UNDP S4H - emission reductions and climate finance

S4H can both **reduce and avoid emissions**. For facilities that currently uses some form of energy - be it grid power, diesel or kerosene - installing solar energy will replace use of fossil fuels and reduce current emissions. Under an assumption that facilities with currently no or limited use of energy will get access and increase energy use over time, installing solar energy can avoid that facilities meet their future energy needs with fossil fuels.

Generally, the emissions reduced per facility depend on the amount of energy consumed, the source of that energy (e.g. genset vs grid) and how much of that consumption which is replaced by the solar energy solution. The emission reductions for each country further depends on the individual countries' grid emissions. Based on the assumptions that make up the main investment scenario, the UNDP could be able to reduce and avoid emissions by **45 ktCO_2e/year for the five countries together**, assuming solar solutions are installed at all facilities.

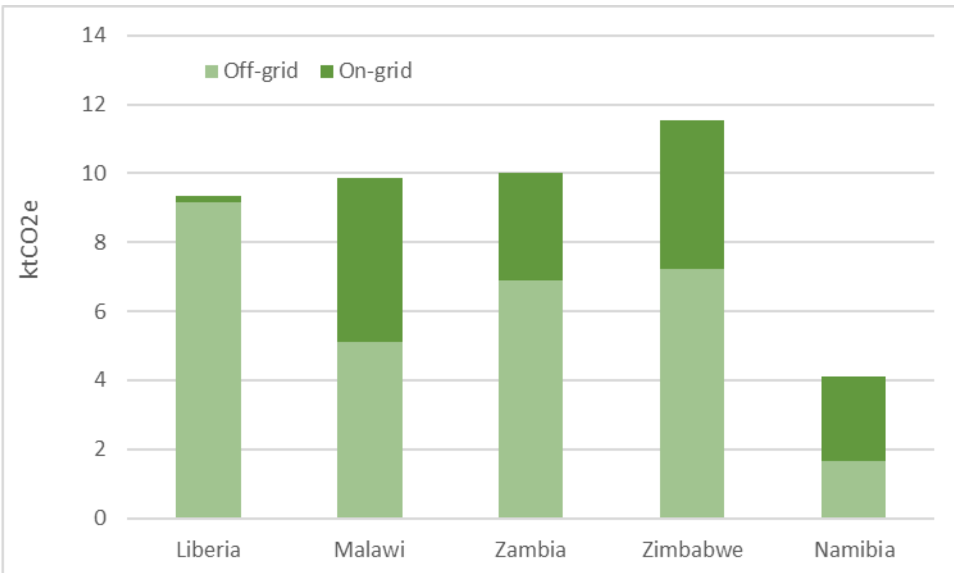

Figure 1: Annual emissions reductions per country

There is however great uncertainty regarding the future potential of **monetizing the emission reductions**. While the Kyoto Protocol arrangements expire at the end of 2020, the Article 6 in the Paris agreement is still yet to be defined in a way that gives visibility for the future mechanics and prices. However, **the UNDP are in a very good position to monetize emission reductions under the Paris agreement**. The UNDP can bring a solid project portfolio to the table with S4H, with good environmental and social benefits.

In addition to the revenue potential from selling emission reductions, it is also possible to get up-front financing for the project. We recommend the UNDP to assess the potential for selling carbon and receiving up—front financing support from Korea, Sweden and Switzerland. Also, the Green Climate Fund could be a source of financing for the scheme.

We would not be surprised if an UNDP pilot deal could be landed at, say €10/tCO_2e (ITMO). Prices would likely be higher if sold to the Korean trading scheme. If we assume that the scheme lasts for 8 years, and ignore ramp-up time, the main volume scenario brings in about **€2.7M for the five countries combined** – provided 75% of reductions go to the UNDP.

Table 1: Price/volume scenarios for annual incomes from selling credits

Price/volume scenarios	*EU/CDM*	*Article 6 - 75% ITMOs*	*Article 6 - All ITMOs to UNDP*	*Korea/CDM or ITMO*
	€ 0.20	*€ 10*	*€ 10*	*€ 20*
CDM std emission factor	6 688	250 817	334 423	668 845
Main scenario	8 966	**336 224**	448 298	896 596
Use pool EF	10 928	409 794	546 392	1 092 785

Using the final investment figures, it is possible to calculate the **cost/ton of emissions reduced**. The cost per emission reduction is expected to be high, in particular for the reductions that require a battery.

1 Climate impact - CO_2 emissions reductions from the project

Solar PV is an environmentally friendly technology with zero emissions. Hence, installation of solar PV completely removes CO_2 emissions from power production at the energy facilities.

The magnitude of the emissions reductions will depend on a few factors. CO_2 emissions are normally derived from fuel consumed and the carbon and energy contents of the fuel burnt. When common diesel burns, it releases about 2.66kgCO_2/litre diesel. 1 litre diesel contains around 10kWh of energy (at 100% efficiency). Since the model setup is based on kWh replaced, it is easiest to work with an amount of CO_2 saved per kWh delivered. We already have kWh/institution in the model.

1.1 Emissions reduction frameworks

The Clean Development Mechanism has been the main framework for emissions reductions since it was designed in the Kyoto protocol. This mechanism is likely at the end of its lifetime, and the parties at the UNFCCC are discussing possible replacements under the Paris Agreement's article 6. CDM has received criticism for different aspects regarding environmental efficiency, additionality, etc. However, the framework for calculation of emissions baselines, -reductions and MRV is comprehensive and well defined, and new standards are likely to use similar frameworks.

CDM has many methodologies covering emissions reductions from electricity production under different circumstances. Small-scale grid connected electricity follows methodology AMS-I.D, while small-scale captive (standalone/off-grid) electricity projects are covered by AMS-1.A, AMS-1.F or AMS-1.L. AMS-1.A and AMS-1.L can also to some degree incorporate suppressed demand. We will use excerpts from this framework here, but note that some of the assumptions we do will have to be substantiated in fuel receipts, grid data, etc.

Discussions around the Paris Agreement's article 6 have not been completed. However, while Certified Emissions Reductions (CERs) from CDM projects were issued and sold in their entirety, reductions under Article 6 are likely to be split between the host country's Nationally Determined Contribution (NDC, the host country's own commitments of contribution) and Internationally Transferred Mitigation Outcomes (ITMOs, credits transferred & sold).

1.2 Grid emissions

CO_2 emissions reductions from grid is found by multiplying the grid emissions factor from the country grid by the number of kWh produced. This factor is not readily available in the countries in question, but we have created our own factors, presented in Table 2 below. The data for the countries are from an old analysis and the data from the power pools are from CDM's standardised baselines, and show grid emissions per kWh produced. The applied factor will be a weighted average between own production and imports from the power pool the country participates in. Note that Liberia is to connect to the West African pool but has not done so yet. Liberia and Malawi have no published analysis of emissions factors.

Table 2: Grid emissions factors, kgCO2e/kWh

Country	Pool (CDM)	Grid emissions factor			Comment
		Pool	Country	Applied	
Liberia	West Africa	0.559	#N/A	0.559	No local data, use pool

Malawi	Southern Africa	1.026	#N/A	1.026	No local data, use pool
Zambia			0.003	0.310	(30% shortfall)
Zimbabwe			0.600	0.728	(30% shortfall)
Namibia			0.490	0.758	(50% shortfall)

1.3 Diesel and off-grid emissions

Most rural sites and some of the urban demand will come from diesel gensets. These are very uneven in performance, particularly for small systems. Larger diesel power plants will convert diesel to electricity at an efficiency of 30-35%, while smaller gensets will deliver in the range of 15-25%. Gensets perform best at high utilisation and even load. Also, gensets running on low power have a tendency being set at supplying too much energy. For this analysis, we have assumed that the smallest facilities/clinics deliver least effective (15%), rural/urban health centres run at 20%/25% and that hospitals can reach efficiencies up to 30%.

When using CDM methodologies for captive systems, some methodologies allow emissions calculations from either fuel usage (Litres fuel consumed) or from electricity emissions factors (kgCO_2/kWh). CDM can allow a standard emission factor of 0.8kgCO_2e/kWh for small diesel networks if this factor cannot be derived from fuel data. However, this factor is conservative, and implies fuel efficiency at around 33%. {2.66kgCO_2/L / (10kWh/L*33%)} = 0.8kgCO_2/kWh.

1.4 Mix of grid and diesel baselines

The mix will depend on country conditions. Small rural facilities are more likely to use diesel generators than large central hospitals. However, since blackouts are common in these countries, we have modelled about 30% diesel also for larger facilities.

Table 3:% with diesel baseline

Country	% Diesel	
	Small/rural	*Large/central*
Liberia	100 %	90 %
Malawi	70 %	36 %
Zambia	50 %	30 %
Zimbabwe	50 %	30 %
Namibia	30 %	30 %

1.5 Calculations

Emissions reductions are calculated as follows

$$ER_{Grid}=[Facilities] \times [kWh\ per\ facility] \times [kgCO2/kWh\ in\ grid] \times [1-\%diesel]$$

$$ER_{Diesel}=[Facilities] \times [kWh\ per\ facility] \times [CO_2/L]/[kWh/L \times efficiency]) \times [\%diesel]$$

1.6 Resulting emissions reductions

Based on this analysis, the UNDP could be able to reduce emissions by 45 ktCO_2e/year, assuming solar solutions are installed at all facilities.

Table 4: Emissions reductions

Liberia	*Total*	*Clinic (Level 1)*	*Clinic (Level 2)*	*Health centres*	*Hospital*
Diesel efficiency	**21 %**	15.00 %	20.00 %	20.00 %	30.00 %
Diesel MWh	**6 826**	1 467	2 993	1 022	1 343
Grid MWh	**336**				336
tCO2/year	9 331	2 605	3 985	1 361	1 380

Malawi	*Total*	*Health clinics (off-grid)*		*Health centres*	*Smaller hospitals*
Diesel efficiency	**23 %**	15 %		20.00 %	30.00 %
Diesel MWh	**4 110**	767		1 737	1 606
Grid MWh	**4 658**	380		1 431	2 847
tCO2/year	9 879	1 750		3 782	4 347

Zambia	*Total*	*Health Post*	*Rural Health Centre*	*Urban Health Centre*	*Hospitals*
Diesel efficiency	**24 %**	15.00 %	20.00 %	25.00 %	30.00 %
Diesel MWh	**5 997**	0	2 957	1 413	1 628
Grid MWh	**10 052**	0	2 957	3 296	3 799
tCO2/year	10 003	0	4 853	2 526	2 623

Zimbabwe	*Total*	*Clinics and polyclinics*	*Rural health centres*	*Other hospitals*	*Hospitals*
Diesel efficiency	**20 %**	15.00 %	20.00 %	25.00 %	30.00 %
Diesel MWh	**5 176**	1 250	3 395	175	356
Grid MWh	**5 884**	1 250	3 395	409	830
tCO2/year	11 526	3 130	6 991	484	921

Namibia	*Total*	*Clinics and polyclinics*		*Health centres*	*Hospitals*
Diesel efficiency	**21 %**	15 %		25.00 %	30.00 %
Diesel MWh	**1 205**	650		116.8	438
Grid MWh	**3 197**	1 460		423	1 314
tCO2/year	4 091	2 260		445	1 385

tCO2e/year	**44 829**	9 745	15 830	85 98	10 656
tCO2e/8 years	**358 631**	77 960	126 637	68 788	85 245

The above numbers assume that solar is installed at all facilities and does not take into account that some facilities might have solar installed already. The numbers also include suppressed demand, i.e. assumes that all installation reduce/avoid emissions.

Note also that if we apply the country-specific emissions factors without import adjustment, the total number reduces by 10% to around 40ktCO_2e. If we use an emissions factor of 0.8kgCO2e/kWh instead of adjusting for efficiencies, the same portfolio reduces to 33ktCO_2e.

2 Climate finance - What are the emission reductions worth?

It is difficult to estimate a market price for the credits in absence of certainty around how Article 6 in the Paris agreement will be implemented. CERs are principally only allowed until end-2020, but it is not difficult to extend the scheme should the parties of the UNFCCC want to.

2.1 CERs and ITMOs?

The resulting emissions reductions produced could potentially generate income for S4H. As indicated in section 1.1, it is likely that emissions reductions under Article 6 are split between own contributions (NDC) and additional reductions that can be monetized (ITMOs). Such a split is likely to be set on a country level or individually negotiated. Academics have argued that (more or less) all credits over the first years should go to ITMOs, and that the share to NDC should increase over time.

Note that ITMOs are linked to country, so the scheme would need an agreement with each of the countries' government to get credits.

2.2 Market prices

In EU, CERs have been trading at almost no value (€0.20 in 2019) for a long time, as there is still an abundance of credits in the market. Korea is in the other end of the scale, contracting CERs at prices reportedly exceeding $20, but then with strict eligibility criteria and a conversion process to Korean credits. There is limited freely available information on these bilateral deals. There is a decent chance credits from small-scale off-grid energy, particularly from LDCs, would work in Korea, however we are not sure what Korea allows after 2020. As an additionality criterion, Korean private sector needs to own a share of the entity producing the credits, or fund a significant part to the project (upfront). This could be an additional source of private sector financing for S4H, should climate finance be pursued as a means of financing the scaling of the scheme.

From 2021, the CDM should in principle have transitioned to Article 6, however that process has not been concluded, and this year's COP (26) has been postponed to November 2021 due to COVID19. A few governments have started exploring ITMO schemes, for example Sweden and Switzerland. Demand from EU has so far not been clear, but the short story is that unless other parties come with firm commitments to the Paris agreement, the EU will not use Article 6, and only commit to internal emissions reductions.

Based on what happened with CDM and the Joint Implementation (JI) projects under the Kyoto protocol, we expect that deals are done with governments in the beginning, probably at prices a bit away from zero, with relatively round figures. (€5, €10, €15?).

UNDP has, however, a good standing, and can bring a decent project portfolio to the table, with good environmental and social effects. We would not be surprised if an UNDP pilot deal could be landed at, say €10/tCO_2e.

Table 5: Price/volume scenarios for annual incomes from selling credits

Price/volume scenarios	*EU/CDM*	*Article 6 - 75% ITMOs*	*Article 6 - All ITMOs to UNDP*	*Korea/CDM or ITMO*
	€ 0.20	*€ 10*	*€ 10*	*€ 20*
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If we assume that the scheme lasts for 8 years, and ignore ramp-up time, the main volume scenario sold to an article 6 government brings in about €2.7M for the five countries combined if all incomes go to UNDP.

2.3 Cost

There will be a cost associated with setting up and negotiating ITMOs with each country. This is also a process involving governments and could be lengthy. The UNDP could apply to Sweden or Switzerland's programmes to cover some of this cost. This is a process UNDP is in a very good position to take part in, however, the process is not clear, and countries have so far been very reluctant to sign schemes trading away emissions reductions.

The CDM has a Monitoring/Reporting/Verification (MRV) framework that needs to be followed. This will also have to be done under Article 6. However, it is too early to say how strict this will be.

For the sake of arriving at a ballpark figure, we would assume it could cost €150.000 to set up an ITMO scheme, but this is pure guesswork. A CDM PoA could probably be created for €50.000 by a skilled consultant. A credit issuance round would cost €20.000 per country, but this does not need to be conducted every year.

2.4 Summary

In conclusion, the total income from credits was estimated to €1.4M over 8 year, discounted at 10%, using a scenario where 75% of the ITMOs go to UNDP for sale at €10. This is a small contribution. If the Korean market prevails, this is also a possibility for UNDP.

Table 6: Incomes from credits

Admin cost	-350 000	-450 000	-450 000	-340 000
8 years, 1-year ramp-up, 3 issuances over period, 10% discount	*EU/CDM*	*Article 6 - 75% ITMOs*	*Article 6 - All ITMOs to UNDP*	*Korea/CDM*
	€ 0.20	*€ 10*	*€ 10*	*€ 20*
CDM std emission factor	-314 083	896 887	1 345 850	3 251 699
Main scenario	-301 853	**1 355 521**	1 957 361	4 474 723
Use pool EF	-291 317	1 750 595	2 484 127	5 528 254