Application of financial additionality tests: case study Peru

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Abbreviations

BAU	Business as usual
fNRB	Fraction of non-renewable biomass
GHG	Greenhouse gas
IRR	Internal rate of return
ITMO	Internationally transferred mitigation outcome
NDC	Nationally determined contribution
Produce	Ministry of Production
SEC	Specific energy consumption
SMEs	Small and medium enterprises

1. Introduction

International carbon markets under Article 6 involve the transfer of emission credits in the form of internationally transferred mitigation outcomes (ITMOs) from a seller to a buyer country. The seller country which is hosting the activity generating the emissions credits needs to do a "corresponding adjustment" of its emissions balance to account for the ITMO transfer. Thus, it cannot use the emission reduction towards the achievement of its own Nationally Determined Contribution (NDC). Therefore, governments hosting mitigation activities need to undertake assessments to identify which activities should be eligible to generate ITMOs so that they do not undermine domestic efforts to achieve their NDCs. One of these assessments, the test of additionality of the activity, aims at identifying which activities are different from a business as usual (BAU) scenario. Let us assume a power plant using renewable energy as the mitigation activity; it replaces a coal-fired power plant at the end of its technical lifetime. If the renewable energy plant is a commercially very attractive hydropower plant, it would be undertaken anyway and thus be BAU. In the absence of an Article 6 transaction the emission reduction due to the closure of the coal plant and the commissioning of the hydropower plant fully accrues to the host country. If the hydropower plant would now sell ITMOs under Article 6, the need for corresponding adjustments would now mean that the emissions volume sold in form of ITMOs would now be added to the host country's emissions balance. The country thus will have to find alternative emission reduction options to make up for the ITMO sale. These might generate substantial costs.

As the example shows, it is not in the interest of the host country for mitigation activities generating ITMOs to be the most easily to be achieved ones ("low-hanging fruit") within the country. If additionality assessments are properly undertaken, Article 6 financed activities would be only the ones that would not have happened in the absence of the incentive generated by the revenue from ITMO sales.

In a previous conceptual report "Financial additionality tests for cooperation under Article 6 of the Paris Agreement: case study Peru" (Michaelowa et al. 2021), we developed the theoretical concepts for undertaking financial additionality tests at higher levels of aggregation (e.g., technology, subsector and sector). Examples from energy-related activities in Peru were used to illustrate the report. The proposed tests aim at minimizing transactions costs and providing simplified parameters to operationalize the financial additionality assessment. The report presented two scenarios. In the first one, activities are deemed automatically additional when it is possible to demonstrate that they do not generate revenues and they are regulatory and policy additional. The second scenario focuses on activities that generate revenues or savings. For industrial sectors with homogeneous technologies and activities that involve small-scale appliances, the suggested additionality test is application of performance benchmarks. For commercial activities that require investments, payback period thresholds testing is recommended.

Based on the theoretical concepts developed in the previous report, this report provides concrete examples on how to apply performance benchmark and payback period thresholds tests to energy sector activities. Three Peruvian energy-related activities have been selected which are part of the 62 mitigation measures proposed by the Peruvian Government[1]. The applicability of performance benchmark tests is illustrated with examples of the cookstove sector and the artisanal brick production sector. Small scale hydropower activities are used to illustrate how to apply the payback period threshold test.

2. Aim of the report

As mentioned in the introduction, the report "Financial additionality tests for cooperation under Article 6 of the Paris Agreement: case study Peru" (Michaelowa et al. 2021) developed by the authors of this study describes in a theoretical manner how host countries, like Peru, could assess the additionality of the mitigation activities through the application of specific tests. The report explained how to run the tests in a conceptual manner but did not provide concrete examples of how to apply them.

This report aims to provide more specific detail to better understand how additionality assessments could be undertaken. This empirical report should therefore be read jointly with the theoretical report to fully put it in context.

We would like to stress that the examples are purely illustrative for demonstration purposes and not meant to show a "typical" activity. They thus do not necessarily reflect the site-specific reality of the different sectors; therefore, the specific numerical results should not be deemed to show the situation of a specific project. The empirical examples and approaches presented can serve as a basis for a more in-depth additionality assessment of future activities under Article 6 to be carried out by the Peruvian Government but could not be relied on in their own right as an assessment of additionality.

3. General methodology and limitations

For this empirical report, the authors undertook a desk review drawing on the available information that could be found online. Official reports from Peruvian government institutions were prioritized, namely reports from the Ministry of Energy and Mines, MINAM, Produce and Osinergmin. Sources reviewed include the technical reports that underpin the prioritization of the 62 measures issued by the Government. For the artisanal brick production sector, several reports issued in the context of the project "Energy efficiency in artisanal brick kilns in Latin America" were used. This project was implemented in seven Latin American countries, including Peru, between 2009-2016 and provided significant insights regarding this sector. In a second step, the authors shared the report with the MINAM and Gold Standard to gather feedback and comments.

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[1] From the scope of the 62 measures, the Government of Peru should use the ones with relatively low mitigation costs to achieve its own NDC. For the ones who become more expensive, carbon mechanisms could be an option to finance them.

The limited resources available for this report required assumptions to be made. Therefore, in each of the sub-sections the corresponding assumptions made have been included. However, in case the MINAM manages to have more detailed data regarding the different sectors, we strongly suggest breaking down the analysis to a more disaggregated level.

Finally, it is important to note that when countries decide to embark on assessing the additionality of the different mitigation activities, the availability and comprehensiveness of information will vary from activity to activity. Hence, the specific steps to be followed might slightly differ depending on the existence and accessibility of the information.

4. Performance benchmarks

As described in the theoretical report, performance benchmarks tests should be applied to activities that generate revenues. The proposed sectors for the applicability of the tests are i) industrial sectors with homogeneous technologies (e.g., cement sector) and ii) activities that involve small-scale appliances in households and small and medium enterprises (SMEs) (e.g., cooking, cooling and heating devices). The aim of the performance benchmarks tests is to look at the distribution of GHG emission intensity of activities within a sector, sub-sector and technology and identify the activities with the best performance. Activities that exceed the performance of those at a pre-defined benchmark threshold are considered additional. In the following examples, the benchmark threshold has been set at the 10th percentile. This means that activities that perform better than the 90% of all the activities within a sector are considered additional.

The benchmark threshold needs to be identified by the government and it is not an easy decision to be made. Discussions aiming at defining the percentile need to take into account, inter alia, the technologies within a particular sector and the characteristics of the distribution curve. For this case, taking into consideration how performance benchmarks have been used in the context of the CDM and different emission trading systems, the authors used the 10th percentile as a threshold.

4.1. Cookstoves

The first illustrative example was applied to the cookstove sector in Peru. The aim was to identify the CO_2 emission intensity per each of the technologies and fuels used to cook in Peru and identify the top-performing ones. To simplify the model, it was assumed for all households to have one cooking device[2] of similar size. Under the methodology section, the steps followed, and the sources used to retrieve the data are explained.

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[2] The authors are aware that this does not represent the reality of the country. It is recommended to further develop this analysis breaking down the emissions taking into account the variations of the cookstove sector.

Table 1: Units used in the analysis

Item	Units
Energy	Terajoule (TJ)
CO_2	Metric tonnes of CO_2 (t CO_2)
Emission factor	t CO_2/TJ
Cookstoves	Unit of cookstoves

Assumptions:

- All households use similar cooking devices with the same levels of final energy output[3]
- Stoves are used only for cooking purposes, not for heating

4.1.1. Methodology

The first step consists of identifying at the national level the technologies and fuels use to cook, and their corresponding energy consumption (TJ). As mentioned before, to simplify the model no differentiation between the different cooking devices was made. Thus, the sector was broken down only as per the type of fuel used. For this case, data was retrieved from the Balance Nacional de Energia 2019 (MINEM 2019). The data found focused on the energy consumption in the residential sector at the national level. Electricity in the residential sector could also be used for other domestic purposes (e.g., fridge, microwave), therefore, to avoid significant data distortion, data from MINEM was not used for this particular case. To calculate electricity consumption, it was assumed a single cookstove has a power of 4500 W (Osinergmin 2013) and this was multiplied by the number of households that use electricity.

Table 2: Identifying energy consumption per fuel

Energy consumption in the residential sector (including rural and urban areas)	(TJ)
Firewood	69750.9
Dung and llareta	5907.8
Solar energy	897.5
Charcoal	3020
LPG	38035.8
Dry gas	6516.5
Electricity	2253

Sources: MINEM (2019), except for electricity (own calculation)

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[3] The cookstove sector is known for its variations – cooking fuel, technology type, availability of fuel, cooking habits, regional variations, family size, among others. In case the government has access to such detailed data, it is recommended to further break down the analysis accordingly.

For the second step, the total number of cookstoves per fuel was identified. This information was retrieved from the 2017 National Census (INEI 2017) that lists the type of fuel used to cook in each household. The unit used was number of cookstoves. As mentioned before, it was assumed that one household has only one cookstove.

Table 3: Number of cookstoves per fuel

Fuel	Total number of households
Total use of LPG or natural gas	6,190,205
Only LPG gas bottle	4,762,809
LPG + other type of fuel	987,162
Only natural gas (pipe system)	416,861
Natural gas+ other type of fuels	12,343
Use Gas (LPG bottle)+ natural gas (pipe system)	11,030
Exclusive use of electricity	108,666
Polluting fuels	1,757,409
Charcoal	66,968
Firewood	1,428,856
Dung	144,908
Total	7,939,603

Data source: INEI (2017)

The third step required to identify the emission factors for every energy source. Emission factors used were those included in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories and for the case of electricity data from MINAM was used.

Table 4: Fuel-specific emission factors

Energy source	Emission factor (t CO_2/TJ)	Source
Wood	112	IPCC 2006, Tables 1.2/1.4
Dung	100	IPCC 2006, Table 2.5
Charcoal	112	IPCC 2006, Tables 1.2/1.4/2.5
LPG	63.1	IPCC 2006, Tables 1.2/1.4/2.5
Electricity	0	No direct emissions
Gas	56.13	MINAM 2021

Based on the data collected, the fourth step focused on calculating the CO_2 emission intensity per fuel used in a single cookstove. To do this, first, the total energy consumed per fuel at the national level was divided by the total number of cookstoves[4]. Then, the results for each fuel type were multiplied by their corresponding emission factor. The emissions factors for biomass fuels assume that 31.2% of the biomass [5] is not renewable. Hence, the last step implied to multiply the CO_2 intensity per cookstove by the fraction of non-renewable biomass (fNRB), 31.2%.

Table 5: CO_2 intensity per stove type

Fuel	Annual energy consumption per cookstove (TJ)	Emission factor (t CO_2/TJ)	CO_2 intensity per cookstove	Co2 intesity per cookstove after fNRB (total)
Firewood	0.048815906	112	5.47	1.71
Dung	0.040769316	100	4.08	1.27
Charcoal	0.045096165	112	5.05	1.58
Electricity	0.020733256	0	0	0.00
LPG	0.006608617	63.1	0.42	0.42
Gas	0.014990143	56.13	0.84	0.84

Based on the calculations made, the final step implied to simulate the distribution of CO_2 intensity within the sector. To do this, first, the percentage of type of fuel used at the national level was calculated. This was done by dividing the number of cookstoves per each type of fuel by the total amount of cookstoves.

Table 6: Share of cookstoves ranked according to emissions intensity

Ranking	Fuel	Share %	CO_2 intensity per cookstove taking into account fNRB (total)
1	Electricity	1.37	0
2	LPG	72.49	0.42
3	Gas	5.48	0.84
4	Dung	1.83	1.27
5	Charcoal	0.84	1.58
6	Firewood	18.00	1.71

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[4] Based on the information of Table 2, the number of cookstoves that use LPG and Gas was calculated as follows: LPG includes the categories “only LPG gas bottle”, “LPG + other type of fuel”, and half of the category: “LPG bottle + pipe system”; natural gas includes the categories “only natural gas”, “natural gas + other type of fuels” and half of the category: “LPG bottle + pipe system”.

[5] Value provided by MINAM

For the final step, we ranked the fuel types based on their CO_2 intensity and their penetration in the sector. The ranking of the CO_2 intensity determined how to organize and stack the percentage of penetration. The most intensive CO_2 fuel type, in this case firewood, was the starting point, and then, the next fuel types were stacked following the CO_2 intensive ranking. The aim was to stack them until the benchmark was reached, which in this case was 90%. In this example, only when the LPG sector was added the benchmark was reached.

Table 7: Applying the benchmark to the stove CO_2 intensity distribution

	Distribution	%
	Firewood	18
	Charcoal	18.84
	Dung	20.67
	Gas	26.14
Benchmark 10%	LPG	98.63
	Electricity	100.00

4.1.2. Possible interpretation of the results in Peru

As described above, the example provided here is for illustrative purposes, and certain simplifications and assumptions have been applied that will influence the results generated.

With this in mind, and as explained before, cookstoves deemed additional would only be the ones that perform better than the 90% of all cookstove types. This translates into a framework in which only cookstoves that generate 0.42 CO_2 emissions per TJ or less could be considered additional. Hence, in this illustrative example, cookstove emissions mitigation programmes would only be additional under Article 6 approaches if the cookstove activities that are financed did not generate more than 0.42 CO_2 emissions per TJ.

4.2. Artisanal bricks

The second example used to illustrate how to apply the performance benchmark tests was the artisanal production of bricks in Peru. This activity is also part of the 62 mitigation measures identified by the Peruvian Government. Similar to the previous case study, the aim in this case was to identify the CO_2 emission intensity per technology used in the artisanal brick production sector, in order to later be able to draw the distribution of the sector and identify which technologies could be considered additional by looking at the upper 10th percentile of the sector.

Table 8: Units used in the analysis for artisanal bricks

Item	Units
Energy	Terajoule (TJ)
Energy consumption	TJ per tonne of product (TJ/t)
CO_2	Metric tonne of CO_2 (t CO_2)
Emission factor	t CO_2/TJ
Bricks	Tonnes of bricks produced per year

Assumptions:

- All types of kilns produce the same amount of tonnes of brick per year. This assumption was also used by the Ministry of Production in Peru (Produce) when calculating the mitigation potential of the sector.
- The analysis does not break down the variety of fuels used per type of kiln. It was not possible to identify in a quantitative manner the specific type of fuels used per each type of kiln. Different sources point out for firewood and coal to be the most common fuel used in artisanal brick production (Minem 2019; De los Angeles and Menton 2016; Swisscontact 2016, Caem 2013). However, there is also some evidence that producers also use sawdust, charcoal, dung, coffee peel, oil, rice husk and tires (Produce 2018). It has been assumed all kilns use firewood as a fuel. As above, the emissions factors for biomass fuels assume that 31.2%[6] are not renewable.

4.2.1. Methodology

The first step focused on identifying the different technologies that exist in the artisanal brick production sector in Peru, the number of units of kilns, and the fuels used. It was identified that four types of kilns are used: i) open kilns, ii) open kilns that have incorporated a fan (open kiln+ fan), iii) down drafts, and iv) mobile kilns. Different sources estimated that by 2012, a total of 2159 kilns existed across the country (Mercadeando 2012, Produce 2018). Produce (2018) estimated the existence of 1447 open kilns and Caem (2013) roughly estimated the number of down-drought and mobile kilns in the country. The total of open kiln+ fans was calculated subtracting the variety of kilns from the total amount. So, the universe of kiln types has been identified as follows:

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[6] Value provided by MINAM

Table 9: Technologies used for brick production

Kiln Type	Total kilns	Source
Open kiln	1447	Produce (2018)
Open kiln + fan	699	Produce (2018)
Down - drought (tiro invertido)	10	Caem (2013)
Mobile kiln	3	Caem (2013)
Total	**2159**	

The second step aimed at identifying the specific energy consumption (SEC) per tonne of brick produced. It was possible to find data on the average of the SEC per kiln. For the case of the open kiln + fan, Zavaleta (2016) identified that these kilns improve the energy consumption in 26% in comparison to a normal open kiln. Hence, the average of energy consumption for the open kiln + fan was calculated based on this energy consumption improvement.

Table 10: Specific energy consumption per tonne of bricks produced

Kiln Type	SEC (MJ/kg)	Source	SEC (TJ/tonne)
Open kiln	4.5	Swisscontact (2016)	0.0045
Open kiln + fan	3.33	Zavaleta (2016)	0.00333
Down - drought (tiro invertido)	3.1	CAEM (2013)	0.0031
Mobile Kiln	1.8	CAEM (2013)	0.0018

The third step implied identifying the tonnes of bricks produced per year. To simplify the model, and following the assumption made by Produce (2018), it was assumed that every kiln produces the same amount of 643.61 tonnes of bricks per year.

The next step was to identify the emission factor, which is the one for firewood (112 t CO_2/TJ). Also, as in the previous case study, the emissions factors for biomass fuels assume that 31.2% of the biomass is not renewable. Hence, based on the information collected from the previous steps, the fifth step implied calculating CO_2 emissions per technology and per tonne of brick produced and multiply it by the fNRB, 31.2%.

Table 11: CO2 emission intensity

Kiln Type	Annual Brick Production per Company (t)	SEC in Brick Production (TJ/t)	Annual Energy Consumption per Company (TJ)	CO_2 Emission Factor (tCO_2/TJ)	Annual CO_2emissions per Company (t CO_2)	CO_2 intensity per Company (t CO_2/t Brick)	CO2 intensity per Company after fNRB (t CO_2/t Brick)
Open kiln	643.61	0.0045	2.90	112	324.38	0.504	0.16
Open kiln + fan	643.61	0.0033	2.14	112	240.04	0.373	0.12
Down - drought	643.61	0.0031	2.00	112	223.46	0.347	0.11
Mobile kiln	643.61	0.0018	1.16	112	129.75	0.202	0.06

Finally, to calculate the distribution curve for the sector, we first identified the penetration of each of the technologies within the market. Then, we ranked the activities based on their CO_2 intensity and its market penetration. In this case, open kilns were identified as the once that produce more CO_2 per tonne of bricks produced, and mobile kilns the less CO_2 intensive one.

Table 12: Penetration of kiln technology in the market

Kiln Type	Share %	CO_2 intensity (t CO_2/t brick)
Open kiln	67.02%	0.16
Open kiln + fan	32.38%	0.12
Down - drought	0.46%	0.11
Mobile kiln	0.14%	0.06

Table 13: Benchmark calculation for the artisanal brick production sector

Distribution	%
Open kiln	67.02%
Open kiln + fan	99.40%
Down - drought	99.86%
Mobile kiln	100.00%

Benchmark 10%

4.2.2. Possible interpretation of the results in Peru

In this illustrative example, artisanal kilns deemed additional would only be the ones that perform better than the 90% of all the kiln types. This translates into a framework in which only kilns that generate $0.12tCO_2$ emissions or less per tonne of brick produce could be considered additional. Hence, additional artisanal brick production kilns are the open kilns + fan, down draft and mobile kilns.

5. Payback period thresholds

Payback period thresholds are a simplification of thresholds for the internal rate of return (IRR). When using payback periods thresholds as a form of financial additionality tests, the aim is to identify the corresponding IRR equivalent to the payback period threshold. The activities with a lower IRR should be the ones considered additional. Payback period thresholds should be applied to all activities involving investments with commercial considerations, for example small hydropower, on-shore wind technologies, and liquid biofuels

5.1. Small hydropower

To demonstrate how to prove additionality under these terms, the illustrative test was run in the small hydropower sector. The promotion of small hydropower is also part of the 62 mitigation measures identified by the Peruvian government.

As identified in the theoretical report, sectors with mature technologies are able to have longer payback periods. Conversely, investments in new technologies have shorter payback periods and higher IRR. Based on the literature review undertook for the theoretical report, small hydropower plants were considered highly mature technologies with payback periods between 8 to 10 years (ESMAP 2011). For this example, 8 years was the threshold used.

Once the threshold has been identified, the only step required to be undertaken is to calculate the accumulated IRR needed to get the full payback within 8 years. In this regard, following the IRR calculation included in Figure 1, the yearly IRR needed to get a full payback (100%) in 8 years would be 9%. Hence, any small hydropower plant proposed as a mitigation activity, would need to have a yearly IRR equal or lower than 9%, leading to a payback period exceeding 8 years in order to be deemed additional.

Figure 1:IRR calculation

100%= 1.09 ^ 8

9% (IRR) raised by the power of 8 (years) equals to 100% (full payback)

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