



 | The Gold Standard<sup>®</sup>

# THE REAL VALUE OF ROBUST CLIMATE ACTION

IMPACT INVESTMENT FAR GREATER  
THAN PREVIOUSLY UNDERSTOOD

A NET BALANCE REPORT FOR THE GOLD STANDARD FOUNDATION

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## IMPACT INVESTMENT FAR GREATER THAN PREVIOUSLY UNDERSTOOD

### A NET BALANCE REPORT FOR THE GOLD STANDARD FOUNDATION

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The content of this study does not represent the official views or opinions of the individuals or organizations listed above.

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## INTRODUCTION

This year, the Intergovernmental Panel on Climate Change (IPCC) released its 5th Assessment Report providing a clear and up to date view of the current state of scientific knowledge relevant to climate change.

That report is the result of seven years work from hundreds of the world's leading scientists who sifted through thousands of the latest peer-reviewed studies examining the causes, impacts and mitigation options of climate change. Its message was clear and compelling. Greenhouse gas emissions need to peak this decade, and then start their rapid decline, if we are to have a chance of staying beneath the "safe" threshold of 2C of warming.

The 5th Assessment Report also explains that, contrary to those who say climate action will cripple the economy, in fact the impact of mitigation policies will be negligible on global growth at around just 0.06 of a percentage point annually throughout the rest of the century. However, what the IPCC did not include in this economic assessment was a valuation of the multiple positive outcomes beyond carbon that can be delivered by reducing energy consumption, switching to clean energy systems and saving forests.

As a leading global player in the delivery of finance to greenhouse gas mitigation projects, The Gold Standard ensures that its projects are designed from the outset to deliver these environmental and social outcomes beyond carbon mitigation. They include improved human health, the 'services' of natural ecosystems, like water purification, improvements to livelihoods

# Robust climate mitigation projects can produce positive environmental, social, AND economic outcomes.

and the food and economic security of communities, regions or countries. Indeed, many of these outcomes help to contribute to climate adaptation and other key global priorities such as the Millennium Development Goals.

In the lead up to COP 21 in Paris in 2015, where countries under the United Nations Framework Convention on Climate Change have agreed to establish a binding international agreement, much of the policy dialogue centres around the costs and benefits of strong climate action and the design of climate interventions in order to achieve the largest mitigation possible while also delivering sustainable development.

As a contribution to this discourse The Gold Standard commissioned the sustainability consultancy, Net Balance, to undertake the first ever portfolio valuation of the outcomes in addition to carbon mitigation in our projects. This was done, where possible, by measuring and assigning a monetary value to these outcomes.

Assigning monetary values, in an objective way, to outcomes beyond emission reductions helps to articulate the positive economic case for strong climate action, enhancing our understanding and appreciation of benefits that in the past may have been considered “secondary”.

This study shows that robustly designed and audited greenhouse gas mitigation projects, such as those developed through The Gold Standard, deliver far more than carbon emission reductions, meaning that it is no longer necessary to choose between climate and other environment and development outcomes. **Strong climate action is not only affordable but, designed correctly, represents an impact investment far greater than previously understood.**

## STUDY OBJECTIVES

The objectives of this study were to:

- capture and monetise the environmental and socio-economic net benefits associated with issued Gold Standard (GS) projects, grouped under key project categories
- aggregate the benefits across the GS portfolio to demonstrate the value and impact created by the projects
- undertake further deep dives of selected case studies to capture and monetise these additional benefits linked to specific carbon projects.

The scope of this study was not to provide a definite valuation of the GS portfolio but, for the first time, to put forward a practical approach and methodology for discussion and for future refinement. The application of the methodology to the case studies is also meant to provide a pragmatic framework to these discussions.

The authors and The Gold Standard acknowledge that this is a first – and partial – valuation attempt and that, at the project

level, there may be many more categories of benefits to be valued than was possible within the scope of this study.

## METHODOLOGY

With an objective to assess the environmental and socio-economic net benefits associated with GS projects that have achieved the issuance of carbon credits, projects were grouped into key project categories. This study focussed on those categories that had the greatest number of projects, and the greatest number of carbon credits issued, as there was more robust documentation available in these areas.

Our detailed approach, key assumptions and limitations for each of the material GS indicators are presented in appendices. Outlined below is an overview of the key steps.

Our methodology for monetising the outcomes accruing to the stakeholders or beneficiaries of a project is broadly based on economic market and non-market valuation techniques, linked with “benefit transfer” techniques to economic studies where primary valuation has been carried out. Our methodology applied the following steps:

- Identification of the material outcomes linked to the Sustainable Development (SD) indicators accruing to the beneficiaries of a GS issued project, using the available documentation;
- Exploration of the availability and suitability of measurement metrics to gauge the magnitude of these outcomes (or “change” occurring for the beneficiaries compared to the baseline or background trend);
- Definition of a “proxy” allowing a monetised figure to be put on the outcomes; this can refer to research undertaken in other regions on similar projects and deemed suitable for “benefit transfer” to the project being reviewed;
- Definition of any moderating parameter, to account in particular for attribution (when other contributing factors play a role) and deadweight (when change would have happened to some extent in the absence of the project, etc.).

In all these approaches, we assessed possible difficulties in quantification and therefore have defined limitations to the proposed quantification and associated uncertainty. These are detailed below. Further methodological details are available in the supplementary methodological report.



FIGURE 1: KEY STEPS IN THE METHODOLOGY

The assignment of monetary value was critical to the project. The techniques mentioned above are widely used and incorporated into such initiatives as The Economics of Ecosystems and Biodiversity (TEEB)<sup>1</sup> and the System of Environmental-Economic Accounting (SEEA)<sup>2</sup>.

To ensure the valuation was robust the following principles were also applied:

- conservatism: when assumptions were required conservative estimates were used; “moderating factors” were applied where appropriate, to account for factors such as the attribution of benefits to a project (when concurring contributing factors existed);
- double-counting was avoided;
- consistency: consistency was used across the portfolio to ensure meaningful comparisons. This included the use of purchasing power parity (PPP) factors to translate monetary impact into an “international currency” that takes into account the relative purchasing power of money in various countries; this also included the use of a unique, identical value for health impacts in relation to cookstoves and water quality;
- standardisation: standardisation was applied with the use of a carbon credit as a “functional unit” allowing the comparison of benefits across categories; and

<sup>1</sup> The Economics of Ecosystems and Biodiversity (TEEB) is a global initiative focused on drawing attention to the economic benefits of biodiversity including the growing cost of biodiversity loss and ecosystem degradation (<http://www.teebweb.org/>).

<sup>2</sup> The SEEA aims to provide a consistent measurement framework in support of sustainable development and green economy policy (<https://unstats.un.org/unsd/envaccounting/Brochure.pdf>).

- transparency: the methodology to attain the results has been fully disclosed and peer reviewed. A model, that The Gold Standard is able to replicate and refine, underpins the results. Assumptions and limitations are presented alongside the results.

## KEY CHALLENGES AND LIMITATIONS

As already noted, the intention of this study was to demonstrate the significant broader environment and development outcomes of robustly designed carbon projects developed through The Gold Standard. It was not designed to produce a definitive valuation of the GS portfolio. The approach taken, and the methodology used, is consistent with most examples of current international work and has been structured to allow for iterative improvements as additional data becomes available.

In the interest of transparency and recognising that this study’s objective is to act as a “stepping stone” for future research, this section brings up some of the key current limitations of the study. However, this section does not intend to provide full discussion of the sometimes complex debates that each of these points warrant.







## **METHODOLOGICAL CHALLENGES**

Critics have suggested that by valuing everything, including human health and life, there is an implication that anything damaged can be “made good” through adequate financial compensation. A premise to this study is that valuation and monetisation may bring interesting perspectives and new angles to assess the merits of projects and the way to structure and manage them.

This is in no way meant to imply that compensation or even comparison between categories of benefits is condoned.

Additional information on the points below can also be found in the supplementary methodological report.

## **NON-MARKET VALUATION**

It has been suggested that non-market valuation techniques present several difficulties, including the fact that:

- value is considered from the sole point of view of human-centric “utility”;
- values for intangibles such as flora or fauna species are problematic to apportion down to a local scale;
- threshold impacts and marginal values are usually difficult to incorporate in such studies;
- values are location specific and, while primary data sources are many, there is a general lack of consistency across studies; this is emphasised by the fact that each field is highly specialised and compartmentalised (health studies, biodiversity, macro-economics) and there is no standardisation of the values produced across these areas of research.

Despite these limitations, non-market valuation techniques remain the only currently widely accepted way to put a value on intangible benefits and hence meet the objectives of this study. The challenges outlined above have been addressed by selecting non-market valuation sources that are authoritative and widely cited and as generic in their coverage as possible.

## **BENEFIT TRANSFER**

Benefit transfer is a practical and low-cost approach, which is not recommended if it is important to produce a very precise value for the project area, in which case primary valuation studies should be undertaken.

Ideally, benefit transfer requires a strict control of the similarity between the two environments between which the value transfer is operated and adjustments can be made to the values when no exact corresponding environment can be found where reliable primary valuation studies have been undertaken. This however requires the definition of attributes and of a value transfer function, which means case by case studies.

# Gold Standard projects make finances go further by deliver an investment impact far greater than previously understood.

In this study, we have addressed some of these challenges in the best way we could, in particular:

- we have attempted to use simple value transfer functions that are generic enough to be applicable to consistent co-benefit categories (i.e. human health impacts from cookstoves, eco-system services, etc.);
- we have linked these value transfer functions to variables that could be readily sourced from the project documentation;
- we have used source valuation studies that provide generic enough value to be applied across a fairly broad range of projects.

Despite these efforts, limitations remain: for example, the valuation of life and health benefits has frequently encountered difficulties due to the highly different socio-economic backgrounds in which people live.

## **PORTFOLIO VALUE EXTRAPOLATION**

The most important limitation is that, given the scope of the study and the diversity of the projects, all co-benefits could not be explored and valued and only those deemed to be material have been included in the analysis (based on an initial high

level assessment). For instance, the following co-benefits are examples of those that have not been valued: burden of disease (only the value of life has been valued in terms of health impact – mostly due to difficulties in dealing with overlap in values), species diversity and ambient air quality impacts.

Mechanisms have been applied for harmonising values across the portfolio, as much as possible, in particular through the use of international dollar value taking into account Purchasing Power Parity. This system could however be further refined. The values have been calculated per project or per valuation unit within each project then apportioned per carbon credit and per year for ease of communication and this may provide some distortions, which must be borne in mind when considering the results.

Given the level of precision required and the final presentation per year and per carbon credit, no Net Present Value has been calculated. This is a deviation to generally applied economic valuation methodologies. On the other hand, it is sometimes recommended to apply a zero (or very low) discount rate when calculating “social good” values, which is by and large the case in this study. We do not believe that this methodological choice would materially affect the results of the study.

Finally, monetising social and environmental outcomes should not be a license to trade them off against each other. There are explicit value judgments to be made when deciding to invest money into biodiversity conservation rather than health improvements and the dollar value put on both outcomes must not obscure these value judgments. For these reasons, it is



appropriate to keep the valuations separate across the Triple Bottom Line rather than to try to aggregate them. While we have aggregated values within each broad category of benefit for ease of presentation, we acknowledge that some stakeholders may object this aggregation, in which case it is possible to revert back to the detailed data.

## ANALYSIS OF THE PORTFOLIO

The first step was to understand the categories of projects that make up the GS portfolio as illustrated in Table 1. Categories with either the highest number of issued credits, the highest number of projects or with different profiles (e.g. afforestation/reforestation) were selected for review. Using these three key criteria about 80% of the certified GS portfolio (based on the number of yearly carbon credits issued) was considered within the project scope. About 100 projects were included in this valuation exercise, while the overall GS pipeline contains in excess of 1000 projects.

While this assignment focussed on GS projects that have achieved credit issuance<sup>3</sup>, it is highly likely that most registered projects would present the same benefits, depending on the category they fall under. GS projects with credit issuance were selected due to the additional level of due diligence and auditing for these projects (monitoring reports)<sup>4</sup>.

<sup>3</sup> As opposed to projects that are simply registered, without having gone through the full due diligence process.

<sup>4</sup> With the exception of afforestation/reforestation projects, which have not all achieved credit issuance.

As indicated in the following table (highlighted) the categories of projects reviewed were:

- wind (40% of GS portfolio by number of credits, mainly in Turkey and China);
- cookstoves and safe water provision (grouped together as domestic energy efficiency);
- biodigesters providing clean gas to households; and
- afforestation/reforestation.

In addition to obtaining a maximum coverage of the portfolio (by number of projects and of carbon credits), we also wanted to achieve diversity of projects and thus included the afforestation/reforestation scope, which is in the process of being progressively integrated into the GS portfolio.

Once the projects to be reviewed were identified, we determined outcomes for each, beyond GHG mitigation, based on the changes identified across social, environmental and economic indicators associated with the project types and formalised in the GS sustainable development matrix.

The categories of outcomes identified included:

- health improvements linked to air quality improvements,
- health improvements linked to water quality improvements,
- biodiversity enhancement (or protection),
- provision of employment,
- improved livelihood of the poor,
- improved balance of payments.

# Despite conservative estimates, Gold Standard projects have led to billions of dollars in additional benefits to people and the planet.

This list does not represent all outcomes relating to GS projects, but those that are material and can be valued using the techniques described in the methodology. In addition, an absence of measurable outcomes for a given project does not mean that co-benefits do not exist, simply that they may be difficult to evidence and measure, or may be multifaceted or dispersed.

## KEY FINDINGS

After mapping co-benefits by project and benefit type (Table 2) and identifying the outcomes associated with GS projects, we were able to assign a monetary value to the co-benefits (as illustrated in Table 3).

The overall results are presented by category of projects, for the 80% of the GS portfolio that was valued as part of this exercise.

The values in Table 3 have not been totalled beyond each identified outcome group, as the outcomes are diverse in nature and the underlying valuation metrics and proxies are from varied sources. The aggregation of all numbers into one single value

would be unhelpful and a misrepresentation of the methodological intent.

It is also important to recognise that:

- the greatest value is likely to arise when a large number of people are impacted due to the larger scale across which impact is generated;
- the macro-economic value calculated (balance of payment) does not consider the initial investment into a wind farm (initial capital investment, which may come from overseas), hence the co-benefit estimated only considers one side of the financial equation, as this was not a full benefit-cost analysis exercise; and,
- there are gaps in the valuation of outcomes for some projects, because of data availability. Some types of outcomes were easier to estimate (economic for example) than others, as they were based on simple, objective metrics.

As the overall GS portfolio results are heavily dependent on the number and nature of projects, carbon credits (annual averages extracted from GS's registry) have been used to standardise (i.e. weighted average) the value created. This is presented in Table 4.

It should be noted that this is presented as an "average" vision of the portfolio and hides the great diversity between projects. The averaging of the results per carbon credit does not reflect the significant spread of values that are dependent on the specific project characteristics, the data available and the country in which projects are occurring.



Additionally, the value created over the total crediting period (7 years for wind and 10 years for the other projects) of the projects is presented in Table 5.

## WIND

The two major outcomes of wind projects are:

- displacement of fossil fuel imports (fuel costs) or allowing of growing fuel exports; and
- employment generated over the construction and operation period.

It should be noted that improvements in ambient air quality (leading to improved health impacts) have not been considered, as they would be location specific and difficult to assess. In addition, they would be subject to “displacement” effects if fossil fuel is then used elsewhere.

The key factors or drivers leading to these outcomes are fuel cost and employment.

## BALANCE OF PAYMENT

- The fuel (coal, gas, oil) displaced by renewable energy projects varies depending on the dominant fuel used for electricity production in the country considered (e.g. coal in China, or gas in Turkey). We checked that such fuels were indeed imported in significant quantities. Differences in price drives the value calculated.
- All fuel prices will vary significantly over time, driving significant (and somewhat artificial) variations in values.

*continued on page 18*










# TABLE 1

**The Gold Standard Portfolio**  
(issued projects – as of January 2014)

Average Annual Credits		Number of Projects		
#	%	#	%	
5,310,061	41%	54	34%	WIND
2,578,624	20%	3	2%	WATER FILTER
1,535,881	12%	34	21%	COOKSTOVES
1,231,637	9%	5	3%	LANDFILL GAS
790,756	6%	13	8%	BIOGAS DIGESTERS (IMPROVED COOKING)
673,785	5%	13	8%	OTHER
539,699	4%	12	8%	METHANE RECOVERY
234,790	2%	13	8%	HYDRO
107,940	1%	7	4%	SOLAR (THERMAL-HEAT AND PV)
26,346	0.02%	5	3%	AFFORESTATION / REFORESTATION
<b>13,029,519</b>	<b>100%</b>	<b>159</b>	<b>100%</b>	<b>TOTAL</b>

# TABLE 2

Mapping of cobenefits by project and benefit type

	 <b>Biodiversity</b>	 <b>Balance of Payments</b>	 <b>Employment</b>	 <b>Livelihood</b>	 <b>Health Impacts</b>
AFFORESTATION AND REFORESTATION	Hectares of forest created or preserved		Agroforestry employment (permanent and temporary)		
WIND		Savings in fossil fuel imports	Construction (temporary) and operation (permanent)		
COOKSTOVES	Forest preservation: note that this was not valued for lack of data		Manufacturing and distribution of efficient cookstoves	Financial savings from reduced fuel use	Reduced respiratory illnesses / death
WATER FILTERS	Forest preservation: note that this was not valued for lack of data		Distribution and / or installation of filters	Financial savings from reduced fuel use for boiling water	Reduced water borne diseases
BIOGAS	Forest preservation: note that this was not valued for lack of data		Building and / or installation of digesters	Financial savings from reduced fuel use	Reduced respiratory illnesses / death
Environmental					
Economic					
Socioeconomic					
Social					





**Biodiversity**  
per year



**Balance of Payments**  
per year



**Employment**  
per year



**Livelihood**  
per year



**Health Impacts**  
per year






# TABLE 3

**Cobenefits per year**  
(estimates in international \$ - 2013)

	<b>\$6M</b>		<b>\$1M</b>		<b>\$84M</b>	AFFORESTATION AND REFORESTATION
		<b>\$100M</b>	<b>\$12M</b>		<b>\$302M</b>	WIND
	Unable to quantify although significant for some projects		<b>\$4M</b>	<b>\$143M</b>	<b>\$84M</b>	COOKSTOVES
	Unable to quantify		<b>\$2M</b>	Unable to quantify	<b>\$302M</b>	WATER FILTERS
			<b>\$1M</b>	<b>\$6M</b>	<b>\$25M</b>	BIOGAS






# TABLE 4

Cobenefits: per carbon credit  
(estimates in international \$ - 2013)

	 Biodiversity	 Balance of Payments	 Employment	 Livelihood	 Health Impacts
AFFORESTATION AND REFORESTATION	\$150		\$27		
WIND		\$19	\$2		
COOKSTOVES	This was not valued for lack of data		\$3	\$93	\$55
WATER FILTERS	This was not valued for lack of data		\$1	Unable to quantify	\$117
BIOGAS			\$2	\$7	\$32
<p><b>GOLD STANDARD PROJECTS DELIVER IMPACT INVESTMENT FAR BEYOND THE VALUE OF CARBON REDUCTIONS.</b></p>					

# TABLE 5

**Cobenefits: across project crediting period**  
(estimates in international \$ - 2013)

	 Biodiversity	 Balance of Payments	 Employment	 Livelihood	 Health Impacts	
	\$37M		\$249M			AFFORESTATION AND REFORESTATION
		\$693M	\$81M			WIND (*)
	This was not valued for lack of data		\$33M	\$1B	\$628M	COOKSTOVES
	This was not valued for lack of data		\$21M	Unable to quantify	\$3B	WATER FILTERS
			\$9M	\$43M	\$180M	BIOGAS

(\*) Calculated over 7 years, although wind projects usually have a provision for two renewal periods for a total of 21 years.

Tables 3 to 5 illustrate the monetary value applied to each outcome by category of project. These are explored in more detail in the following paragraphs.



## EMPLOYMENT

Employment has been conservatively valued based on a national minimum salary. A Purchasing Power Parity (PPP) factor has been applied to this minimum salary, however discrepancies remain. The value of this outcome, as well as the number of people employed, will vary from project to project (and from country to country). It has been assumed that sufficient unemployment or under-employment existed in most countries and regions to justify always considering employment as a benefit.

## COOKSTOVES, BIOGAS AND WATER FILTRATION

The major outcomes of these projects are:

- improved health (from better air quality or water quality depending on the project);
- increased employment (provided to those manufacturing and distributing the technology); and
- improved livelihood (through financial savings in fuel purchases).

Biodiversity/ forest conservation outcomes associated with these projects have not been valued because of the difficulty in aligning the decrease in firewood collection to hectares of forest protected (only valid for some projects).

## HEALTH

For health impacts, two key drivers are:

- whether the stove was used indoors / outdoors prior to the implementation of the project; (this does not apply to water filtration projects ) and

- the family size / number of people exposed to the cookstoves' smoke.

Health impact valuation is highly dependent on the assumptions made between the link of air quality (or, for water filtration projects, water quality) and related illnesses. This varies greatly depending on other factors and the vulnerability of each individual.

While this could be subsequently refined through further research, an assumption has been made that cookstoves used outdoors would only deliver 25% of the health benefit delivered by improved indoor cookstoves.

Note that, for consistency, the same value of life/ health has been applied across all projects and all countries, i.e. a life-year in Kenya has been valued at the same value as in China. We recognise that this is an ethical rather than economic choice.

Another important caveat is that the “exposure-response” function applied to all cookstove projects was extrapolated from one specific African project for a typical type of cookstove. It is recognised that each type of cookstove will bring different reductions in air pollutants and deliver different related health benefits. Assessing this would however require significant in-depth research that was beyond the scope of this project.

Health impacts have been valued very conservatively, with a number of 3 people per household impacted (where families are typically larger) and the impact of water quality solely calculated for children under 5 (whose main cause of mortality is diarrhoea), which represents a very conservative approach as it only values

**"My time is saved and I can now use it for other things. I can now buy more food with the money we used to spend on paraffin for lighting fires. This stove has changed my life."**

**– Mama Mavis, a Xhosa grandmother in Mapuzi, South Africa**

a portion of the benefits. It is acknowledged that this could be developed much further in subsequent iterations of the work. In particular, while information provided by the Global Alliance for Clean Cookstoves has been heavily relied upon, it is acknowledged that it could be used even more extensively in the future as more up-to-date and more detailed information continues to be produced<sup>5</sup>.

### **EMPLOYMENT**

For employment impacts, the structure of the project largely drives the value. Hence the value of employment varies very significantly across the projects.

<sup>5</sup> In particular the following study, recently published, is of relevance: <http://ehs.sph.berkeley.edu/krsmith/publications/2014/ARPH%20HAP%20CRA.pdf>



\$302  
MILLION

value of health  
benefits delivered  
annually by  
Gold Standard  
water filter projects







Copyright: Paradigm

## FINANCIAL SAVINGS

For financial savings, the nature of the fuel and the technology (savings obtained) drives the value. Note that the initial investment required from beneficiaries (purchase of the device, in some cases), has not been factored in these calculations. It is recognised here that this equates to a partial valuation, which may not be as conservative as it could be, but information would have been too difficult to trace and this was considered as outside the scope of this project.

## AFFORESTATION/ REFORESTATION

The major outcomes are:

- Employment, mostly on agro-forestry farms, but also in the management of forest conservation areas; and
- Biodiversity, through the valuation of ecosystem services.

As these projects produce a low number of carbon credits per year because of the long timeframe of the projects, the value per carbon credit consequently appears inflated.

## EMPLOYMENT

The key drivers for the value of employment are:

- the number of people employed (including temporary/seasonal staff), which seems to vary significantly from project to project; and
- the value of the minimum wage (after applying PPP) in the country of the project.

## BIODIVERSITY

The drivers for the value of ecosystem services are:

- the number of hectares dedicated to conservation, as opposed to agroforestry, as the former have been considered as having a higher value. In particular, there is a significant difference between agroforestry opportunities in temperate and tropical forests; and
- the category of the forest (or biome) restored or preserved (tropical forest, temperate forest, woodland or grassland), ranging from \$600 to \$1550 per hectare for conservation.

- It must be noted that the presence of specific species (endemic, iconic or endemic) could potentially be considered a component of biodiversity valuation, but it has not been applied here, due to:
- overlaps between the valuation of ecosystem services and the valuation of specific species; and
- the need to source specific values for each specific project.

## CONCLUSION

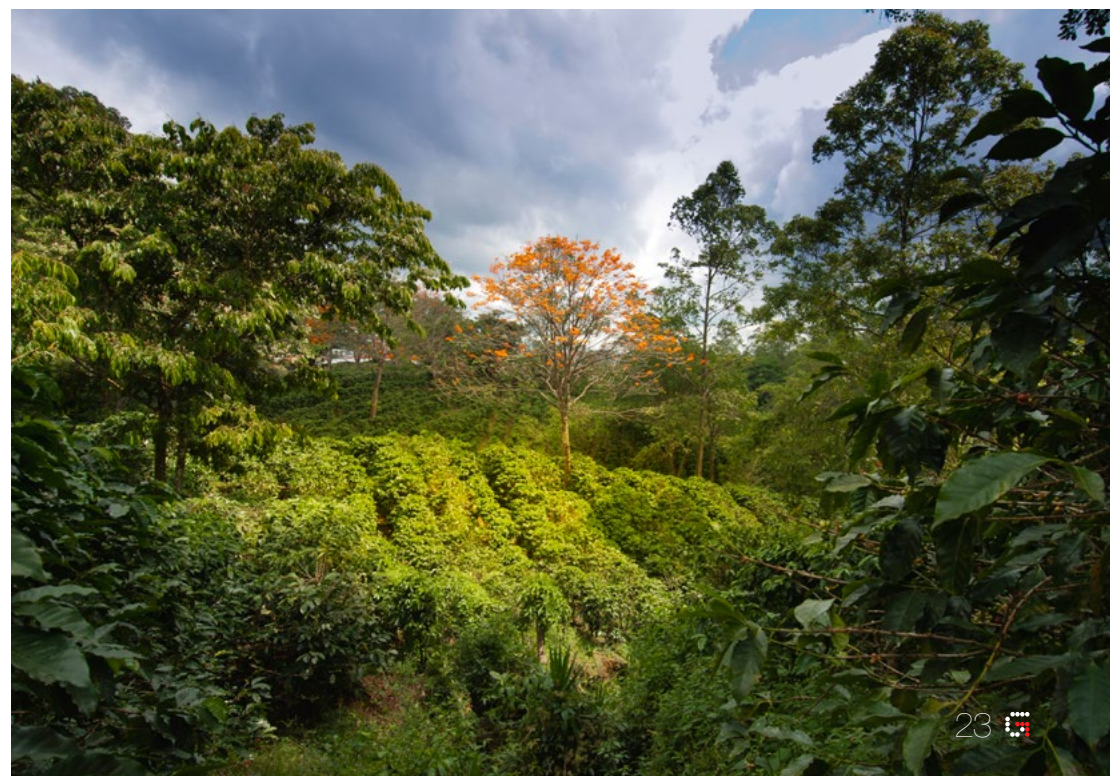
As illustrated above, by assessing monetary values of, sometimes intangible, benefits, we provide a more comprehensive picture of the value of Gold Standard certified projects. This evaluation of beyond carbon benefits not only enhances the economic case for strong action on climate change through well designed market based mechanisms, it also provides insights into the formation of social, economic and environmental value associated with these projects.

This report's ambition is to open a discussion around the valuation, and value, of broader environment and development benefits from well designed carbon projects. It aimed to propose an adaptive methodology that can be developed further if found useful, and to highlight future monitoring requirements to allow for a better quantitative assessment of these co-benefits, bearing in mind that a balance needs to be struck in relation to associated project assessment and valuation costs.

This report should also open a discussion amongst policy makers and stakeholders around:

- the design of future climate action in order to maximise the value of public and private sector investment
- integrated policy and project design to simultaneously address greenhouse gas mitigation, climate adaptation and broader sustainable development
- how far a valuation approach should be developed for multiple outcomes;
- the need of standards to underpin co-benefit valuation;
- the work to be undertaken of address some of the pitfalls and limitations highlighted in this report;

The Gold Standard welcomes feedback and suggestions and looks forward to playing a key role as the discussion moves forward.





## CASE STUDY 1

# FIREWOOD SAVING COOKSTOVES MAMIZE NATURE RESERVE, CHINA

### BACKGROUND AND PROJECT DESCRIPTION

The Mamize Nature Reserve is located in the province of Sichuan, in a mountainous, subtropical region of China. The reserve is famous for its abundant biodiversity and has a reputation as a gene bank of animal and plant species. The reserve covers 38, 800 hectares and also marks the southern edge of the Giant Panda's habitat.

At present, families living within the Gold Standard project boundary use firewood as the main fuel for cooking and heating. Three Stone or rough Mud Stoves are the main cooking instruments; no other cooking instruments are used. Due to low thermal efficiency, these kinds of stoves use a considerable amount of firewood per year, causing local people to spend a lot of time (3 months a year) gathering firewood. As population increases, so too does the demand for firewood. This leads to

more deforestation. In addition to deforestation, cooking with the traditional stoves causes health threatening smoke pollution, especially for women and children who typically spend more time in the kitchen area than men.

Due to the Mamize Nature Reserve area's under-developed transportation infrastructure<sup>1</sup>, patchy electricity supply and high electricity prices, there is no affordable alternative to replace wood as a source of heat. Without outside financial support, local people are not able to afford to upgrade their stoves. To solve this challenge, WWF Switzerland has invested in the roll out of a Firewood Saving Cookstoves project - that greatly reduce non-renewable biomass combustion, and therefore, slows the deforestation rate - in return for future Gold Standard carbon credits issued to the project.

<sup>1</sup> It is recognised that transportation infrastructure may not necessarily be desirable in a Nature Reserve

Firewood Saving Cookstoves, as a mature rural energy technology, which has been used for more than 30 years in China, and is still been encouraged in rural areas. These cookstoves have chimneys and a proper air supply system, which ensures the fuel is fully burnt and extracts the waste gas and smoke out of the kitchen. At the same time, thermal efficiency is maximised. As per data from the local official energy department the stove can save as much as 50-70% in firewood use.

## **SOCIAL AND ENVIRONMENTAL OUTCOMES OF THE PROJECT**

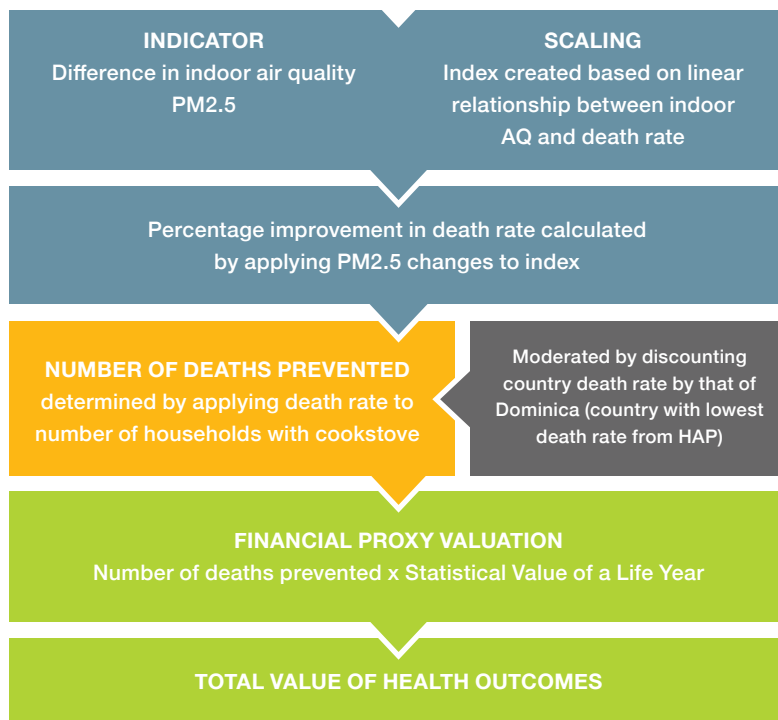
In addition to overall greenhouse gas emission reductions, the two key direct outcomes for the local community that have adopted the cookstoves are as follows:

- 1) Improvements in health
  - Reduction in air pollution associated with cooking with the old stoves and the consequent protection of human health
- 2) Enhanced livelihoods
  - Decreased time spent on collecting firewood (from three months to three weeks according to the project sheet)
- 3) Biodiversity conservation
  - Easing the human impact on the Mamize Nature Reserve (reduced deforestation)
  - Conserving species diversity (both flora and fauna) by preserving the natural forest

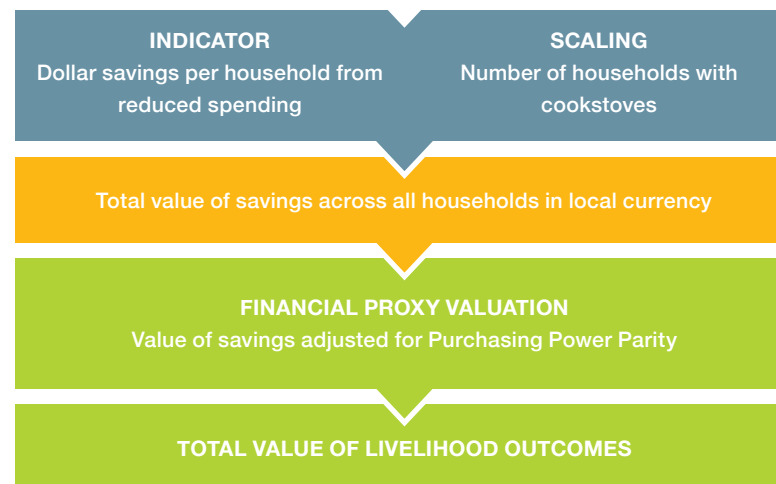


The following diagrams schematically represent the measurement and valuation process for the outcomes considered.

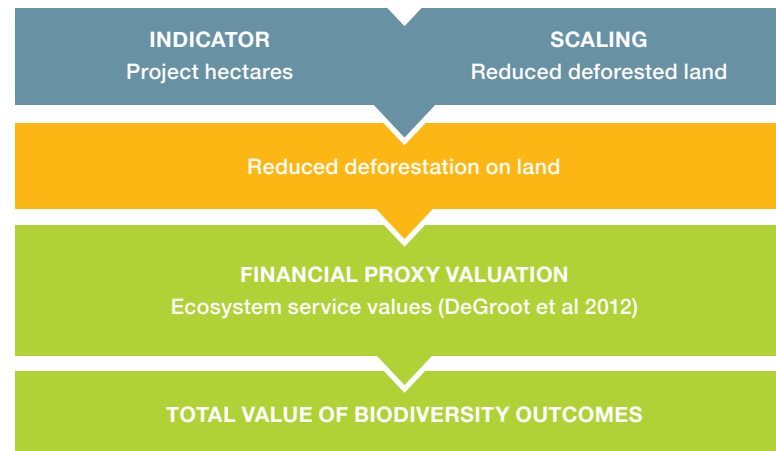
### IMPROVEMENTS IN HEALTH



### ENHANCED LIVELIHOODS



### BIODIVERSITY CONSERVATION



## EVIDENCING THE OUTCOMES

### IMPROVEMENTS IN HEALTH

The World Health Organisation Air Quality Guidelines represent the most widely agreed and up-to-date assessment of the health effects of indoor air pollution, recommending targets for air quality at which the health risks are significantly reduced. The Guidelines indicate that by reducing particulate matter (PM<sub>2.5</sub>) pollution from 75 to 25 micrograms per cubic metre, air quality related deaths can be reduced by around 15%<sup>2</sup>. In homes where biomass fuels and coal are used for cooking and heating, PM levels may be 10–50 times higher than the guideline values<sup>3</sup>. A recent study by Berkeley University has reinforced the finding that there is a link between PM concentration and health impacts<sup>4</sup>.

The introduction of Firewood Saving Cookstoves in homes aims to significantly reduce the Particulate Matter (PM) concentrations in the air due to their ability to funnel out the waste pollutants. The most ideal way to evidence and quantify this change would be to record the PM<sub>2.5</sub> concentrations in the air pre and post the introduction of Firewood Saving Cookstoves in homes.

However, the monitoring requirements for this project only included qualitative data that described the conditions in homes:

Pre Firewood Saving Cookstoves:

**“Serious cooking-smoke pollution. Cause wide health problems such as eye sickness.”**

<sup>2</sup> World Health Organization, 2005

<sup>3</sup> ibid

<sup>4</sup> <http://ehs.sph.berkeley.edu/krsmith/publications/2014/ARPH%20HAP%20CRA.pdf>

Post Firewood Saving Cookstoves:

**“Obvious indoor smoke reduction.”**

Therefore in order to quantify the potential impact of the health outcomes associated with Firewood Saving Cookstoves, evaluations of similar projects were researched that provided evidence of the reduction of PM<sub>2.5</sub> indoor concentration, as a first link to a reduced impact on health.

A similar introduction of cookstoves was carried out in Yunnan province by The Nature Conservancy China Program with PM<sub>2.5</sub> data collected during the monitoring process to determine the change in Particulate matter after the new technology was adopted<sup>5</sup>. The results of this project were as follows:

Pre Firewood Saving Cookstoves: **600 µg/m<sup>3</sup>**

Post Firewood Saving Cookstoves: **150 µg/m<sup>3</sup>**

Assuming that the efficiency of the cookstoves installed in the Mamize project are similar to that used in the Yunnan project, the results indicate a 75% reduction of PM<sub>2.5</sub> levels in participating homes resulting in a significant improvement in air quality levels.

Research in this space suggests a linear relationship between an increase in PM<sub>2.5</sub> levels and the risk to health of those exposed. It has been argued more recently that this may not be so, however, this has not as yet been quantified so for the purposes of this exercise we have based the impact of Air Quality on health on projects where there is a linear relationship between the two<sup>5</sup>.

<sup>5</sup> World Health Organization, 2005



An index was created by Net Balance to identify the reduction in mortality in relation to the quantified decrease in indoor air quality. The 600 to 150 µg/m<sup>3</sup> decrease in the Yunnan study, would thus lead to a 79% improvement in the short-term mortality or death rate related to Hazardous Air pollutants. This value also allows us to calculate the number of deaths prevented per year in affected communities. This is conservatively used as a proxy for any negative health impact that inefficient stoves may have. This is conservative because no other health impact (non fatal diseases) is taken into account.

#### **METHODOLOGICAL SUMMARY**

1) A death rate due to Hazardous Air Pollutants (HAP) for particular countries is calculated<sup>6</sup>

- Number of deaths from HAPs/country population

2) This is then discounted by the death rate due to HAP from the country with the lowest Air Quality related deaths to account for what would have potentially occurred regardless of the Firewood Saving Cookstove (Dominica was the country in the database that provided such a point of reference)<sup>7</sup>.

3) We are thus left with an adjusted death rate that can be applied to the number of households with stoves to determine the number of deaths that would be prevented within the participating communities.

<sup>6</sup> Data sourced from Global Alliance for Clean Cook Stoves initiative, <http://www.clean-cookstoves.org/>

<sup>7</sup> ibid

When applied to the households receiving cookstoves as part of this project, the likely outcome is the prevention of 2.75 deaths every year for the useful life of the stove (assumed to be the crediting period).

#### **IMPROVED LIVELIHOODS**

Livelihoods are increased as a result of the Firewood Saving Cookstoves introduction. Typically, for the same type of project, it has been considered that the installation of new stoves in homes would create employment, usually locally, as a result of the work required for the manufacturing or installation of the cookstoves. The second stems from the fact that family members do not have to spend as much time gathering firewood and can also potentially reduce their expenditure on other fuel sources.

New jobs creation

- The project proponents indicated that employment creation was not one of the monitored objectives for this project. While employment remains an impact, it is unlikely to be material and unlikely to directly benefit the region.

Household budget / time savings

- The Firewood Saving Cookstoves in homes required less cooking time and firewood. Household members save time by not having to go out and gather firewood from the nature reserve and are able to dedicate time to other tasks.
- The monitoring reports for this project did not include quantitative data to assist in quantifying this outcome. We thus had to build assumptions to estimate the value of time saving. These assumptions were based on a case study in another

region of China, where people had to make 4 to 7 journeys a week in winter to collect between 20 to 40 kg of wood at every journey<sup>8</sup>.

- Assuming that a trip would take 2 hours (conservatively) to collect 30kg of wood, considering that a family was found to use 26t of wood per year, the overall collection effort would be the equivalent of 866 hours a year.
- By investing in a cookstove, families would save half that time, i.e. 433 hours.

## BIODIVERSITY CONSERVATION

The forest in the project area in Sichuan province is at a high altitude in a subtropical region, with high conservation value, as it is one of the three provinces where the Giant Panda can be found. By reducing the need for firewood (by 50% to be conservative), the rate of degradation of the forest can be slowed down, as only half of the previous quantity of firewood is required.

The quantity of wood used per family was estimated at 26t/year in the baseline (according to the Project Design Document or PDD). If only 10.9t/year is used after installation of the stoves in 1600 households (this number may increase over time), 17,440t of wood can be saved per year in the project area.

This has been estimated to correspond to approximately 224 hectares of forest conserved per year. The project proponent plans are to increase the number of stoves, delivering proportionally higher benefits.

<sup>8</sup> [http://www.id-ong.org/cn/import/Leaflet\\_ID\\_ecostove\\_English\\_display.pdf](http://www.id-ong.org/cn/import/Leaflet_ID_ecostove_English_display.pdf)

## VALUING OUTCOMES

### IMPROVED HEALTH

The value of statistical life is often used to estimate the benefits of reducing the risk of death. The value of statistical life is an estimate of the monetised value society places on reducing the average number of deaths by one. The value of statistical life is most appropriately measured by estimating how much society is willing to pay to reduce the risk of death. A related concept is the statistical value of life year (SVOLY) that can be adjusted to take into account the reduced quality of life related to a life with injuries or diseases<sup>9</sup>.

The SVOLY can be applied to the number of deaths prevented over the crediting period of this project resulting in a social value of \$325,000 in health outcomes per year, or about 3.25 million dollars over the 10 years of the project's crediting period, or about \$20 per carbon credit, considering an approximate number of credits of 16,000 annually.

### IMPROVED LIVELIHOODS

To calculate the value of the estimated savings per household, the number of hours saved was valued using the same minimum wage for China, corrected using PPP, with a factor of 50% applied, to account for the fact that only half of the time saved would be dedicated to productive tasks<sup>10</sup>.

<sup>9</sup> Abelson 2007, Establishing a Monetary Value for Lives Saved: Issues and Controversies, Working Papers in Cost benefit Analysis, Department of Finance and Deregulation

<sup>10</sup> Our assumption, consistent with similar other studies in developing countries

The following livelihoods values were derived from these assumptions:

- Financial savings per year - \$374 per family per year, \$600,000 per year, \$6M over 10 years and \$37 per carbon credit.

## **BIODIVERSITY PROTECTION**

There are many different economic valuation methods attempting to capture biodiversity value and it must be recognised that there is no clear consensus on the best method to use. However, the most common method for valuing biodiversity and avoiding double-counting is the valuation of ecosystem services associated with a fully functioning natural environment. By focusing on ultimate “services”, double-counting and over-estimates are avoided.

Proxy values for ecosystem services have been derived from a study by de Groot et al (2012), where global estimates of the value of ecosystems and their services have been estimated based on a review of studies contained within the Ecosystem Service Value Database (ESVD). Amongst the list of ecosystem services itemised in the study, the following basket of ecosystem services have contributed to the proxy values<sup>11</sup>:

- Water provisioning service.
- All regulating services including air quality, disturbance moderation, regulation of water flows, waste treatment, erosion

<sup>11</sup> This selection of ecosystem services is based on a review of the PDDs, or some of the PDDs in each sub-category of projects.

prevention, nutrient cycling, pollination and biological control, excluding climate regulation.

- Habitat services.

The value per hectare for a temperate forest protected (assuming it is not used as agroforestry) is \$1560 per year, resulting in a value of \$349,000 per year, or \$22 per carbon credit, or \$3.5M over the 10 year crediting period.

## **LIMITATIONS AND AREAS FOR IMPROVEMENT**

### **IMPROVED HEALTH**

- The same value of life-year (118,500 int. \$, sourced from an Australian study and actualised into 2013 international dollars) has been applied across all countries, out of concern for fairness (no PPP was applied)
- Variation in indoor air quality, represented by PM2.5 concentration before and after implementation of the project was sourced from a similar project in a neighbouring project. The communities involved in the geographical location of the project used could have considerably different cultural practices, weather conditions and cooking habits that might lead to an over or underestimation of the resulting health impacts. It is thus recommended that quantitative data collection is undertaken to monitor Air Quality levels to make comparisons of project outcomes to WHO guidelines and thresholds.
- The reference for the “best possible” level of air quality related deaths due to Hazardous Air Pollutants has been sourced

from the same database as the levels for project countries. In this case it happens to be Dominica, although no explanation has been sought for why that might be the case. Similar information could not be found for developed countries.

- The household size in this region is 4.6 people per family, as advised by the project proponent. This does not mean that all people in the household are exposed in the same way, but refining this estimate would require far more time than available for this study. The Berkeley study referenced above proposes an approach for such refinements.

### **ENHANCED LIVELIHOODS**

- Employment numbers were not always available: to fill in the gaps, the average number of jobs created by cookstoves was calculated for projects for which this information was available and applied to projects for which information was not available. This can be improved in future monitoring reports providing quantitative data.
- The financial value of fuels purchased was not available to calculate financial savings (livelihood outcome). This may include cases when people gather wood and their own time is involved. The same savings as the closest project (same country / region) was applied. The time value of gathering wood is therefore approximated by reference to the market value of the fuel. However, obtaining a good estimate of the time saved and surveying the communities to understand how this time saved was used would allow for better valuation.
- Outcomes such as women's empowerment have not been considered to avoid double counting with the financial value

mentioned above, and also because of the difficulty in unravelling the number of contributing factors for such an outcome.

- The reduced expenditure on fuel will have an impact on economic livelihoods in different ways depending on how it is used. For example, the broader economic impact might be larger depending on the assumed marginal propensity to consume. Greater granularity on this aspect in monitoring reports or stakeholder consultation can enable this to be taken into account in the future.

### **BIODIVERSITY PROTECTION**

- Sourcing of a non-market valuation study for a forest with characteristics close to that observed for the Sichuan forest, including the specific value of habitat for the Giant Panda, could help improve on the relevance of the value per hectare used as a proxy. It is noted that other significant wild species also populate the region. It was not possible to precisely match the natural habitat in the region with primary valuation studies of similar biomes within the scope of the study and this is certainly an area for potential improvements.
- We have been however advised that according to the Assessment Report of Forest Ecological Services in China (2010)<sup>12</sup>, the forest can provide ecological services average RMB 42,600 per hectare per year, which would translate into approximately \$6,800, hence a much higher value than the one we have conservatively applied.

<sup>12</sup> We could not source this report.





\$143M  
\$1BILLION

\$143M saved  
annually in fuel or  
firewood collection  
time = \$1 billion in  
livelihood benefits  
over project period



## CASE STUDY 2

# SAYALAR DISTRICT WIND PROJECT MANISA PROVINCE, TURKEY

### BACKGROUND AND PROJECT DESCRIPTION

Sayalar District is located in Manisa Province in western Turkey. Manisa Province has traditionally been an agricultural centre, producing grapes, olives, tobacco, sesame and cotton. Today, the Manisa Province has seen the emergence of many renewable energy projects that are helping to meet the country's electricity needs, like the Sayalar wind farm. The electricity generation mix in Turkey is dominated by fossil fuels, in particular natural gas that accounts for around 55% of the electricity production. The demand for electricity in Turkey is growing at 8% every year. At present, Turkey relies on importing energy from its neighbours to meet demand.

The Sayalar wind project consists of 38 wind turbines, each with a capacity of 900kW and generates 116,050 MWh per year. The generated electricity is fed into the national grid, lessening the

reliance on fossil fuel based electricity and reducing the greenhouse gas emissions.

The project is increased the existing capacity to 54.2 MW installed capacity by adding 20MW in capacity (10 more wind turbines were installed) with the acceptance on December 25, 2013. The electricity generation from the capacity addition is estimated to be approximately 54,404 MWh/year and will also be delivered to the national grid.

The project reduces greenhouse gas emissions by replacing electricity generation from the Turkish grid system with wind generated electricity.

The Sayalar wind farm is intended to contribute to the development of the wind energy sector in Turkey, create local employment, contribute to local economies through procurement,

promote the transfer of technology and reduce Turkey’s dependency on fossil fuel imports (gas).

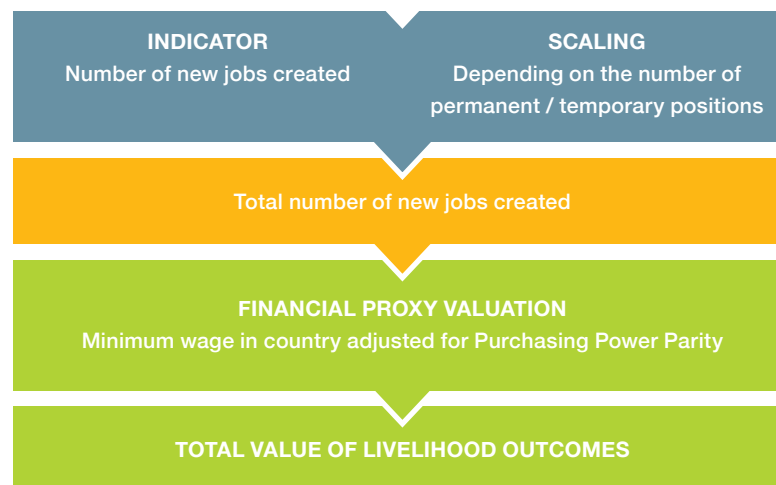
## SOCIAL AND ECONOMIC OUTCOMES OF THE PROJECT

Material outcomes that were quantified and valued for this projects include:

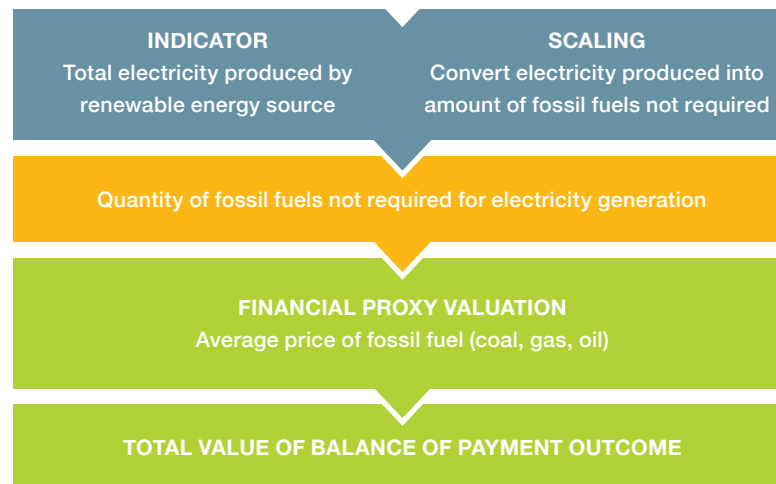
- 1) Enhanced Livelihoods of the poor through creation of new employment opportunities
  - Local employment will be created during both the construction and operational phase. In Turkey the unemployment level is 11% and hence it has been assumed that the project will have a positive impact on the local and regional employment.
- 2) This project is likely to result in positive macro-economic balance of payment impacts for Turkey
  - Although macro-economic impacts are complex to model, an increase in domestic production of energy should lead to a reduction of Turkey’s reliance on imports of energy, in particular natural gas.

The following diagrams schematically represent the measurement and valuation process for the outcomes considered.

### ENHANCED LIVELIHOODS



### BALANCE OF PAYMENTS





## EVIDENCING OUTCOMES

### IMPROVED LIVELIHOODS

Livelihoods are increased primarily through access to new and better quality jobs, created by the operational and construction needs of the Sayalar wind farm. It was stated that all new job opportunities would be made available to the local communities as a priority, hence improving local families' household incomes. In addition, local employees are also trained in specific technical and security skills for future employment opportunities. The construction phase of the first phase of the project saw 9 people hired from the local community and several other employees hired from the region. For the operational phase, 13 local people will be hired for the project, including:

- 4 electricity board operators,
- 4 security staff,
- 4 technicians, and
- 1 electrical engineer.

The second part of the wind project will employ 3 more local people as operators. Thus the total number of job opportunities created through the Sayalar wind project amount to:

- 57 construction staff, and
- 14 operational staff.

Construction jobs have been considered as part of the overall employment impact, with a moderating factor to take into account their temporary character.

## BALANCE OF PAYMENT IMPACTS

The evidence for this outcome is straightforward, with the average annual electricity generation of the 48 wind turbines being relatively easy to predict. This provides adequate data to determine the scale of this outcome.

- The combined annual electricity generation capacity of the initial wind turbine installation and the additions amount to 170,454 MWh.

The methodology for calculating the benefits of reduction in required imports of fossil fuels is a cost avoidance valuation process, using the cost saved as a result of not purchasing fossil fuel imports.

## VALUING OUTCOMES

### IMPROVED LIVELIHOODS

To be conservative, Turkey's minimum salary has been used to value this outcome. Considering the wide range of projects in various countries, the Geary Khamis (International dollar) was used to normalise the increase in wages per household due to the creation of new jobs across the project portfolio. The Geary Khamis based minimum wage was used to calculate the minimum wage in Turkey countries based on Purchasing Power Parity (PPP)<sup>13</sup>.

- Value created through 71 new jobs created: \$200,000 per year, or \$2.30 per carbon credit.

<sup>13</sup> World Bank Database, <http://data.worldbank.org/indicator/PA.NUS.PPPC.RF>

## BALANCE OF PAYMENTS

The methodology for calculating the benefits of reduction in natural gas import is a cost avoidance valuation process, using the cost saved as a result of not purchasing fossil fuel, involving the following steps:

- Assessment of the renewable energy electricity production: 170,454 MWh.
- Conversion of the electricity produced into the quantity of gas not required to produce that electricity.
- Natural gas conversion: 1 KWh = 0.00341 Million BTU.
- Application of the percentage of energy produced from gas (55% for Turkey), assuming that only that percentage of fuel import would be displaced.
- The total natural gas import avoided is multiplied the average price of gas.<sup>14</sup>

Given the above process, the total value of balance payment impacts in Turkey as the result of the new renewable energy source is over \$2,500,000 per year or about \$30 per carbon credit.

## LIMITATIONS AND AREAS FOR IMPROVEMENT

- All fuel prices will vary significantly over time, driving significant (and somewhat artificial) variation in values.
- Having actual wages of people employed at various levels would allow a more representative value to be applied.

<sup>14</sup> Turkey assumptions: Fossil fuel use in electricity generation: 55% of electricity production is from natural gas generators (U.S. Energy Information Administration, 2013). Reliance on fossil fuel imports: Turkey is particularly reliant on fossil fuel imports, with 73% of its energy use in 2012 imported (World Bank, 2013). Therefore, assumption for renewable projects in Turkey is that the increased availability of renewable energy will offset the requirement to import natural gas. Therefore natural gas is used to price the balance of payment benefit.













# APPENDIX: METHODOLOGY

## INTRODUCTION

The methodology for this project has been tailored to meet the specific objectives and scope of the assignment. In particular, it was necessary for the methodology to be both simple and robust enough to allow for the estimation of a wide range of impacts (environmental, social and economic) across a large number of diverse projects (over 150 projects with credit issuance in the Gold Standard portfolio and 1000 projects in the pipeline). The methodology remains however robust and allows for subsequent continuous refinement.

The methodology applied to this study draws upon:

- economic market and non-market evaluation techniques
- environmental-economic accounting techniques (including The Economics of Ecosystems and Biodiversity (TEEB)<sup>1</sup> and the System of Environmental-Economic Accounting (SEEA)<sup>2</sup>).
- Net Balance understanding of carbon credit accounting
- the Social Return on Investment (SROI) methodology<sup>3</sup>.

As mentioned in the body of the report, the main methodological steps applied were:

- **Step 1:** review and analyse the portfolio to identify key projects types;
- **Step 2:** identify key (material) outcomes by project types;
- **Step 3:** link measurement metrics to outcomes identified and assess information available;
- **Step 4:** apply a value in an equivalent international currency (\$) using the economic benefit transfer technique and financial “proxies” to represent intangible outcomes; and

1 <http://www.teebweb.org/>

2 <https://unstats.un.org/unsd/envaccounting/Brochure.pdf>

3 <http://www.thesroinetwork.org/what-is-sroi>

- Step 5: aggregate co-benefits across the whole portfolio based on assumptions about the similarities between projects.

### Step 1: Portfolio review

A review of Gold Standard projects in each category and sub-category was undertaken with a view to identifying the main project types and selecting the types that should be analysed as part of this limited scope review. This was done in collaboration with Gold Standard technical experts.

Categories with either the highest number of credits, the highest number of projects or with different profiles (e.g. afforestation/reforestation) were selected for review. Using these key criteria about 80% of the certified GS portfolio (considering the yearly average number of carbon credits issued) was valued within the project scope.

While this assignment focussed on GS projects with credit issuance, it is highly likely that most registered projects would present the same benefits, depending on the category they fall under. GS issued projects were selected due to the additional level of due diligence and auditing for these projects (i.e. monitoring reports).

As indicated in table 1 (see main body of the report) the categories of projects reviewed were:

- wind (40% of GS portfolio by number of credits, mainly in Turkey and China);
- cookstoves and water filtration (grouped together as domestic energy efficiency);
- biogas digesters; and
- afforestation/reforestation.

In addition to obtaining a maximum coverage of the portfolio (by number of projects and of carbon credits), we also wanted to achieve diversity of projects and thus included the afforestation/ reforestation scope, which is in the process of being progressively integrated into the GS portfolio.

## Step 2: Identification of outcomes

Once the projects to be reviewed were identified, outcomes for each category were collaboratively identified, based on the changes identified across social, environmental and economic indicators associated with the project types and formalised in GS sustainable development matrix. The identification process required:

- a review of a sample of project documentation from each category of projects selected in step 1
- online meetings / workshops with Gold Standard technical specialists to discuss Net Balance's preliminary findings.

The categories of outcomes identified included:

- health improvement linked to air quality improvements,
- health improvement linked to water quality improvements,
- biodiversity enhancement (or protection),
- provision of employment,
- improved livelihood of the poor,
- improved balance of payments.

This list does not represent all outcomes relating to GS projects, but those that are material and can be valued using the techniques described in the methodology. In addition, an absence of measurable outcomes for a given project does not mean that co-benefits do not exist, but simply that they may be difficult to evidence and measure, or may be multifaceted or dispersed.

It should be noted that only material impacts that could be extrapolated to all projects in a category were considered. It must therefore be recognised that only a partial quantification and valuation of the co-benefits associated with Gold Standard projects has been carried out.

## Steps 3 and 4: Measurement and valuation of outcomes

The methodology for these steps is described in the sections below, first in general terms and then for each category of co-benefits identified. Desktop research was carried out to define measurement and valuation parameters for each of these categories. The sections below describe the following key points that were explored and analysed through the study:

- Exploration of the availability and suitability of **measurement** metrics to gauge the magnitude of these outcomes (or “change” occurring for the beneficiaries compared to the baseline or background trend);
- Definition of a “proxy” which allows a monetised figure to be assigned to the outcomes; this can refer to research undertaken in other regions on similar projects and deemed suitable for “benefit transfer” to the project being reviewed;
- Whenever appropriate, definition of any moderating parameter, in particular:
  - *Attribution*: other contributing factors that may explain the occurrence of the outcome apart from the project itself (e.g. campaign unrelated to the project);
  - *Deadweight*: the amount of change that would have happened anyway in the absence of the project; in some cases that may be captured in the baseline (e.g. people buying efficient cookstoves anyway);
  - *Displacement*: the benefit fails to eventuate because of other reasons than those addressed by the project (e.g. forest is still logged for other reasons than firewood);
  - *Drop-off*: the effect of the project diminishes with time (e.g. a cookstove may lose efficiency over time).

These moderating elements play an important role in guaranteeing the robustness of the co-benefits claim, as they demonstrate that overstatement of the benefits have been duly considered. Most of the time, this was found to be already considered in The Gold Standard rules and methodologies themselves.

## Step 5: Portfolio valuation

For the portfolio valuation, outcomes for a sample number of projects in each category were valued. In a further step, these outcomes were extrapolated to all the projects in the category. This was done in an Excel model. This also required the collection of information for each project, which was extracted from available project documentation.

An important underlying **assumption** is that projects of a similar nature in the same country or region would bring the same types of benefits. This assumption may require further testing as The Gold Standard's understanding of value creation across the portfolio progresses.

**Extrapolation** has been carried out on the basis of the most appropriate “functional unit” (or scaling metric), i.e. either the number of people benefitting or capacity of infrastructure or any other relevant metric.

Outcome values were **consolidated** per broad category of outcomes across the portfolio. No overall valuation was calculated because:

- outcomes are very different in nature, the sources of valuation are heterogeneous and there are fundamental ethical issues in aggregating economic, social and environmental outcomes, and
- providing “triple bottom line” values allows for richer information to be presented.

Summary results are presented in tabular form in the body of the report and detailed calculations and results are available in the Excel model provided to The Gold Standard. They have been normalised by carbon credit to allow easy communication and comparison.

## Case studies

Note that the values presented in the case studies (provided in Appendix 1 of this report) sometimes differ slightly from the values for the same projects calculated in the Excel model. This is because it was sometimes possible to include additional specific outcomes for these case studies that could not be generalised to a broad category, for

lack of evidence about their widespread character or for lack of project specific data available.

## VALUATION FUNDAMENTALS

Our methodology for monetising outcomes accruing to stakeholders or beneficiaries of a project is broadly based on economic market and non-market valuation techniques, linked with “benefit transfer” techniques to secondary research.

The “**benefit transfer**” or “value transfer” is applied to estimate outcome values in a study area or for a study population when relevant valuation exercises have been carried out in similar conditions elsewhere. Then the values calculated in the original study area can be “transferred” to the new study area, provided underlying parameters and conditions can be shown or assumed to be similar. The benefit transfer approach is widely used and accepted if direct valuation is not possible (because significant time and resources required for the collection of primary information are constrained).<sup>4</sup>

**Non-market valuation** techniques are methods that estimate value for goods or benefits that do not have a price in the marketplace (e.g. intangibles). Such techniques have been refined and adapted in methodologies such as Social Return on Investment (SROI), which was also used in the development of the methodology. Non-market valuation techniques were not applied directly in the study (as they are usually time consuming), but values from such studies (“proxies”) were sourced from various fields of research (i.e. social, environmental) and applied to the identified outcomes.

An essential step in the application of the technique was to explore the availability and suitability of **measurement** metrics in the project documentation to gauge the magnitude of these outcomes (or “changes” occurring for the beneficiaries compared to the baseline or background trend).

<sup>4</sup> This is based on criteria outlined in Defra Value transfer guidelines (eftec, 2009).

Moderating parameters were subsequently defined, in application of the principle of conservatism. In particular, “**corrective**” factors to the value calculated have been considered for:

- *Attribution*: other contributing factors that may explain the occurrence of the outcome apart from the project itself (e.g. campaign unrelated to the project);
- *Deadweight*: the amount of change that would have happened anyway in the absence of the project; in some cases that may be captured in the baseline (e.g. people buying efficient cookstoves anyway);
- *Displacement*: the benefit fails to eventuate because of other reasons than those addressed by the project (e.g. forest is still logged for other reasons than firewood);
- *Drop-off*: the effect of the project diminishes with time (e.g. a cookstove may lose efficiency with time).

It should be noted, however, that project documentation was generally not structured to allow effective assessment of these parameters. In most cases, it has been assumed that the monitoring and verification processes would control for such elements.

Finally, **fairness and consistency** were applied as guiding principles across the portfolio. This means that the review attempted to standardise proxy values across the portfolio notwithstanding the vast differences in standard of living that may exist between regions where projects are implemented. The normalisation of outcomes valuation was done mostly through:

- The use of a single proxy value (in \$) for outcomes that could be considered as “universal”, such as health / survival.
- The use of Purchasing Power Parity equalisers for financial impacts.

Given the level of precision required and the final presentation per year and per carbon credit, no Net Present Value has been calculated. This is a deviation to generally applied economic valuation methodologies. On the other hand, it is sometimes recommended to apply a

zero (or very low) discount rate when calculating “social good” values, which is by and large the case in this study. We do not believe that this methodological choice would materially affect the results of the study. However, when proxy values were sourced from various points in time, they were brought back to 2013 dollars (if material).

Specific sources and parameters applicable to each main category of outcomes are described in the following sections.

## HEALTH OUTCOMES – AIR QUALITY

### DESCRIPTION OF THE OUTCOME

Poor indoor air quality may pose a risk to the health of over half of the world’s population. Inefficient cooking methods produce particulate matter (PM) and other air emissions that may be, depending on concentration and exposure, very detrimental to human health. Many Gold Standard domestic energy efficiency projects involve the provision of cooking apparatus and technology that can help significantly improve the indoor air quality for communities, thus reducing the incidence of respiratory diseases. The projects are thus delivering health outcomes for the exposed population.

### BACKGROUND

Throughout the world, people use a variety of cookstoves and fuels to meet their daily cooking needs. Over 40% of the world’s population still burns various forms of biomass – such as wood, dung, charcoal, or crop residues – or coal as a cooking fuel ( (Smith, et al., 2014)).

They cook over open fires or on rudimentary cookstoves. This way of cooking emits a harmful smoke that causes range of deadly chronic and acute health effects such as child pneumonia, lung cancer, chronic obstructive pulmonary disease, heart disease, and low birth-weight (Ibid.). Cooking and heating with solid fuels on open fires or traditional stoves results in high levels of indoor air pollution. Indoor smoke contains a range of health-damaging pollutants, such as particulate matter (PM), carbon monoxide and poly-aromatic hydrocarbons (Ibid.).



In poorly ventilated dwellings, for instance, indoor smoke can exceed acceptable levels for small particles 100-fold. Exposure is particularly high among women and young children, who spend the most time near the domestic hearth.

Indoor air pollution is responsible for 2 million children's deaths annually (World Health Organisation<sup>5</sup>). Acute lower respiratory infections, in particular pneumonia, continue to be the biggest killer of young children and this toll almost exclusively falls on children in developing countries (ibid.).

The primary goal of many of the projects in The Gold Standard portfolio is the provision of clean, efficient, durable, safe, and affordable stoves as a solution to the health and environmental risks linked with wood and coal fires.

## MEASUREMENT INDICATORS

The metrics used to record air quality improvement across the sample of project documentation reviewed varied considerably. Ideally, systematic health studies would be carried out to find out the incidence of key pathologies linked with cookstove smoke (such studies have been carried out for the incidence of diarrhoea in young children in relation to water quality). The nature of available data differed and, in the majority of cases, reporting of improvements was mostly qualitative and lacked numerical data to quantify change.

The definition of indicators to measure air quality health impacts required several steps. It must be noted that in the absence of detailed information, only approximation was attempted. The following links were established:

- Linking air quality indicators (in this case particulate matter) to adverse (fatal) health impacts.
- Establishing the relationship between improvement in air quality from reduced cookstove emissions and health improvement.

<sup>5</sup> [http://www.who.int/indoorair/health\\_impacts/burden\\_global/en/](http://www.who.int/indoorair/health_impacts/burden_global/en/)

- Identifying information sources to establish the baseline and the “deadweight”.

These steps are described below. As mentioned, this represents only one pathway for measuring and valuing the complex impacts of air quality improvement from more efficient cookstoves.

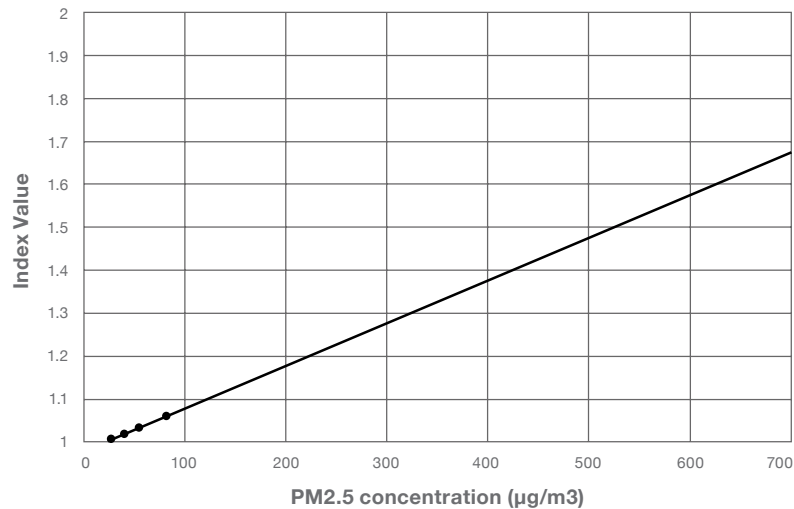
## Evidence of harm

The World Health Organisation (WHO) air quality guidelines represent the most widely agreed and up-to-date assessment of health effects of indoor and outdoor air pollution, recommending targets for air quality at which the health risks are significantly reduced. The Guidelines (World Health Organization, 2005) indicate that by reducing particulate matter (PM<sub>2.5</sub>) pollution from 75 to 25 micrograms per cubic metre, air quality related deaths can be reduced by around 15%. In homes where biomass fuels and coal are used for cooking and heating, PM levels may be 10–50 times higher than the guideline values.

It is acknowledged that this could be developed much further in subsequent iterations of the work. In particular, while information provided by the Global Alliance for Clean Cookstoves has been heavily relied upon, it is acknowledged that it could be used even more extensively in the future as more up-to-date and more detailed information continues to be produced, in particular the appendices to the Berkeley study recently published (Smith, et al., 2014). This study uses PM<sub>2.5</sub> concentrations as a proxy for household air pollutants.

The WHO guidelines on indoor air quality state that no safe level of exposure to indoor air pollutants can be recommended, which leads to the assumption that improvement brings a linear positive outcome (i.e. no threshold effect was considered).

Linearity is recognised as being a simplification, but allowed in order to create an index for PM<sub>2.5</sub> concentration starting at 7 µg/m<sup>3</sup> (Smith, et al., 2014). This index (see figure below) was used to calculate relative improvements in air quality, as described in the next sub-section.



Obviously, other air pollutants are also relevant and may have other acute, chronic or carcinogenic impacts (such as carbon monoxide at high concentration or poly-aromatic hydrocarbons at low concentrations), but considering the interactions between these pollutants and other factors, and how this impacts on health, would require significant further research. It was therefore decided to simply link PM concentration to premature death (see below), recognising that this is just a proxy for all the complex health impacts caused by bad indoor air quality across the majority of the projects. Trying to accurately measure these

health impacts would require site-specific detailed health studies. Without these, trying to refine the valuation of health impact is likely to lead to a “false accuracy”.

### Evidence of improvement in air quality through the adoption of efficient cookstoves

The introduction of efficient cookstoves in homes aims to significantly reduce the PM concentrations in indoor air quality. However, quantified and monitored evidence of such a reduction is difficult to find. Efficient cookstoves were introduced in Ghana and the monitoring project reported the following improvement in PM2.5 concentration over a 24-hour average (Agbeve):

- Pre Firewood Saving Cookstoves: 650 µg/m3
- Post Firewood Saving Cookstoves: 320 µg/m3

Using the index described in the previous sub-section, this corresponds to a 52% reduction in PM2.5 levels in participating homes, resulting in a significant improvement in air quality levels. Based on the above, this is assumed to contribute to a corresponding reduction in Hazardous Air Pollutants related deaths (see below). While this percentage is bound to vary significantly from project to project, the available information did not allow for the assessment of these variations, and this percentage was applied across all cookstove projects in the portfolio, except for some case studies where more specific information was available.

### Health impacts

As mentioned above, the linkage between air quality and health impacts, while well demonstrated, is difficult to quantify. To link assumed air quality improvements (as calculated above) with quantifiable impacts on human life, the following steps were followed:

- An indicator that is readily available from the Global Alliance for Clean Cookstove Initiative is the death rate due to Hazardous Air



Pollutants (HAP) in most developing countries<sup>6</sup>. This allowed calculating the yearly number of deaths from HAPs/country population, which was considered as the baseline figure.

- Each country's HAP related death rate was then compared with the death rate due to HAP from the country with the lowest Air Quality related deaths, in order to account for what would have potentially occurred regardless of the improved cookstove (Dominica was the country in the database that provided such a point of reference or "deadweight")<sup>7</sup>.
- This differential in death rate represents the maximum improvement considered possible from the implementation of clean cookstove projects.
- This differential rate can then be applied to the number of households participating in clean cookstoves projects to determine the number of deaths that could be prevented within the participating communities if air quality was improved to the best possible standards.
- Due to the lack of robust data on a country level, we have assumed a conservative number of 3 people per household affected directly by indoor air pollution (Net Balance conservative assumption), unless more precise information was available (via case studies for example).
- The percentage in PM2.5 concentration improvement is then applied to this number of avoidable deaths (i.e. in most cases, 52.8% as per the above), as a proxy for the progress towards the best air quality standards.

### Outdoor use

Cookstoves are not always used indoors. The impact on health is significantly different if cookstoves are mostly used outdoors. As too many different factors can affect outdoor air quality (industry and traffic pollution, meteorology etc) and it would be very difficult to assess the contribution of efficient cookstoves to outdoor air quality, it was not attempted to use outdoor air quality as a measurement metric. When

<sup>6</sup> <http://www.cleancookstoves.org/resources/data-and-statistics/>

<sup>7</sup> *ibid*

cookstoves where used outdoors all or most of the time, the outcome value was arbitrarily apportioned (see below).

As specific outdoor air quality information could not be sourced for each project, 25% of the value of was used as a proxy. This was based purely on an assumption and the need to apply a conservative value.

### VALUATION

The **value of statistical life** is often used to estimate in dollar terms the benefits of reducing the risk of death (EPA 2000, Viscusi 2003). The value of statistical life is an estimate of the financial value society places on reducing the average number of deaths by one unit. A related concept is the **statistical value of life-year (SVOLY)**, which estimates the value society places on reducing the risk of premature death, expressed in terms of saving a statistical life year.

The SVOLY has been applied to the number of deaths avoided (see previous section) as a result of each project for the duration of the project.

The SVOLY was sourced from an Australian government study (Office of Best Practice Regulation, 2007). The value was actualised to 2013 dollar value and translated from AUD to USD using a purchasing power parity factor for consistency. As mentioned above, the same value of life has been applied to all projects, as it has been considered that life should be valued identically everywhere in the world.

### POSSIBLE METHODOLOGICAL ENHANCEMENTS

To go beyond the proposed approach, the following would need to be considered:

- More accurate health outcome valuation would require more consistent project monitoring quantitative data to provide air quality levels on specific pollutants before and after the roll out of the cookstove technology, as well as population health indicators (evaluation of respiratory capacity, etc.: this will need to be determined in collaboration with health practitioners). Such information would allow the baseline levels



to be compared with minimum air quality thresholds and the post implementation levels could consider optimal air quality standards.

- A consistent metric for the collection of air quality data applied across all projects would ensure that changes identified as a result of technological interventions are valued consistently across the whole portfolio (the most representative air quality indicator should be selected in collaboration with health specialists).
- As indicated, the HAP related deaths indicator has been used as a proxy for health impacts. It is recognised that many illnesses are linked to air quality. Whilst not all are fatal, many result in a reduction in quality of life and increase burden on the health system. Such impacts can be valued but due attention needs to be given to the avoidance of double-counting benefits and to the question of attribution. The mapping of more refined relationships between air quality indicators and health outcomes could be a separate research project.
- A conservative number of 3 people per household (assuming women and children mostly would stay at home most of the day) has been applied across all studies. This number can be refined with more specific data.
- Some of these improvements in data collection would represent a significant burden. However, it appears that epidemiology studies have been carried out in some project areas in partnership with health organisations, thus providing better data. A common framework could potentially be disseminated through the various projects.

## HEALTH OUTCOMES – WATER QUALITY

### DESCRIPTION OF THE OUTCOME

The main benefit of water quality projects is the reduction of adverse impacts on people as a result of not systematically boiling drinking water. Whilst water quality projects also improve air quality by removing the need to boil water, and hence use potentially inefficient stoves, this impact is less material. It was then considered that the most material impact would be for children under the age of 5, for which diarrhoea can lead to dramatic effects, including death. Applying the principle of conservatism, the valuation therefore focussed on this segment of the beneficiaries (children under 5 and the risk of fatality from acute diarrhoea), although it is recognised that water quality would benefit the whole family.

### MEASUREMENT INDICATORS

#### Evidence of improvement

The evidence for one of the projects (Lifestraw) was provided by a study undertaken by the Kenyan Ministry of Public Health and Sanitation, which concluded that there was a significant decrease in the incidence of diarrhoea for children under the age of 5 in areas using Lifestraw. Given that this is a well-documented impact internationally, it has been assumed that the same benefit would also occur for the two other water quality improvement projects.

While there will obviously also be benefits for adults, they have not been accounted for within the scope of this study. This is therefore a very conservative estimate.

#### Indicator

The measurement indicator, as mentioned above, is the number of children under 5 benefitting from water of suitable quality, compared to the baseline. The following steps were applied to estimate this number.



- Country statistics provided the average number of people per household, which was used to estimate the number of people benefitting from filtered water (based on the number of filters distributed).
- The number of children under 5 amongst the benefitting population was calculated applying the proportion of children under 5 in the overall population, using country statistics.
- Country specific World Bank statistics<sup>8</sup> also provided the mortality of children under 5 (U5MR).
- The percentage of death attributable to diarrhoea for the under 5 population in Kenya and Cambodia (the two countries where these projects were deployed) was 23% and 22% respectively, based on a 2000 study of the situation in sub-Saharan Africa and in South Asia countries respectively (Morris, Tomaskovic, & Black, 2003).
- This percentage was applied to the calculations.
- The attribution of diarrhoea to water and sanitation was high; 88% according to a World Health Organisation fact sheet<sup>9</sup>, and this was also considered in the calculations.
- Finally, the baseline level of households already using appropriate water treatment in a rural environment (40%) was sourced from a 2009 USAID study for Kenya<sup>10</sup>. It was assumed that the same would apply in Cambodia.

These elements enabled the calculation of the number of deaths avoided yearly for the target population for children under five.

An important assumption was that the water filters operated properly and consistently and were replaced when necessary.

## VALUATION

As with 'Health Outcomes – air quality', the **statistical value of life-year (SVOLY)** has been applied to the number of deaths avoided (see previous section) as a result of each project for the duration of the project.

8 <http://wdi.worldbank.org/table/2.21>

9 [http://www.who.int/water\\_sanitation\\_health/publications/factsfigures04/en/](http://www.who.int/water_sanitation_health/publications/factsfigures04/en/)

10 <http://dhsprogram.com/pubs/pdf/FR229/FR229.pdf>

## POSSIBLE METHODOLOGICAL ENHANCEMENTS

- The monitoring of health impacts on children for each project (as per the Kenyan study) would enable the calculations to be refined.
- Diarrhoea as a cause of death for the under 5 population was sourced from an article over 10 years old. Better information may now be available but could not be sourced as part of this study. Updating such data and making it more country specific would allow an improvement of the estimates.
- An analysis of health impacts on adults may add to the benefits considered. While still subject to water-borne diseases, adults are overall less vulnerable and, to be conservative, these impacts have not been estimated as part of this study.
- Close monitoring of the use of the devices (as they age and potentially deteriorate) would help better define moderating factors.

## BIODIVERSITY VALUATION

### DESCRIPTION OF THE OUTCOME

Biodiversity outcomes have been identified for projects that either:

- directly aim to restore a piece of degraded environment, such as afforestation / reforestation (A/R) projects
- reduce the need for fuel<sup>11</sup> from forests (such as efficient cookstoves), with the result of avoiding or slowing further forest degradation.

These outcomes were considered as material when explicitly mentioned in the aims of the projects. This is par for the course for all A/R projects. Areas reforested to be used as “working forests”, with agro-forestry carried out following best practices deliver both biodiversity benefits (albeit to a lesser extent than areas reforested for conservation purposes) and livelihood benefits, as farmers derive revenue from the cultivation of appropriate crops or livestock roaming the forest.

11 Arguably, it could be a reduction in timber resources uses of any kind



For cookstoves, it all depends on the baseline and whether people cut wood from forests to meet their heating / cooking needs. Some use dead, dried wood and some use coal, in which case the biodiversity outcome does not eventuate.

In both cases, evidence of preservation of natural areas needs to be gathered.

## MEASUREMENT INDICATORS

In order to measure this outcome it was necessary to take into account:

- the surface area concerned, i.e. the number of hectares of forested environment either protected or restored as a result of the project,
- the magnitude and time scales of change in environmental quality, and
- the type of environment concerned (or type of biome).

In all cases, the number of hectares involved in the projects and allocation to different uses was the key metric collected. The nature of the restoration and the biome then influenced the corresponding value (see below). This information was sourced from the project documentation.

## VALUATION

### Valuation / Proxy

There are many different economic valuation methods attempting to capture biodiversity value, including market prices, cost-based

approaches, stated preference methods, revealed preference methods and production function approaches (de Groot, et al., 2012). Probably even more than for social outcomes, it must be recognised that there is no clear consensus on the best method to use.

However, the most common method for valuing biodiversity and avoid double-counting is the valuation of ecosystem services associated with a fully functioning natural environment. This is skewed towards “use values” of the environment and is anthropocentric, but it does recognise spiritual and cultural values that people attach to such an environment. By focusing on ultimate final “services”, double-counting is avoided, as each category of final outcomes is clearly distinct from the other.

The ecosystem services are usually broken down into the following broad categories such as:

- Provisioning e.g. timber, water
- Regulating services e.g. water quality, carbon sink, erosion
- Supporting services e.g. soil formation
- Cultural e.g. tourism.

It is therefore possible to use some or all of these components of ecosystem value depending on the environment considered. This enables the valuation to be refined and for some conservatism to be applied to the estimates.

For the present study, the characterisation of ecosystems (“biome”) and the specific categories of ecosystem services have been aligned with those defined in the study used as the main reference for the proxy value (see below).

### Main reference

Proxy values for ecosystem services have been derived from a study by de Groot et al (2012), where global estimates of the value of ecosystems and their services have been estimated based on a review of studies contained within the Ecosystem Service Value Database (ESVD).

The reasons for the use of the de Groot paper are as follows:

- The paper represents the most recent publication calculating global values for ecosystem services.
- The paper is consistent with and builds on work done by world class experts or organisations such as the work completed for The cost of policy inaction report (Braat & ten Brinks, 2008), (Costanza, et al., 1997), (de Groot, Fisher, & Christie, Chapter 1: Integrating the ecological and economic dimensions in biodiversity and ecosystem service valuation, 2010) and with TEEB.
- The values calculated for the paper provide estimates of values for three key biomes relevant to Gold Standard projects, including **tropical forest, temperate forest and woodlands**.
- The value is broken down by 22 ecosystem services. This provides a wide database from which to choose values for subsets of ecosystem services. The full list is provided below, with the actualised yearly values for ecosystem services.

Relevant ecosystem services that could be validly valued were selected from the long list provided in the literature, in order to calculate a proxy value (for ecosystem services and, therefore, biodiversity). A judgment was made based on the nature of the project (A/R or cookstoves) as to which ecosystem services were prominent in the area concerned. In selecting those services, a focus on avoiding double counting was maintained (by seeking to identify final services rather than intermediate services) as well as on ensuring some level of conservativeness in the value estimates. The following basket of ecosystem services have contributed to the proxy values<sup>12</sup>:

- Water provisioning service.
- All regulating services including air quality, disturbance moderation, regulation of water flows, waste treatment, erosion prevention, nutrient cycling, pollination and biological control, excluding climate regulation.
- Habitat services (applied to land areas managed for conversation only).

<sup>12</sup> This selection of ecosystem services is based on a review of the PDDs, or some of the PDDs in each sub-category of projects.

### Value in USD per year and per hectare for various biomes and per type of ecosystem services (adapted from de Groot, et al., 2012)

	Tropical forest	Temperate forest	Woodlands	Grasslands
Total proxy for land managed for conservation	617	1559	1480	1560
Proxy value for land managed for agroforestry	573	594	49	200
Provisioning services (only water was included)				
1 Food				
2 Water	30	214		67
3 Raw materials				
4 Genetic resources				
5 Medicinal resources				
6 Ornamental resources				
Regulating services (without climate reg)	543	380	49	133
7 Air quality regulation				
8 Climate regulation				
9 Disturbance moderation				
10 Regulation of water flows				
11 Waste treatment				
12 Erosion prevention				
13 Nutrient cycling				
14 Pollination				
15 Biological control				
Habitat services	44	965	1430	1360
16 Nursery service				
17 Genetic diversity				
Cultural services	Not included			
18 Aesthetic information				
19 Recreation				
20 Inspiration				
21 Spiritual experience				
22 Cognitive development				

### The valuation process

The valuation process was as follows:

- Dollar value for the ecosystem services provided yearly by each type of forest environment was derived from the study mentioned above,



based on a judgment made on relevant ecosystem services (see above).

- Estimated values were provided directly in US dollars per hectare per year, and no adjustment was made for the different host countries of the projects, effectively considering that the value of biodiversity is universal. It is acknowledged that locally appropriate ecosystem values may be available but the level of detail required does not lend itself to the portfolio approach such as the one applied here. It may however be relevant to a case study approach.
- Proxy values were applied to the project hectares, based on the identified biome of the project / sub-categories of project.
- Adjustments were applied to take into account the likely baseline value of the environment and the growing period of trees (see moderating factors below).

### **Moderating factors**

The yearly values for ecosystem services are appropriate for a fully functioning environment, i.e. a grown forest. This is a valid assumption when existing high value environments are protected from destruction (as the case may be for avoided deforestation); however, for reforestation projects where a forested environment is recreated in a paddock for example, the forest needs to be given time to grow.

To take this into account in our calculations and still use a yearly value, we considered a linear growth rate for trees over a period varying depending on the type of forest (quicker growth for tropical forest) and averaged the value over the whole project period (expressed as a percentage of the full ecosystem value). This percentage (ranging from 66% to 76%) was then applied to the yearly value, as a moderating factor.

The second moderating factor relates to the baseline (or deadweight). Degraded environments (such as ploughed fields or paddocks, or cleared forests) still provide some ecosystem services. As it was impossible to assess the value of such services, or even the extent of the degradation in the baseline (as this would depend not only on the

project, but even on the specific area within the project), an assumption had to be made. It was assumed that 20% of the value of the ecosystem services would still be generated in the baseline scenario (albeit with a different mix of services), hence a 20% deadweight (or reduction in differential value) was applied to the value of ecosystem services. It is acknowledged that a specific evaluation of each project's baseline would be required to refine this assumption. This was beyond the scope of this study. Note that the higher the deadweight, the more conservative the valuation.

### **POSSIBLE METHODOLOGICAL ENHANCEMENTS**

This outcome was applied primarily to A/R projects, where a core component of the project was to achieve biodiversity benefits. For cookstove or biogas projects it may be also relevant, but apart from case studies, it was not possible to identify robust and consistent information on the areas effectively conserved in the limited scope of this review. This outcome was therefore not included for cookstove or biogas projects.

The process outlined above, while robust, required some simplifications and assumptions. As mentioned, biodiversity and ecosystem valuation remains a heavily debated area. To go further and increase the accuracy of the estimated value of biodiversity outcomes, a more in-depth review of each project and tailored approach would be necessary. It could then be possible to refine proxy values using benefit transfer between areas that present a high level of similarity to the project area. The following points could be considered for further research:

- *Baseline:* As mentioned above, it was assumed that the ecosystem value of the baseline was not null but was set arbitrarily at 20%. More detailed work would be required to justify this assumption.
- *Threshold and ecosystem limits:* Consideration of the project's and proxy value's inclusion of valuing changes in ecosystems over threshold or ecosystem limits. Projects enhancing ecosystem

condition from below a threshold limit<sup>13</sup> to above this threshold, create a higher return than projects that improve the ecosystem condition by the same percentage amount but at a level well above the threshold.

- *Existence of iconic flora and fauna:* Some projects directly mention the existence of iconic flora and fauna in the project area. Depending on the source of proxy value, protecting and improving habitat for iconic species is likely to attract a higher value than those areas that do not, as a result of peoples' interest in such species. Therefore, the existence of these species on certain project areas would need to be valued separately. This could not be done within the scope of this project.
- *Decreasing marginal returns from larger forested areas:* This is linked to the concept of threshold, although slightly different. Benefits are not linear, and there may be decreasing marginal returns in adding a small protected area to a large area of protected forest. Therefore considerations of the precise location of the land protected by a given project, in the context of the general environment condition in the region, could influence the value of any changes on the project areas.
- *Delivering connectivity and other specific outcomes:* A project that delivers increased connectivity and builds the resilience of forest systems may be valued more greatly.

The considerations described above highlight the complexity of ecosystem valuation and the additional possible refinement that could be applied to each project. However, the precision has to be traded-off against the significant resources required to achieve such extension. Growth in research in ecosystem service valuation suggests that improved techniques and more robust data will emerge in the short to medium term.

<sup>13</sup> A threshold limit, is a limit under which the delivery of many regulating and supporting services may be significantly compromised. For example, in many ecosystems a reduction of native vegetation to less than 30% of the land area can lead to losses in biodiversity and ecosystem condition that render the ecosystem unable to provide its previous suite of ecosystem services.

## LIVELIHOOD OF THE POOR (LOCAL EMPLOYMENT)

### DESCRIPTION OF THE OUTCOME

The introduction of new projects in communities can have the effect of improving the livelihoods of local residents in a number of ways, such as providing permanent or temporary employment related to the implementation of the project, or project-related equipment manufacturing or infrastructure building.

The majority of projects for which this outcome has been identified as material are implemented in relatively rural areas (cookstoves, construction of renewable energy generation capacity). New jobs are therefore likely to occur as a result of the project, provided local employment is favoured during project implementation. Beneficiaries of the jobs created will therefore have access to a new source of income and improved livelihood for themselves and their families.

### MEASUREMENT INDICATOR

The measurement of new jobs (i.e. additional over the baseline) is objective in nature. The following indicators have been considered, depending on the nature of the project and information available:

- Number of permanent new jobs created as a result of a new project being implemented (management, maintenance, ongoing employment)
- Number of temporary jobs created (e.g. construction, plantation)
- Number of seasonal jobs created (e.g. for a couple of months each year, especially in farming / forestry).

It is likely that some of these jobs might be of a higher skill level than others. However, this impact was too complex to collect information about and has therefore not been valued within the scope of this project.

## VALUATION

There was minimal information available on the nature of jobs and skills required across projects. Therefore a conservative approach was utilised and the proxy value applied to new jobs created was the **minimum wage** for the country in which the project was deployed.

Consistent with the principle of fairness, the minimum wage was then normalised into international dollar using the Geary Khamis Purchasing Power Parity (PPP) system, taking into account differences in standard of living. Therefore the value of outcomes was to some degree equalised across countries with disparate standards of living. The normalised minimum wages are provided in the table below.

Seasonal jobs and temporary jobs have been moderated by applying a factor of 10% to temporary jobs, 16.6% (2/12) for seasonal jobs and 100% for full time jobs.

### Selected minimum wage levels and PPP factors

Country	PPP factor	Min annual wage (\$)
Algeria	0.600	\$4,712
Bolivia	0.496	\$2,820
Brazil	0.968	\$4,980
Cambodia	0.385	\$1,746
Cameroon	0.505	\$1,094
China	0.671	\$3,594
Costa Rica	0.600	\$5,469
Eritrea	0.905	\$581
Ethiopia	0.400	\$913
Ghana	0.797	\$1,603
Honduras	0.556	\$3,623
India	0.391	\$1,535
Indonesia	0.700	\$1,788
Kenya	0.543	\$933
Lesotho	0.600	\$2,696
Madagascar	0.465	\$1,008
Malawi	0.400	\$1,005

Mali	0.581	\$1,100
Nepal	0.500	\$2,289
New Caledonia	No data – assumed 1.000	\$20,955
New Zealand	1.172	\$17,875
Nicaragua	0.438	\$2,695
Nigeria	0.583	\$1,609
Panama	0.500	\$4,297
Peru	0.631	\$5,202
South Africa	0.667	\$1,038
Taiwan, Province of China	No data – assumed 1.000	\$7,538
Tanzania, United Republic of	0.387	\$594
Thailand	0.567	\$5,098
Turkey	0.581	\$0,120
Uganda	0.411	\$56
Viet Nam	0.463	\$1,158
Zambia	0.872	\$1,427

The source for the PPP was the World Bank<sup>14</sup>. The source for minimum salaries were multiple, including the minimum-wage.org website.

## POSSIBLE METHODOLOGICAL ENHANCEMENTS

It is recognised that some jobs can just be “better” (e.g. small farmers gaining more independence). If such an impact is material, a variation of the present methodology may need to be developed. For example, it could be possible to apply a factor to the minimum wage to account for various skills identified in different projects.

## LIVELIHOOD OF THE POOR (ACCESS TO AFFORDABLE AND CLEAN ENERGY SERVICES)

### DESCRIPTION OF THE OUTCOME

Access to sustainable sources of clean, reliable and affordable energy can help with multiple development outcomes, from economic activity to the ability to study or communicate. It relates not only to physical

<sup>14</sup> <http://wdi.worldbank.org/table/4.16>

infrastructure (e.g. local PV electricity generation) but also to energy affordability, reliability and commercial viability. It can be as simple as reducing fuel use in cookstoves, which were the type of projects that this outcome was mostly related to.

The introduction of new, cleaner and more affordable energy in communities will improve the livelihoods of local residents by reducing the amount of household expenditure on fuel (typically coal). Where fuel was not purchased but collected (as for firewood gathered from forest accessible to all), the time spent in collecting and transporting the wood could also be valued, whether the time saved is allocated to productive activities or personal development.

## MEASUREMENT INDICATOR

Various projects across the portfolio provide communities with technology that is less costly (or burdensome) to run than that used in the past, and thus can improve their financial position (directly or indirectly by leaving more time for additional activities).

The measurement indicator for cookstove and similar projects was the decrease in money spent on acquiring fuel for the stove. This was usually a direct financial value.

Where the outcome was time savings related, the savings in gathering fuel (firewood), information on time saved and ultimate outcomes achieved by reallocating time to other activities was typically not available. This has therefore only been valued for case studies.

## VALUATION

When the direct value of fuel or electricity is measured, no financial proxy is required, as the market value of these commodities is known and can be used directly in the financial savings calculations.

However, to normalise this value, a conversion taking into account Purchasing Power Parity has been applied to achieve comparison at portfolio level (Geary Khamis method or International dollar).

As mentioned above, when the value / quantity of fuel saved was not available, the benefit was “transferred” from projects in the same region / applying the same technology or an averaged value applied, under the assumption that such projects would deliver similar outcomes.

## POSSIBLE METHODOLOGICAL ENHANCEMENTS

Improvements in the valuation of outcomes can be refined if detailed and robust information can be collected, such as:

- detailed financial savings data for each project, allowing project specific information to replace averages and estimated values;
- detailed estimates of fuel collection time saved, coupled with a survey of what activities time saved was allocated to (or is likely to be allocated to), so that more accurate valuation can be attempted.

## BALANCE OF PAYMENTS

### DESCRIPTION OF THE OUTCOME

Some of the larger renewable energy Gold Standard projects result in macro-economic impacts, in particular improvements in the balance of payments for the country in which they are implemented. This is particularly the case for large-scale renewable energy projects, such as wind and hydro, as an increase in domestic production of energy should mechanically lead to a reduction of the country’s reliance on imports of energy resources.





## MEASUREMENT INDICATOR

The most direct indicator is the quantity of renewable energy produced, assuming that any renewable energy displaces fossil energy.

This information was sourced from the project documentation. By definition, electricity generation is likely to vary over time but to average out in the long run.

## VALUATION

The methodology for calculating the benefits of reduction in required net imports of fossil fuels is a cost avoidance valuation process, using the cost saved as a result of not purchasing fossil fuel imports.

The following valuation process was applied:

1. Collection of data on electricity produced by the project considered
2. Calculation of the fossil fuel equivalent to this electricity production (using conversion factors – see below).
3. Balance of payment impact = total fossil fuel avoided, moderated by the proportion of electricity from this fossil fuel in the country's energy mix, multiplied by the average price of this fuel in the country or region (expressed in \$). To be conservative, only the main fossil fuel was used as a reference.

To legitimize the application of this calculation for each project, a number of assumptions were made for each country where the renewable projects were located, based on evidence of the country's mix of energy (percentage of fossil fuel in energy mix), and dependence on fossil fuel imports (see below).

## ASSUMPTIONS

The baseline data and assumptions for the main countries in which the projects in the Gold Standard portfolio are located are outlined below, as well as the main energy conversion factors.

## Conversion factors

- Coal conversion: 1 kWh = 0.000123 tonne of coal
- Natural gas conversion: 1 kWh = 0.00341 Million BTU
- 1 MMBTU = 28.32 cubic meters

## Turkey

- **Fossil fuel use in electricity generation:** 55% of electricity production is from natural gas generators (U.S. Energy Information Administration, 2013).
- **Reliance on fossil fuel imports:** Turkey is particularly reliant on fossil fuel imports, with 73% of its energy use in 2012 imported (World Bank, 2013). In 2012, Turkey consumed 45.3 billion cubic metres of natural gas, of this 98.6% was imported. (IEA, 2013)<sup>15</sup>
- **Gas price:** 400\$ per thousand cubic meter (estimate average Russia and Iran)<sup>16</sup>

Therefore, an assumption for renewable projects in Turkey is that the increase availability of renewable energy will offset the requirement to import natural gas. Therefore natural gas is used to price the balance of payment benefit.

## China

- **Fossil fuel use in electricity generation:** 66% of China's electricity installed capacity are coal fired generators.
- **Reliance on fossil fuel imports:** China's reliance on imports for energy generation is increasing. In 2009, percentage energy use in China from energy imports was 8%, however, this rose to 11% in 2011 (World Bank, 2013). China became the largest importer of coal in 2011, even though coal imports make up only 5% of the domestic supply. (IEA, n.d.)<sup>17</sup>.
- **Coal price (\$US/t):** \$80<sup>18</sup>.

<sup>15</sup> <http://www.iea.org/publications/freepublications/publication/name,38110,en.html>

<sup>16</sup> <http://www.naturalgaseurope.com/turkish-gas-sector>

<sup>17</sup> <http://www.iea.org/aboutus/faqs/coal/>

<sup>18</sup> <http://www.platts.com/latest-news/coal/singapore/falling-chinese-domestic-thermal-coal-prices-26594785>

Therefore, our assumption for renewable projects in China is that the increased availability of renewable energy will offset the requirement to import coal. Therefore coal is used to price the balance of payment benefit.

## Nicaragua

- **Fossil fuel use in electricity generation:** Approximately 49% of Nicaragua's electricity production was from fossil fuels in 2013 (Agencia EFE, 2014). Of this, Nicaragua has a higher proportion of thermal oil based electricity production.
- **Reliance on fossil fuel imports:** Nicaragua's percentage of energy use from energy imports is approximately 50% (World Bank, 2013). Nicaragua imported approximately 560 kt oil equivalent oil products for electricity production in 2011 (IEA, 2011). Oil products are the main source of fossil fuel for electricity production.<sup>19</sup>
- **Oil price (per barrel):** \$105.87 (OPEC 2013 average)

Therefore, our assumption for renewable projects in Nicaragua is that increase availability of renewable energy will offset the requirement to import oil. Therefore oil price is used to price the balance of payment benefit.

New Zealand (gas: 20%), New Caledonia (coal and fuel) and Taiwan (coal and gas) were the three other countries where such projects took place, that also required similar assumptions to be made.

<sup>19</sup> <http://www.iea.org/Sankey/index.html#c=Nicaragua&s=Balance>

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