM will tend to involve more risks than others. According to SEA, the risk of negative impact is usually higher if the project involves land use or affect areas where people not related to the project have some form of interest. This is certainly true in LDCs, where institutions and national government control regarding issues such as corruption or the protection of human rights can be lacking in comparison to many developed countries. For this reason, the CDM and the Swedish programme is associated with a high level of quality and administrative control, and each project goes through due diligence procedures to minimise the risk of any negative impact. However, the target of the programme has never been to completely erase all potential risks involved. This would have made the programme

[40] Reforestation as Renewable Source of Wood Supplies for Industrial Use in Brazil Project Design Document
[41] Romania Afforestation of Degraded Agricultural Land Project Project Design Document
[42] SD Questionnaire response, Katchung project in Uganda

and its activities impossible. In this section, we present some of the findings regarding negative impacts based on previous studies as well as the case studies performed in this evaluation.

The forestry projects, such as the Kachung Forest Project in Uganda, have generated some negative impacts that have been highlighted in Swedish national media. The claimed negative impacts are in relevance to issues that these plantations have caused for local communities, regarding access to land and forced evictions[43]. According to Swedwatch, other negative impacts concern pesticide pollution of adjacent water sources. Adequate community development benefits to balance these negative impacts have not been provided according to Swedwatch.[44] The SEA introduced corrective actions to mitigate the negative impacts. For example, the SEA required the project developer Green Resources to develop an action plan with nine focus areas to improve the social and environmental situation. They were also obliged to produce tangible improvements for communities, to be verified by external consultants[45].

In the Mongolian MicroEnergy Credits PoA, according to interviewed stakeholders, materials and technical knowledge necessary for the maintenance of stoves were simply not available, thus making certain repairs impossible and reducing their lifespan and positive impact. Some of the stove makers also exited the Mongolian market which contributed negatively to the sustainability of the stoves distributed by the programme. In the Nkolfoulou Landfill Gas Recovery project the case study indicates that some people's livelihoods have been negatively impacted by the project, since the access to the landfill was restricted, thereby negating the collection of waste material to use for sale. Similar negative impact on local people's livelihood was observed in a PCF landfill project in South Africa.[46]

Further examples of negative impacts can be found in wind power projects, where installed turbines have impacted local fauna negatively, specifically birds who are killed or injured by the rotating blades.[47] The negative impact can be reduced however, for example by taking the migratory patterns of certain species of birds into account when planning for the location and operational schedule of wind power plants, but also by painting the blades black.[48] Similar negative impact on local fauna has been observed in some hydropower projects, where fish and other water-living animals can be impacted negatively.

4.4 Transformative impacts of the programme

In this evaluation, transformative impacts refer to impacts that have wide and long-lasting impact on accelerating climate-related innovation, policy development or the enabling system of climate change mitigation[49]. Transformative impacts can be found on programme level, in ways the programme has impacted the development of international flexibility mechanisms and cooperative approaches and bringing project-level experiences to the global climate negotiations.

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[43] https://www.ejatlas.org/print/forest-plantation-by-green-resources-in-kachung-uganda
[44] https://swedwatch.org/uncategorized/lessons-learned-from-kachung/
[45] https://swedwatch.org/uncategorized/lessons-learned-from-kachung/
[46] Technopolis group (2018). Midterm evaluation of the Swedish Programme for International Climate Change Mitigation
[47] Technopolis group (2018). Midterm evaluation of the Swedish Programme for International Climate Change Mitigation
[48] BBC (2020). Black turbine blades can cut bird deaths: https://www.bbc.com/news/science-environment-53909825
[49] For example, see Green Climate Fund's transformative approach: https://www.greenclimate.fund/sites/default/files/document/financing-climate-action-oct2021.pdf

4.4.1 Pioneering role in market creation and mechanism development

The Swedish programme for international climate change mitigation was one of the pioneering programmes set up at the dawn of the carbon trading market and its flexible market mechanisms set up in the wake of the Kyoto protocol. In the early years of the programme, the focus was mostly on the Baltic States and Russia through JI, utilizing the lessons learned from the early pilot activities under the AIJ programme that ended in 2000. Sweden had some pilot activities under AIJ before the programme officially started, for example in the Baltic states[50], and was piloting the carbon market even before the CDM and JI mechanisms were established.

A pioneering effort to develop the flexibility mechanisms was the Prototype Carbon Fund (PCF) managed by the World Bank, which Sweden signed up to in 1999, before its official launch in 2000. The PCF mission was to pioneer a market for project-based greenhouse gas emission reductions within the framework of the Kyoto Protocol. The PCF was originally envisaged as a portfolio of 12-15 large projects, but it evolved into a pioneering program of 30-35 smaller projects by 2004, because of unanticipated high demand for funding during its early stages[51]. From 2005 onwards the CDM and JI mechanisms officially launched as the Kyoto Protocol entered into force and the EU Emissions-Trading System (ETS) officially started. At that time Sweden had already gathered experience and affected the development of the future mechanisms through PCF and AIJ, thus having a role in creating a larger carbon market.

4.4.2 Perseverance in difficult market situation and showing the way in Africa

The Swedish programme has been one of the most active investors in emissions reducing projects in the world, with over 250 projects in the programme portfolio. A long period of engagement in the market, combined with extensive project experience, has led to the Swedish programme being widely regarded as a serious and legitimate partner for emission reduction efforts worldwide. The Programme kept going as an active partner despite market prices plummeting in 2012 in the wake of global economic recession and an oversupply of carbon credits in relation to demand. The Swedish programme showed trust in the flexibility mechanisms during a difficult period when many private sector investors disappeared from the market. The Swedish programme stayed active in the market, with SEA continuing its CER purchases and honouring ERPAs. This contributed to SEA maintaining credibility as a funding partner.

The programme's perseverance in a difficult market situation, and the move towards more PoA-focused purchasing from projects in LDCs and other African countries can be seen as having a transformative impact on the market. The Swedish Programme kept going with CDM development towards more programme- and household-based activities, demonstrating to other potential buyers how African projects can be successful. This also contributed to the development of the carbon market toward the current situation of the new Article 6.4 mechanism being finalized, with a focus on net mitigation and sustainable development benefits.

[50] AIJ project document https://unfccc.int/files/kyoto_mechanisms/aij/activities_implemented_jointly/application/pdf/2006_jelgavaee.pdf

[51] World Bank (2004). The Prototype Carbon Fund - Addressing Challenges of Globalization: An Independent Evaluation of the World Bank's Approach to Global Programs

4.4.3 Providing project-level expertise to policy development in global and EU climate negotiations

One key transformative impact of the Swedish programme for international climate change mitigation, or more specifically the expertise of SEA staff involved in the programme, has been to contribute to policy-level international development of the flexibility mechanisms (CDM, JI and the Article 6.4 of the Paris Agreement) through UNFCCC- and EU-level negotiations. Experts from the SEA have had leading roles in the EU delegation and acted as co-chairs, leading negotiation groups during negotiation sessions under the subsidiary bodies of the UNFCCC. A key contribution from this participation has been the development of the regulatory framework for CDM, especially the CDM Programme of Activities (PoA), and also the new mechanism under the Paris Agreement.

The expertise of SEA staff has had a lasting impact on international climate policy related to the flexibility mechanisms. And because of its pioneering CDM/JI-oriented programme, Sweden has been in a good position to provide many project-level experiences in the negotiations. These experiences have helped shape innovative approaches such as PoAs, that in turn help address some of the challenges of emission reduction efforts in LDCs.

4.4.4 Accelerating technological development and know-how in developing countries

There are indications that the programme has helped to push the technological development in hosting countries and contributed to increasing the confidence in renewable energy and energy efficient technology. For example, wind power projects in China, low-energy lightbulb projects in India, bioenergy projects and household-level projects have contributed to impacts such as job opportunities for the local population, technology and knowledge transfer, increased income for suppliers and reduced emissions of hazardous substances. Renewable energy projects such as hydropower and wind power projects help generate a more reliable power supply, further enabling economic growth. Among the case study projects, the Nkolfoulou LFG project, the Bokpoort CSP project and the Cabeolica wind power project all demonstrate technology transfer benefits, bringing new types of technologies to the area, and acting as reference projects to enable systemic change.

4.4.5 However, all projects were not transformative

The potential for transformative impact is highly context specific. In order for transformative impacts to occur, many different conditions must be met. And just because one project provides such impact in one region, that does not necessarily mean that an identical project somewhere else will do the same. The potential for transformative impact in the Swedish CDM/JI portfolio can be found in PoAs in Africa, in projects that use new technology or methodology, but also in projects using established wind or hydro power technology in China or India, which are already numerous in the markets. Even though the technology used may not be innovative, there may be other important conclusions to draw from more “basic” projects such as these, that deal with issues such as project efficiency or a method of working to minimise transaction costs. The point is, a decent system for follow-up and project support always has the potential to provide lessons that might be important further down the road, in other projects, or in the development of new mechanisms, methodology, project types.

5. Conclusions

This chapter concerns the conclusions regarding programme impact, and how it relates to the achievement of the objectives set out in the Swedish programme for international climate mitigation.

5.1 Contribution to national climate objectives

The main objective of the Swedish programme for international climate change mitigation is the same as the national climate objective "limited climate impact". It is a broad policy target but is operationalized as reducing or stabilizing the emissions of carbon dioxide and other greenhouse gases, in order to limit the average global temperature increase to less than two degrees Celsius, in comparison to pre-industrial temperature levels.[52] The target is valid for efforts both home and abroad. The programme in focus for this evaluation aims to contribute to this target mainly through international cooperation, specifically through the purchase of CERs from projects in developing countries.

This evaluation finds that the Swedish programme clearly contributes to reduced emissions, certainly through the purchase and delivery of CERs. The number of delivered and projected future CERs amount to 34.5 million (2008-2025). Of these, 22.3 million CERs have so far been cancelled, further contributing to the overall objective of reduced emissions. The project portfolio consists of over 250 bilateral and multilateral fund projects, with activities taking place in more than 60 different countries. In addition, the Swedish decision to focus more actively on CERs from projects in the world's least developed countries should be highlighted here, as the Swedish portfolio contains a relatively high share of projects in these countries, compared to the global CDM portfolio in total.

The purchase of CERs also contributes to the transfer of technology as well as knowledge crucial to limiting emissions and the use of fossil fuels in energy production. For example, through renewable energy projects, methane gas capture projects as well as projects aimed at affecting energy consumption through increased energy efficiency. The purchase of CERs has also been found to be a cost-effective way to contribute to reduced global emissions.

Our analysis also points to the value of significant quality control frameworks in place, for example through the CDM mechanism, that contribute to minimizing the potential risks of the investments made, such as a failure to deliver on the promised CERs and corruption-related issues. The ongoing support from SEA to projects included in the programme is also found to be an important factor in the individual projects capacity to deliver on desired targets.

5.2 Contribution to the development of market-based mechanisms

Another important objective of the Swedish programme is to be involved in, and contribute to, the development of mechanisms for emissions trading. This evaluation finds that the Swedish programme have been both pioneering and consistent over time, contributing to long-term sustainability and credibility of the various mechanisms used.

[52] Sveriges miljömål. Begränsad klimatpåverkan, https://www.sverigesmiljomal.se/miljomalen/begransad-klimatpaverkan/

Sweden's programme was initiated around the time the Kyoto protocol was being established, making it one of the earliest programmes globally dealing with the international trade of carbon credits. The Swedish pioneering efforts contributed to the development of a larger market for carbon credits, not least through the involvement in pilot activities through AIJ and JI. The lessons learned from these activities, as well as the experience gathered from the PCF, has been very valuable for the development of these mechanisms as well as the initiation and development of mechanisms such as CDM. Lessons learned from the Kyoto-related mechanisms have also carried over to the development of related mechanisms and methodology under the Paris climate accords.

The Swedish programme has sustained its efforts through periods of systemic challenge, for example during the carbon market collapse of 2012, when prices for carbon credits collapsed, rocking the CDM system to its core. The Swedish programme however, persisted with its projects and investments, contributing to the rebuilding of trust in the system during a period when many other investors shied away. Not least due to the fact that investments from a credible partner such as SEA can be used as an incentive when trying to attract further investment.

The development of PoAs has been crucial to making the CDM mechanism more accessible to projects in less developed countries and regions. The Swedish programme has, through its representatives' expertise, contributed to the development of this tool through participation in UN and EU-level negotiations. The development and implementation of PoAs has been important for LDCs and regions in many ways, for example through reducing transaction costs and investment-related risks, speeding up the approval process, and making participation in CDM possible for smaller projects than was previously possible.

5.3 Contribution to sustainability in host countries

A further objective, added later during the programme period, concerns the programme and its projects' contribution to sustainability in project host countries. While the conditions for evaluating this type of impact are challenging – a lack of systematic reporting and documentation is one such challenge – this evaluation still finds evidence to support this type of impact. At the project level the case studies, along with the results of previous evaluations and studies, project follow-up and impact analyses, suggests that many of the projects supported have contributed to, or have a clear potential to contribute to, sustainability-related impacts. These include economic, social as well as environmental impacts. Much of the gathered evidence concerns the project level and it is challenging to estimate programme-level impacts with the data available. This suggests a need for more structured and easily quantifiable data.

That being said, this evaluation has found several examples of promising impact regarding sustainability in host countries, ranging from technology and knowledge transfer enabling a shift from fossil-dependent to renewable energy production, job creation, reduced reliance on fuel imports, a more reliable power supply, reduced emissions of hazardous gases, better air quality outdoors and indoors, higher personal safety as well as other related impacts. The Swedish efforts in LDCs in particular deserve a mention here, since the access to investment capital and institutional readiness is generally very low. Foreign investments in climate-related projects have the potential to make a significant contribution in this context, since the alternatives are less apparent compared to developing countries. While the risks can be said to be higher in LDCs (regarding the potential for delivered CERs), the impact on sustainable development goals is also potentially higher.

Appendix: Case studies

MicroEnergy Credits – Microfinance for Clean Energy Product Lines

Cookstoves and blankets, Mongolia

Contract period: 2014 – 2020

Project lead partners: Micro Energy Credits (MEC), XacBank Mongolia

Contract volume CERs: 400 000 (option for another 80 000)

The project involved distribution of ger blankets and efficient stoves for cooking and heating in low-income areas near Mongolian capital Ulaanbaatar. Mongolian winters are cold, with temperatures often dropping to - 40 degrees. Many households use coal-burning stoves to heat their *gers* (*yurts*, large family tents) which they insulate with wool felts. Neither stoves nor tents retain heat particularly well. Consequently, poorer households in Ulaanbaatar use a lot of coal for heating and cooking, thereby producing a lot smoke which turns contributes to smog.

Households have been offered microloans through the project from XacBank to help them purchase improved stoves and ger blankets used to insulate family tents. The aim has been to reduce households' GHG emissions by contributing to a decrease in their consumption of fuel.

The project, which consists of three CPAs, was registered with the CDM programme in in 2012.[53] Its renewal period expired in 2019. Micro Energy Credits was the coordinating managing entity and the financial intermediary. XacBank did the groundwork, carrying out the microlending programme which was central to the project.

SEA and Micro Energy Credits signed an ERPA for 400 000 CERs priced at five EUR per CER (EUR 2 000 million) with delivery starting in 2015 and finishing 2019. The contract included a sales option for another 80 000 CERs. All in all, Micro Energy Credits estimated that approximately one million CERs would be issued through the project.

CER sales were important to the project for two reasons. First, XacBank planned to use revenues from CER to lower interest rates on microloans, a necessity given that low-income households make up the target group.[54] Second, proceeds from selling CERs are also used to scale up the programme in Mongolia. Later in project, XacBank partnered with Green Climate Fund, securing a 19.5 million USD loan and 500 000 USD in grant funding.

The annual GHG emission reduction target for the project was set to approximately 50 000 metric tonnes of CO_2-eq. To achieve this goal XacBank expected to sell approximately 60 000 energy efficient stoves and ger blankets over the project period.

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[53] The programme is classified as a Programme of Activities (PoA) with three subprojects, so called CDM Project Activity (CPA).
[54] SEA estimates up to ten percentage points, from 22 % to 12 %.

Certified emission reductions

The project did not fully achieve its CER issuance goal. A total of 396 896 CERs have been issued which amounts to 38 percent in relation to target. The lion's share of this volume, 368 738 CERs, were issued to SEA which thereby received 94 percent of the contract volume. So far, 40 000 fuel-efficient stoves have been sold through the project.[55]

Additional impact

Despite not fully reaching the CER issuance target, the project has generated noteworthy additional impacts. That being said, all project results must be seen as temporary until proven otherwise. The stoves sold during the project have an estimated lifespan of 10 years. Affordability at listing prices is low, very few stoves are produced in Mongolia and there are doubts about customers possibilities of getting after-sale services. According to interviewed stakeholders, there is a lack of technical capacity and materials for the maintenance of stoves after their warranty period and some of the stove makers have already exited the Mongolian market.

Project monitoring reports suggest that the share of stoves and blankets in use among participating households was around 90 percent. There was no data available to substantiate if stoves and blankets had been sold on the black market.

Environmental impact

By XacBank's own calculations they have offset more than 1.46 million tonnes of CO_2 emissions through their sustainable finance program since 2009.[56]

The project has contributed to reducing pollution and smog caused by particulate matter released during the burning of fuels. Monitoring reports indicate that the distribution of ger blankets reduced households' fuel consumption by 30 percent whereas the replacement of heating stoves resulted in increased efficiency of 40-50 percent compared to traditional models. With the new stoves, less than 3 tonnes of coal are used each winter, down from an average of 5.1 tons.

Air quality improvement is probably the largest impact of the project. At the start of the project, Ulaanbaatar's air quality ranked the worst in the world. Up to 70 percent of city smog coming from old stoves in the so called ger districts on the outskirts of the city.[57] The project's co-benefits have since, unexpectedly, been amplified by the increasing poverty in the wake of the pandemic. Many households have started burning cheap dirty fuels such as trash which has worsened air quality even further. Other co-benefits, though not quantified, include less deforestation by using less firewood.

Economic impact

The business model with microloans appears to have been successful. The project can thus be seen in this broader picture of transforming the microfinancing landscape in Mongolia. Interviewees

[55] 19,902 (CPA1), 16,538 (CPA2), 826 (CPA3)
[56] Xasbank, annual report 2020.
[57] See for instance: Air Quality Analysis of Ulaanbaatar Improving Air Quality to Reduce Health Impacts, World Bank. URL: https://openknowledge.worldbank.org/bitstream/handle/10986/26802/660820v10revis00Mongolia0Report0Web.pdf?sequence=1&isAllowed=y

pointed at increased disposable income as a key achievement in the project. For families that forage biomass, the stoves and insulation have freed up more time to spend on productive activities.

XacBank engaged its own staff as well as local distributors, technicians, and other service providers to market the lending program for stoves and blankets. People in ger districts were offered training to become retailers, distributers or technicians. A number of enumerators were also trained to carry out surveys and get monitoring data.

As for the distribution of stoves, however, there are serious doubts about the possibilities of achieving a transformative economic impact in Mongolia. The stoves are primarily utilized with pit-coal; wood is used to a lesser extent. In 2019 the Mongolian Government introduced a complete ban of use of pit coals for household heating which led to a reduced demand for stoves and contributed to the project's poor performance in terms of sold stoves. Moreover, the stoves sold early in project benefitted from government subsidies covering over 90 percent of the stove price. This increased affordability, but it also incentivised many households to sell their subsidized efficient stove on the black market in other regions and return to their traditional stoves. However, stove prices quickly reverted to the unsubsidized prices due to politicians smuggling money from the MCC fund.[58] This led to a further reduction in demand for stoves. Current list prices of imported stoves are unaffordable without high subsidies and there is a shortage of qualified local stove models.

The distribution of ger blankets was not hampered in the same way even though the question of long-term affordability remains unanswered. Previously ger blankets were not easily available on the market: producers did not think there was a demand because low-income people could not afford them and because of difficulties in marketing and distribution. XacBank thus had to work with a local company to develop a high quality ger blanket before creating the financing program that would make the products affordable.

Social impact

The project has contributed to reducing the amounts of smog and indoor air pollution inhaled by predominantly women and children, reducing respiratory disease, decreased eye irritation and other related health issues. These are significant effects, not least because population growth is putting additional pressure on the air quality in Ulaanbaatar. The low-grade coal produces high level of particulates that result in smog, contributing to a variety of health conditions such as respiratory diseases. A UNICEF study from 2018 showed a 350 percent increase in fetal deaths in the winter compared to summer months. The negative impacts fall disproportionately on poor households. Health impacts were not directly measured by the monitoring data so no data on for instance disability-adjusted life years (DALYs) averted or avoided deaths was available.

SEA contribution

SEA represented one of the major carbon credit purchasers under XacBank's program. XacBank used CER sales revenue for testing a proof-of-concept for this carbon financing business model.

Early subsidies of stove prices did not cover all of the costs of rolling out the program or XacBank's new ecobanking division. The SEA purchase of carbon credits allowed this ecobanking division to continue their work.

[58] Jargalsaikhan, D. 2018. "Mongolian government – source of toxic smog." Jargal Defacto. https://www.jargaldefacto.com/article/mongolian-government-source-of-toxic-smog?lang=en

Lessons learned

- XacBank switched business model from a subsidy dependent sales scheme to a more sustainable business model involving microcredits and carbon financing.
- Including the carbon price cost of impact monitoring would be a potential for developing the monitoring system further.
- Technology risk and unintended consequences – the aftersales market was not seen as a risk but proved a problem.
- Tracking individual end-consumers through the programme is difficult. The monitoring system developed by MEC and integrated in XacBank helped, but the complexity should not be underestimated.
- Smaller intermediaries such as MEC reported difficulties with cash flow given the uneven crediting of CERs. The estimated delivery dates in contracts are often optimistic and downstream cash flow issues resulted in MEC having to seek outside funding to stay afloat.

Nkolfoulou Landfill Gas Recovery Project

Contract period: 2014-2018

Project lead partner: Hygiène et Salubrité du Cameroun (HYSACAM)

Contract volume CERs: 230 000

The project involves a landfill gas (LFG) collection and flaring system at the Nkolfoulou landfill, 10 km north-west of Cameroonian capital Yaoundé (Ydé). Nkolfoulou is managed by HYSACAM, Cameroon's largest private waste management contractor.

The project was registered in 2010. Its first crediting period (2011-2018) – described in this study – involved the construction of a system for collection and flaring of LFG. In the current phase (2018-2025), the focus lies on electricity generation from captured and purified LFG.

Two authorised project partners were involved in the first phase: HYSACAM and the Belgian CDM consultancy Solvay Energy Systems (SES). HYSACAM signed two ERPAs for delivering CERs to SES and to SEA respectively. The one with SEA concerns the delivery of 230 000 CERs priced at 5.50 EUR per CER (EUR 1.3 million), starting in 2013 and ending in 2018.[59]

HYSACAM financed the project with a corporate loan from Société Générale de Banques au Cameroun. Revenues from CER sales were earmarked for covering the LFG collecting and flaring operations. With tariffs for landfill municipal solid waste in Cameroon at a meagre 6 EUR per tonne,[60] HYSACAM's everyday waste management operations at Nkolfoulou rely heavily on government subsidies, leaving little room for infrastructure projects such as this project.

Certified emission reductions

The GHG emission reduction target for the first crediting period was 1.5 million tCO_2-eq. The contract quantity with SEA for 2014-2018 (230 000 CER) has been delivered. HYSACAM still has CERs for sale from the first crediting period. HYSACAM did not achieve the GHG emission reduction target. A HYSACAM spokesman says the company reached 38 percent of the target whereas official UNFCCC estimates arrive at around 50 percent.

Additional impact

The project has potential of contributing to lasting change for operations at Nkolfoulou landfill. A HYSACAM spokesman puts the likelihood of this happening at 50 percent. If it happens, the project could potentially bring big co-benefits in the foreseeable future. Nkolfoulou remains the region's only sanitary landfill. Every year 360 000 tonnes of household waste are deposited at the landfill, the trend pointing steadily upwards amid population growth and urbanization. The project could also contribute to lasting change elsewhere.

[59] For each CER sold, 1,25 euro will go to CDM consultant Solvay Systems.
[60] In EU27 the tariff lies between 40 and 120 EUR per tonne.

Environmental impact

Gathering and flaring of LFG prevents methane, a potent gas with 26 to 34 times the greenhouse effect of carbon dioxide over a 100-year period, from reaching the atmosphere. Methane is formed as organic waste decomposes and LFG is released; 80 percent of waste processed at Nkolfoulou is organic matter.

The project's most important co-benefit may be that of a reference project. Getting systems in place to prevent methane emissions is an urgent matter in SSA, where population growth will be high in the upcoming decades. Many SSA countries lack strategies to control LFG emissions. In a report released in 2021 by the CCAC and the UNEP, cutting methane emissions from landfills is described as the "strongest lever" available to "slow climate change over the next 25 years", with benefits to societies, economies and the environment far outweighing the costs.[61]

Social impact

Growing numbers of people inhabit the areas surrounding Nkolfoulou landfill. LGF causes major damages to crops, plants and animals. Since the start of the project, living conditions have improved in the area. Air pollutants and odors have been reduced and visual improvements have been made to the sites. When addressing social impacts, the possibility of using LFG in electricity production seems particularly promising. In 2020, construction works began on a powerplant that will produce electricity from captured and purified LFG for 580 000 households in Ydé. This is a continuation of the LFG project and of administrative reforms undertaken in Cameroon's energy sector.

Economic impact

The HYSACAM spokesman points at a scale-up from lower to higher administrative level ("the same CDM project has been implemented in Douala"). Building on experiences from this project, HYSACAM has also opened a subsidiary (Africa Waste Energy) specializing in renewable energies.

Jobs have been created at the landfill, but not the desired number. Some of the informal waste pickers who used to scavenge recyclable materials from the dump sites have received education and been offered jobs at Nkolfoulou facilities. HYSACAM managers have gained experience in how to set up contracts for carbon financing and manage international projects. Moreover, technology transfer from partner organizations to HYSACAM employees has led to improvements in operations at the landfill.

The future of LFG operations at Nkolfoulou comes down to challenges of funding and maintenance. Waste management remains unprofitable in Cameroon: the project has been an economic loss for HYSACAM which so far has invested nearly 2.5 billion CFA francs. Weak funding is slowing ongoing work to extend the biogas network. There are bottlenecks in the supply of equipment for installations and maintenance which threatens to roll back some of the transformative effects. Key materials are imported from Europe and are therefore not subsidised; customs clearance costs are expensive. HYSACAM must also carry out the calibration of the equipment together with experts from Europe. However, a partnership has been signed with local company that will soon be able to take over and carry out this work.

[61] CCAC and UNEP (2021). Global methane assessment.
https://www.ccacoalition.org/en/resources/global-methane-assessment-full-report

SEA Contribution

The contribution made by SEA through its purchases of CERs was important to the project as it allowed HYSACAM to pay off debt.

Lessons learned

HYSACAM's spokesman puts forth one lessons as particularly important: "The main lesson we have learned is that of properly assessing the risks before launching this type of project because the costs of the carbon market are very unstable and do not guarantee the profitability of investments."

Fuel Efficient Stoves in Zambia

Contract period: 2012 –2018

Project lead partner: 3 Rocks Ltd (3RL), ICECAP

Contract volume CERs: 300 000

The focus of this project has been to distribute and install domestic, fuel-efficient stoves in rural and peri-urban communities in Zambia where 80 percent of households use traditional fireplaces (three-stone stoves) to cook over open fire. By introducing more efficient stoves, the project aimed at contributing to lowering households' fuelwood consumption which in turn would lead to cuts in domestic GHG emissions.

Project lead partner 3RL's main source of funding was equity capital and a USD 1.3 million loan from ICECAP Holding, a parent company of 3RL. CER sales revenue was the only source of revenue during the project. In 2014, 3RL and The Swedish Energy Agency (SEA) signed an ERPA for the delivery of 300 000 CERs priced at 7 USD per CER (USD 2.1 million), starting in 2013 and ending in 2016.

Certified emission reductions

The annual GHG emission reduction target of the project was set to 58 814 tCO_2e. To achieve this goal, 3RL estimated that 53 000 stoves had to be distributed and installed on the spot in recipient communities. The assumption was that each stove would on average cut households' fuelwood usage by 66 percent.

3RL planned to have all stoves installed by 2013. Thereafter, the project focus would be to monitor/verify results and sell CERs. 3RL decided to have all stoves cemented to the ground to be able to keep track of them and prevent recipients from reselling them.

The project did not deliver CERs on schedule. As for 2021, SEA has purchased 171 479 CERs from 3RL out of the 300 000 initially agreed. By 2013, a total of 41 968 stoves had been sold and installed. No further stoves have since been distributed. Consequently, the GHG emission reduction target has not been met.

Additional impact

3RL monitored and verified results until 2018 through field studies in recipient communities. Accordingly, user satisfaction turned out high among households that received a stove. These households overwhelmingly preferred their new stoves over traditional fireplaces with 90 percent still using the stoves after one year of use. Self-reported fuelwood savings (60 %) were in line with ex-ante estimates. Several co-benefits were noted on household level and community level.

According to a 3RL representative, the project has not resulted in any systemic change. The question is how long co-benefits will persist in households and communities and if attitude changes live on after stoves start breaking down. Estimates by 3RL put their lifespan at between 5 and 7 years but field surveys differ on this account. In its 2016 follow-up report of the project, SEA notes that many stoves have started showing signs of deterioration after just a few years due to problems with corroding inner linings; 3RL would take measures to prevent early breakdowns. Later field surveys by 3RL from 2018, on the other hand, indicate many stoves were still in use after 7 years.

Environmental impact

Fuelwood savings in households has contributed to a slowdown in deforestation near recipient communities. This claim is made by a 3RL spokesman who refers to internal calculations indicating that each stove used consistently may save 3 to 5 trees annually throughout its entire lifespan. Although difficult to prove, this is a plausible effect of fuelwood savings in Zambia where the firewood used for cooking and heating is often gathered from local forests.

Economic impact

Co-benefits of fuelwood savings are difficult to assess since we do not know how they affect households' expenditures. While it is certainly plausible that savings translate to lower expenditures, other studies of cookstove initiatives worldwide suggest this does not always happen.

Subsidies were a key cost item in the project. Because few households could afford a stove at normal price, 3RL had to sell at discount rate and subsidise distribution and installation. Recipients paid with a contribution in kind: 25 bricks, sand and water. Due to a combination of high costs for up-front investments and delays on CER sales, 3RL made losses from the project.

SEA identified a risk regarding the long-term use of the more efficient stoves. When they eventually break down, "many households may to return to using the three-stone stove again, especially if new improved stoves are not available in the region". From what is known about the project, two assumptions can be made: demand for new stoves will be high, but affordability will be low – at least at normal prices. Then there is the question of geographical availability after the project – the extent to which recipients can access one even if they have the money.

Social impact

Firewood savings have come with co-benefits for gender equality in recipient communities. Traditionally in Zambia, older women are responsible for cooking whereas younger women in the household gather the firewood. Many spend all days searching, often chopping down entire trees. Fuelwood savings mean girls have to forage less, freeing up time for other activities. School attainment has therefore increased in recipient communities, according to a 3RL spokesman.

Cooking has also become cleaner and safer. To heat up three-stone stoves fires must go on for much of the day, producing a lot of smoke and turning kitchens into hazardous smokehouses. Field surveys suggest new stoves cook faster and produce less smoke. Recipients report less negative health impacts and fewer burn injuries on children (a big problem with old fireplaces).

SEA Contribution

The 3RL spokesperson gives thanks and praise to their SEA counterparts for being cooperative, communicative and understanding of the challenges that 3RL unexpectedly had to face during the project. The constructive demeanor of SEA made it easier for 3RL to conduct activities and the CER purchases made by SEA were crucial to financing said activities, especially after prices on the CER market started slumping in 2012. Because of problems registering the project with the CDM programme, 3RL did not receive any CERs to sell until 2016. 3RL has therefore sold less CERs than initially planned.

Lessons learned

A first lesson is that the CDM programme has heavy administration. According to 3DL, their problems registering the project with the CDM programme effectively delayed project activities and CER sales schemes. 3RL had already begun the costly process of selling and installing stoves, reaching a total of 19 500 installed stoves by November 2011. 3RL's first two applications were rejected for failing to pass the UNFCCC Secretariat's *Information and Reporting Check*. A 3RL representative describes them as so opaque they had to shift to *Gold standard* in other SSA projects.[62]

A second lesson is the importance of trust building in cookstove initiatives. Initiatives must be carried out on community level (addressing all households there) and with a high degree of sensitization. 3RL was aware of this thanks to experiences from earlier projects. CPA implementers – trained local partners hired by 3RL – played an important role in this process. First, they approached local chiefs to demonstrate how stoves work. With their approval, this demonstration would be repeated for local headmen and their wives. It was not until then that 3RL could go into the villages to show women how to use the stoves. Giving a stove to all households in the community was important; anything else would have triggered jealousy and destroyed trust.

Finally, SSA cookstove initiatives come with logistical challenges. 3RL initially partnered with American producer Envirofit because they produced the cheapest stoves but importing them from China caused delays. In later projects, 3RL have used stoves manufactured in Zambia or South Africa.

[62] Instead of AMS II. Energy Biomass efficiency measures in thermal applications of non-renewable biomass.

Bokpoort Concentrated Solar Power (CSP) Project

Contract period: 2013 –2022

Project lead partner: ACWA Power Africa, ACWA Power Solafrica CSO Power plant, Solafrica Thermal Energy

Contract volume CERs: 570 000

The Bokpoort Concentrated Solar Power (CSP) plant is located on Bokpoort Farm near Groblershoop in Northern Cape, South Africa. The purpose of the project has been to reduce GHG emissions by installing a CSP. This power plant represents a green energy alternative in South Africa, where energy production is mainly based on fossil fuels (87 percent). The project was registered under the CDM in 2012. Its crediting period expires in 2026. SEA and Bokpoort signed an ERPA in 2013 for the delivery of 570 000 CERs priced at 3 EUR with delivery starting in 2015 and finishing in 2020.

Bokpoort CSP is structured as an independent power producer, with Saudi Arabian based ACWA Power International acting as the operational partner. The financing is based on a 20-year Power Purchase Agreement with ESKOM[63] and supported by government guarantees. ESKOM is South Africa's leading electricity public utility responsible for 95 percent of the national power production.

Certified emission reductions

In 2020, the project had delivered approximately 80 percent of the total CERs as per the PDD. All the CERs contracted by SEA have been delivered.[64]

Additional impacts

In 2016 power production began at Bokpoort CSP, making it the second utility-scale CSP plant in South Africa awarded under the government's REIPPP[65] program introduced in 2011, and a driver of solar energy in the country. Today five CSP plants are in operation. During the project, between 2013 and 2018, South Africa's solar power capacity more than tripled.

Solar power is key to South Africa's climate targets to phase out coal power production and replace it with renewable energy. The momentum from the REIPPP programme likely contributed to South Africa's government and Eskom's success in 2021 when seven countries, including the US and Germany, pledged to make major investments in South African energy transition projects, including CSP power plants. Thus, there are reasons to believe that results and experiences from this project have already contributed to transformative effects on the national and regional level in South Africa.

Environmental impact

Coal still supplies 87 percent (43 GWs) of South Africa's electricity, down from 93 percent in 2001. Energy production, in turn, accounts for 80 percent of South African CO_2 emissions. Bokpoort CSP

[63] The South African public electricity utility
[64] SEA and UNFCCC databases
[65] Renewable Energy Independent Power Producer Procurement Programme

plant has contributed to increasing electricity generation at a time when coal powerplants were starting to break down all over the country. In 2021, Eskom CEO André de Ruyter stated:

> *Eskom's fleet of coal fired power stations, excluding Medupi and Kusile, are on average 41 years old. These power stations have been run far harder than international norms and have not been maintained as they should have been.*

Economic impact

On local level, the project has created employment opportunities and provided skills development for a range of people. Roughly 1 300 people were employed during peak construction phase and Bokpoort CSP now employs 61 permanent staff members. 20 of the jobs created there are unskilled and another 20 are semiskilled.[66] The construction phase attracted approximately 1.4 billion rand in foreign direct investment, with almost 42 percent of total project costs directed to the local economy.

Community revenue sharing is integral to the project's structure. It is stated in the power purchase agreement that 1,8 percent of revenues at Bokpoort CSP plant are earmarked for local communities – a condition which has resulted in a host of community improvements. Interviewees noted that this had increased local community support for the project.

The transformative impact mainly occurs on national and regional level. High upfront investment costs are a major barrier to CSP projects, with initial investments at Bokpoort amounting to 565 million USD. Meanwhile, South Africa is a country in dire need of energy. Low energy security is arguably one of the biggest hurdles to foreign investments in South Africa. Attracting further foreign capital to the country is, in turn, crucial to its energy transition. Domestic investors have been cautious about CSP investments and Eskom is heavily indebted and thus unable to finance major greenfield projects.

The project is clearly acting as a trailblazer for the transition. Citing positive experience from the Bokpoort CSP project, ACWA has now decided to invest 11.6 billion rand in another CSP project in Redstone, Northern Cape – the largest renewable energy investment in South Africa to date.

Social impact

The project activity is likely to have positive social impacts on local level. Northern Cape has weak infrastructure and the Groblershoop area is characterised by high unemployment, low levels of education attainment, water shortages and public health problems.

Bokpoort CSP was awarded African Community Project of the Year 2015 and Best renewable energy project 2016 by the South African National Energy Association. Key to this was its community revenue sharing scheme which has created a sizeable budget for activities. ACWA Power Africa has partnered with LoveLife, a local NGO based in Groblershoop. Over half of the committed spending on communities is funnelled through LoveLife which has implemented a series of activities aimed at benefitting women, securing local water supply systems, enabling soup kitchens as well as offering training on primary healthcare and gender-based violence. These activities will get a more permanent framework in the form of five-year SME and social-econonomic development plans for the region. Results will be reported on a six-month basis.

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[66] Bohlweki SSI Environmental (February 2011). Environmental Impact Assessment for a proposed 75MW Concentrating Solar Thermal Power Plant and associated infrastructure in the Siyanda District, Northern Cape.

It has been the intention of the project developer to involve the local community directly with the project by including 10 percent local or regional ownership according to the incentives set up within the Broad-Based Black Economic Empowerment programme. LoveLife will receive a 5 percent share in the project with the remaining 5 percent going into a bespoke community trust benefitting community members within a 50 km radius. There will be further socio-economic development contributions of 1.25 percent. An enterprise development programme will be established to support Black Economic Empowerment (BEE) farming initiatives for the majority within a 50 km radius of the project.

SEA contribution

The main role the SEA purchases played was contributing to a lower risk for the project during the development phase. Interviewees note that having a strong institutional player such as SEA on board, provided added legitimacy, and in turn an incentive for other investors to step in. The relationship with SEA is also something which all interviewees praise in terms of dialogue and support during the project period.

Lessons learned

The project has been quite successful and the reasons for this can often be traced back to a well-established environment for renewable energy projects of this scale. In contrast to many other countries in sub-saharan Africa, South Africa is well placed in terms of regulatory environment, financing availability, project precedents, and the capacity of the public and private sectors to get deals done.

CDM Sustainable Energy Programme

Cookstoves, Zambia

Contract period: 2015 – 2022

Project lead partner: The Senegal Ecovillage Microfinance Fund (SEM Fund), Shared Value Africa (SVA) VITALITE Zambia AS

Contract volume CERs: 203 000 (contracted), 50 000 (optional).

This project involves two main activities: 1) sales and distribution of portable, improved cookstoves (*mbaulas*) from manufacturers EcoZoom and Supamoto to households; 2) production and distribution of refined biofuel to households. There are two sub-programmes (CPAs), one of which is carried out near Zambian capital Lusaka, and the other one in Senegal. The second part of the project was cancelled in practice after 2016, due to a lack of demand. This case study concerns the Zambian CPA and focuses mainly on cookstoves.[67]

Many Zambians use traditional cookstoves (*mbaulas*) that consume much charcoal due to low thermal efficiency. By selling improved stoves and biofuel to households around Lusaka, the project aims at reducing households' consumption of biomass for cooking and heating, thereby cutting GHG emissions whilst also improving living conditions for recipients.

Project lead partner VITALITE started working on the project in 2013. It was registered in 2015 and the renewal period expires in 2022. VITALITE does all work on the ground. SEM Fund is responsible for project documentation, registering the CPA and finding CER buyers whereas Shared Value Africa coordinates and monitors project activities.

The main source of funding is equity capital from the VITALITE group and Norwegian energy advisor Differ, which makes milestone payments to VITALITE.[68] VITALITE has also secured donor funding.

In the PDD, "acceptable profitability" is described as precondition for equity financing. CER sales were the only major source of revenue in the project. The Swedish Energy Agency (SEA) and Sem Fund signed an ERPA in 2014 for the delivery of 203 000 CERs priced at 5 EUR per CER (EUR 1 million), starting in 2016 and ending in 2021. SEM Fund initially expected 271 000 CERs to be issued in the project.

Certified emission reductions

The annual GHG emission reduction target for the project was set to 31 337 tCO_2e. VITALITE aimed at selling 15 400 stoves over the project period. The underlying assumption was that each stove would lower recipients' charcoal use by 70 to 80 percent.

The project has failed to deliver on schedule. Approaching 2022, VITALITE has yet to issue its first CERs to SEA. However, a VITALITE spokesperson confirms they are closing in on their first issuance. As yet, there are no final accounts for GHG emission reductions. Available figures indicate the project facing difficulties in fulfilling its goals. Between 2016 and 2017, estimated GHG emission

[67] This case study concerns the Zambia project which is the geographical scope of SEA's CER purchases.
[68] In 2014, Differ withdrew funding from the project's Senegalese CPA, choosing instead to focus entirely on the Zambia CPA.

cuts from project activities reached 70 percent of the annual reduction target. By 2019, VITALITE had sold 8 890 stoves, corresponding to 57 percent of the target with about two years remaining of the project.

Additional impact

In 2019, VITALITE staff went on a door-to-door marketing campaign in two Lusaka districts, offering 535 households vouchers for an EcoZoom stove at discount rate provided they answer a series of survey questions about household income, energy expenditures, energy usage and cooking habits. About a year later, the same households were revisited by researchers from EPPSA[69] for monitoring of results.

Reaching out to 83 percent of the 535 households, researchers identified households that had bought an EcoZoom and created a control group of comparable households that never used the voucher. The average recipient had received the stove 2 - 6 months prior to the interview and expressed high user satisfaction. 88 percent of recipients reported used EcoZoom as their primary stove and self-reported charcoal usage was 60 percent lower than in the control group.

Effects are temporary and it is unclear how long they will persist. Scheduled follow-ups in 2020 had to be postponed due to the outbreak of Covid-19 pandemic. VITALITE claims EcoZoom has a lifetime of up to 5 years with consistent usage.

Environmental impact

Eco Zoom recipients were using 1 kg of charcoal less per day than households in the control group. Deforestation is a major problem in Zambia. Although it is difficult to prove that this project has contributed to slowing deforestation rate where recipients live, such effects are likely given that much of the charcoal used in Zambia is made of biomass that is harvested locally.

Social impact

The project has likely contributed to improving gender equality. Respondents overwhelmingly said that EcoZoom cooks faster, which – all else being equal – means time will be freed up for women in the households. However, there is no confirmation of time savings or how household members may have spent any possible time gains.

VITALITE claims that EcoZoom emits 60 percent less smoke than traditional *mbaulas*. 32 percent of recipients reported that they were using EcoZoom to heat their homes, which could indicate that there is some truth to it. However, EPPSA did not find any differences in exposure to carbon monoxide and fine particles during cooking compared to the control group.

Economic impact

Households that bought an EcoZoom made substantial cuts to energy expenditures. This did not happen in households belonging to the control group. All EcoZoom buyers have been guaranteed the opportunity of buying a new stove later. From what is known about the project, demand for new stoves will likely be high but if subsidies are removed, affordability could become an issue. The field survey indicates households with above-average incomes were overrepresented among those

[69] The Energy Poverty PIRE in Southern Africa

that bought the EcoZoom. There is also a question of availability, as much of the project depended on two sales hubs that were specifically set up for the project.

The project lacks profitability due to a combination of high initial costs and delayed CER issuance. Stoves have also been sold at subsidised prices. A VITALITE spokesperson describes the project as proof-of-concept, stating that a continuation CPA is being planned where there will be better chances of improving the profitability margins and possibly also cutting end prices for customers.

SEA Contribution

According to a VITALITE spokesperson, SEA has been key to the project. SEA's pledges to buy CERs encouraged VITALITE to spend internal resources on issuing CERs.

Lessons learned

A first lesson is that cookstove initiatives demand large up-front investment to generate CERs. This applies to the entire process from drawing up a PoA to monitoring and verifying project results. Once investments are CERs have been issued, operations may continue with improved profitability and possibly a lower end price for consumers.

Second, improved stoves are difficult to sell in Zambia and similar SSA countries because the alternative remains much cheaper. 80 percent of Zambians cook over open fire, using traditional fireplaces (three-stone stoves) or inefficient but cheap *mbaulas*. Many consider biomass harvested from chopped-down trees a free product (tragedy of the commons).

Bundled Wind Power Project Cape Verde

Contract period: 2014-2020

Project lead partner: Cabeólica S.A.

CER volume: 350 000

The project consists of four separate wind farms located on four of Cape Verde's islands. The farms have a capacity to generate 25.5 MW in total, making up approximately 20 percent of the country's electricity generation, and the main source of renewable energy.

Cabeolica S.A. was started as a public-private partnership in 2009 with the purpose of developing the first wind farms in Cape Verde. The partnership includes Africa Finance Corporation (42 % ownership), Finnfund (37 %), Infraco Africa ltd (15 %), Electra SARL (4 %) and the state of Cape Verde (2 %). The project was fully funded in 2010 (USD 61 million) with a 30 percent capital investment by the owners as well as a 70 percent loan from EIB and ADF. The wind farms were completed and started delivering electricity to the grid[70] in 2011, increasing further in 2012.

The project was registered with the CDM programme in 2013. The Swedish Energy Agency and Cabeolica signed an ERPA in October 2014 for the delivery of 350 000 CERs priced at four EUR per CER (EUR 1.4 million), starting from July 2015 to September 2020.

Certified emission reductions

As shown in table 1 below, the project has generated 80 percent of the estimated CERs without any significant delays. The first delivery date was in 2015 and includes CERs generated in 2013-2014.

Table 2. Yearly PDD estimates and CERs issued 2013-2020.

Year	PDD estimate	CERs issued
2013	50 814	0
2014	67 444	0
2015	67 444	92 313
2016	67 444	52 697
2017	67 444	51 481
2018	67 444	51 514
2019	67 444	58 167
2020	16 630	69 292
Total	472 108	375 464

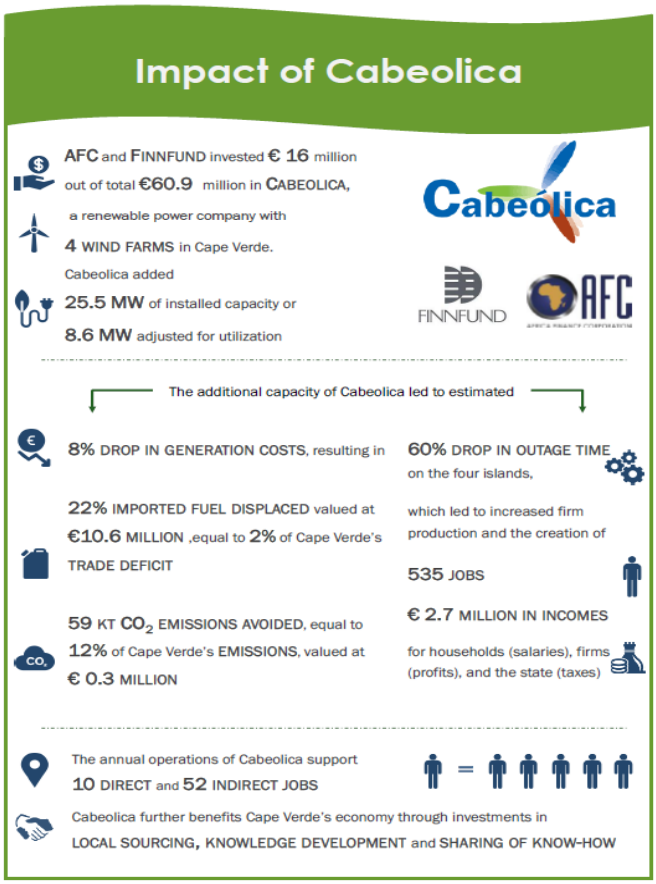
[70] Cape Verde lacks a unified electricity grid, instead each island has its own grid. Each wind farm delivers electricity only to the island on which it is located.

Additional impact

Figure 1 illustrates the significant impact that the wind farm project and its electricity generation has had on power supply and sustainable power generation in Cape Verde. It also highlights several additional impacts.

The wind farms have a production capacity of 25.5 MW in total. But mainly due to technical limitations only about a third of that capacity can be safely accepted in the grid and delivered to consumers.[71] Electra, one of the owners of Cabeolica as well as the state-owned electricity company, have looked at ways to increase the grids capacity to accept more wind power (energy-storage, automated dispatch technology). But at this time no viable solution has been found and no plan of action is in place to address this.[72]

Figure A. Impact of Cabeolica Wind power project.[73]



Environmental impact

The Cabeolica project has had significant environmental impact. Before the wind farms became operational almost all electrical power generated on the islands originated from fossil fuel-powered

[71] Steward Redqueen (2018). The Link between Power Investments, Incomes and Jobs in Cape Verde.
[72] Interview Telma Veiga
[73] Steward Redqueen (2018). The Link between Power Investments, Incomes and Jobs in Cape Verde.

thermal generators. In addition to the Cabeolica project, solar power generators were installed during 2010. Together with wind power, these renewable energy sources represented 23 percent of installed power capacity on the islands in 2016 (25.5 MW wind, 11 MW solar). The government has set a target of 50 percent renewables by the year 2050.

The wind farms have, mainly by replacing diesel power generators, contributed to a 12 percent reduction in national CO_2 emissions.

> *"Cabeolica is the main producer of renewable energy within the Cabo Verdean energy matrix and the largest sole off-setter of greenhouse gas emissions in the country, significantly contributing towards the nation's obligations in the global challenge of tackling climate change." (Cabeolica sustainability report, 2017)*

Social impact

During the project period, the electricity grid has been expanded to reach a larger share of the islands and their population. Before 2010 around 60-70 percent of the population had access to one of Electra's grids. Today, that share is 96 percent. According to Cabeolica, the wind farm project contributed to further investment in the grid from Electra, part of a strategy to enable the added power generation to be utilized to a larger extent, and by a larger share of the country's population.[74]

Cabeolica engages in various social and educational activities. Before 2020, specific schools were targeted for courses and seminars on the importance of renewable energy in the fight against climate change. There were also training activities oriented towards biodiversity on the islands. The company also participated in a food distribution programme directed towards schools with pupils from lower-income households. After the pandemic hit in 2020, many of these and other activities were halted or redesigned to work under the social restrictions that were implemented in the country. Most are expected to continue or restart after the restrictions are lifted. In all of these activities, Cabeolica has collaborated with local NGOs to contribute resources to ready-made concepts and established relations.

Economic impact

The project has had a major impact on the country from an economic perspective. The country has long been reliant on diesel and other fuel imports to generate electricity. But with the addition of relatively cheap, locally produced renewable wind power, the project has contributed to an eight percent drop in the country's average electricity generation costs. The power supplied from the wind farms have also contributed to lower imports of diesel fuel for electricity generation, amounting to EUR 10.6 million, or 12 % of Cape Verde's fuel imports.[75]

The daily operations of Cabeolica employs ten people directly and a further 52 indirectly. The added capacity to the four separate island grids that the wind farms represent, is estimated to have had further impact in the form of a decrease in power outage time of around 60 percent. This, the impact study suggests, has had led to an increase in production output in electricity-dependent businesses as well as job-related impacts. The study estimates a total increase in the economy's output by EUR 3.8 million or 0.2 percent.

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[74] Interview Telma Veiga
[75] Steward Redqueen (2018).

The revenue generated by the sold CERs has not been used by Cabeolica at this point. It is saved in a capital reserve to be used when the need for major investment arises, either due to repairs and maintenance, or due to further investment and expansion. Cabeolica has participated in the CDM programme since 2013 and has delivered CERs regularly and close to estimates. The crediting period has been extended for the period 2020-2027.

Lessons learned

- Regular dialogue, openness and complete transparency between Cabeolica and its partners, as well as the Cape Verde government, have been key to a well-functioning public-private partnership (Cabeolica). Monthly reporting has been the minimum.
- Monthly reporting
- Strong monitoring on everything from technical to CSR aspects have been an important factor in the success of the project
- Right leadership: Extensive experience in managing wind power facilities and investments
- Public-private partnerships in developing countries are often associated with corruption/bad business practices, but Cabeolica can be an example in how to do it right!
- The contacts with SEA have been good throughout