Renewable Energy Manual

Understanding Carbon Emission Reductions

A Guide for Energy Entrepreneurs

USAID

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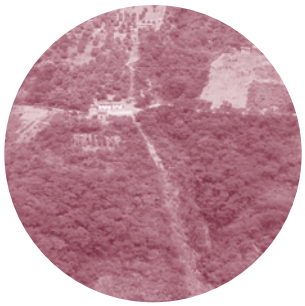

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UNDERSTANDING CARBON EMISSION REDUCTIONS

A Manual for Energy Entrepreneurs

Renewable energy projects reduce the amount of carbon being added to the global environment. This document describes the causes and consequences of carbon additions, the benefits of carbon emission reductions and how to estimate and document the carbon impact of renewable energy projects. Further, it describes how to summarize and present such a project to entities with social, environmental or financial interests.

I. SOURCES OF GREENHOUSE GASES AND CARBON EMISSION REDUCTIONS

The Earth's greenhouse effect is a natural phenomenon that helps regulate the temperature of the planet. The sun heats the Earth and some of this heat, rather than escaping back to space, is trapped in the Earth's atmosphere by clouds and so-called greenhouse gases, such as water vapor and carbon dioxide.

If greenhouse gases were to suddenly disappear from the Earth's atmosphere, our planet would be 60ºF (15.5 ºC) colder and uninhabitable for humans.

Conversely, increases in the amount of greenhouse gas raise the temperature of the planet, because too much heat is trapped in the atmosphere. It is these increases – and especially the increases that are the result of human activity -- that have been the focus of scientists and policymakers for over a decade.

Human activities -- the production of energy, cutting down trees and growing certain agricultural products -- impact the amount of greenhouse gases (GHGs) in the Earth's atmosphere. Atmospheric measurements of greenhouse gas concentrations have indicated that since the 1860s, important increases have taken place in carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride (SF_6).

Since pre-industrial times atmospheric concentrations of CO_2, CH_4, and N_2O (carbon dioxide, methane and nitrous oxide) have climbed over 30%, 145% and 15% respectively. Over roughly the same period, average world surface temperatures have risen by 0.3-0.6ºC. The Intergovernmental Panel on Climate Change (IPCC) states that, assuming no action is taken to reduce emissions, computer models of the earth's climate indicate that global average surface temperatures may rise by 1.5-4.5ºC over the next 100 years. Provides information on the increasing production of carbon dioxide and increasing global temperatures.

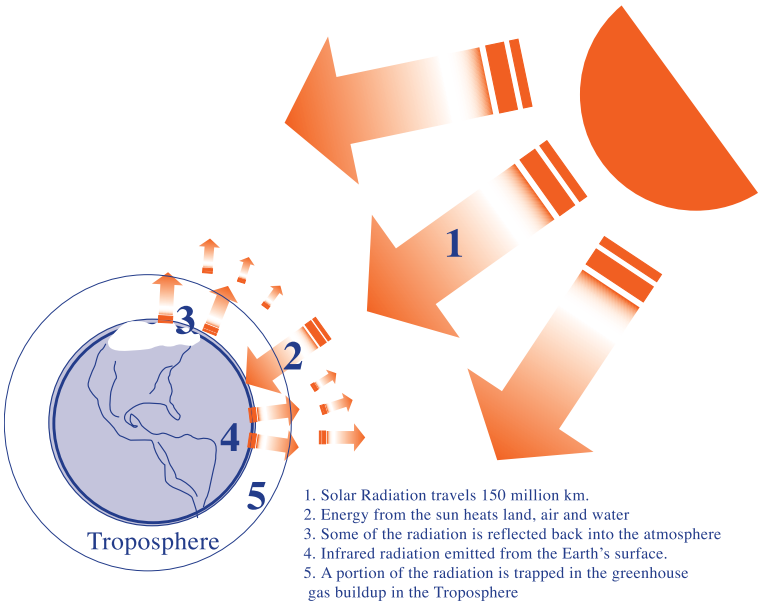


Figure 1. Greenhouse Effect

Many greenhouse gas-emitting activities are now essential to the global economy and form a fundamental part of modern life. If emissions from these activities continue to increase, the planet will be warmer in the future. Increasing the average temperature of the planet by merely a few degrees may seem inconsequential but these slight increases lead to more pollution and disrupted weather patterns. In turn, these changes affect people's health, damage agricultural products, deplete the water supply and result in rising sea levels which threaten low-lying coastal areas and small islands.

Mankind impacts greenhouse gas emissions by increasing processes that produce GHGs and by shrinking the processes that remove GHGs. Fossil fuels are the largest single source of greenhouse gas emissions from human activities. As oil, natural gas, and coal have increasingly been used to produce electricity, run engines, heat houses and power factories, large amounts of greenhouse gases have been added to the atmosphere. Most emissions associated with energy use result when fossil fuels are burned. The supply and use of fossil fuels accounts for about three-quarters of mankind's carbon dioxide (CO_2) emissions.

Deforestation is the second largest source of carbon dioxide. When forests are cleared for agriculture or development, most of the carbon in the burned or decomposing trees escapes to the atmosphere. However, when new forests are planted, the growing trees absorb carbon dioxide, removing it from the atmosphere. There is a great deal of scientific uncertainty about emissions from deforestation, but it is estimated that approximately 600 million to 2.6 billion tons of carbon are released globally every year.

Producing lime (calcium oxide) to make cement contributes to CO_2 emissions from industrial sources. The carbon dioxide released during cement production is derived from limestone and is thus of fossil origin. In this way it is similar to fossil fuel emissions.

Extracting, processing, transporting, and distributing fossil fuels also releases greenhouse gases. These releases can be deliberate, as when natural gas is flared or vented from oil wells, emitting mostly carbon dioxide and methane. Releases can also result from accidents, poor maintenance, and small leaks in well heads, pipe fittings, and pipelines.

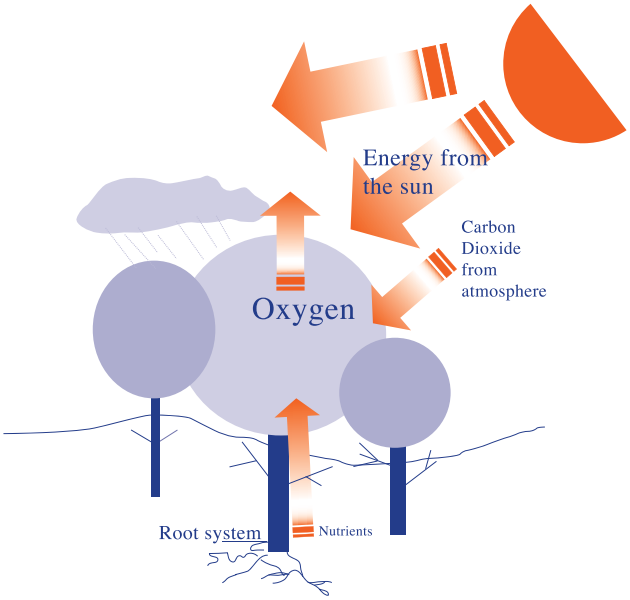


Figure 2. Photosynthesis

Domesticated animals emit or produce methane, the second-most important greenhouse gas after carbon dioxide. Cattle, dairy cows, buffalo, goats, sheep, camels, pigs, and horses also produce methane. Most livestock-related methane emissions are produced by "enteric fermentation" of food by bacteria and other microbes in the animals' digestive tracts; another source is the decomposition of animal manure. Livestock account for about one-quarter of the methane emissions, totaling some 100 million tons a year.

Rice cultivation also releases methane. "Wetland" or "paddy" rice farming produces roughly one-fifth to one-quarter of global methane emissions from human activities. Accounting for over 90 percent of all rice production, wetland rice is grown in fields that are flooded or irrigated for much of the growing season. Bacteria and other micro-organisms in the soil of the flooded rice paddy decompose organic matter and produce methane.

Disposal and treatment of garbage and human wastes affect greenhouse gas concentrations. When garbage is buried in a landfill, it sooner or later undergoes anaerobic (oxygen-free) decomposition and emits methane (and some carbon dioxide). This source of methane is more common near cities, where garbage from many homes is brought to a central landfill. Garbage emits methane into the atmosphere unless the gas generated is captured and used as a fuel. Methane is also emitted when human waste (sewage) is treated.

Carbon dioxide is naturally removed from the atmosphere by a complex network of natural sinks that include the oceans and the Earth's soils. Most estimates suggest that about one-third of the CO_2 being released at present is absorbed by the oceans. In addition, green plants remove (i.e., sequester) carbon from the atmosphere through photosynthesis. This process involves extracting carbon dioxide from the air, separating the carbon atom from the oxygen atoms, returning oxygen to the atmosphere and using the

Hydroelectric Project, Brazil

carbon to make biomass in the form of roots, stems and foliage. This process is commonly referred to as "carbon sequestration", indicating it is a natural process that removes carbon dioxide from the atmosphere and stores it in the soil.

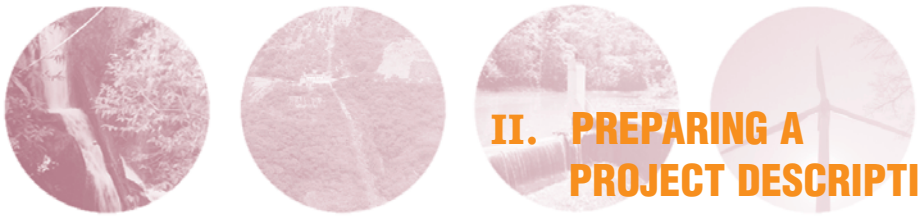
Learning about greenhouse gases, carbon sequestration, and the impact of human activities on the Earth's climate is important because renewable energy projects can potentially reduce the amount of Green House Gases (GHG) emissions released to the atmosphere.

By utilizing renewable sources of fuel such as water, sun, biomass or wind to produce energy, the amount of fossil fuels being burned can generally be reduced in the country where a project is taking place. Thus, the total quantity of greenhouse gases released to the global atmosphere is reduced. Therefore, individual renewable energy projects have a positive impact on both the local and global environment.

Reductions in greenhouse gas emissions from renewable energy projects are known as carbon emission reductions or CERs. These reductions represent an important value-added component of renewable energy versus conventional (i.e., fossil-fueled) energy projects. It therefore makes sense for project developers to understand the extent of the carbon emission reduction (CER) impact of their projects.

The process of estimating and documenting carbon emission reductions can be divided into four manageable steps:

- Preparing a Project Description.
- Estimating Carbon Emission Baselines.
- Estimating Project Carbon Emission Impacts.
- Preparing and Implementing a Plan to Monitor, Verify and Document Project Impacts.



II. PREPARING A PROJECT DESCRIPTION

In this first step an entrepreneur wants to determine two things. First, does the proposed renewable energy project offer significant potential for carbon emission reductions? It turns out that some renewable energy technologies have greater CER benefits than others. As a result, entrepreneurs need to know how much effort to expend and the level of detail necessary when estimating carbon emission reductions. This results in a simple screening process.

The second step is for the entrepreneur to determine what information should be captured in a project description if the CER screening effort indicates that significant CER potential exists.

There is a certain hierarchy among renewable energy projects. Projects that capture landfill methane have far greater impact than projects that distribute solar home systems to households[1]. Projects using waste biomass as fuel (e.g., bagasse from sugar cane) tend to produce greater CO_2 emissions than wind projects Renewable energy projects are unique and may have tremendous CER benefits because of the local setting. For example, a wind project in a country dominated by a coal and liquid fossil fuel mix has more impact than one in a country with an energy mix dominated by natural gas, which is a cleaner fuel.

Most of the required information for a project description should be readily available to an entrepreneur. It is the same type of information needed to present a project to potential partners, government approval and permitting bodies, financial institutions and contractors. See Table 1

Box 1
Relative Carbon Emission Reduction Benefits - Various Renewable Energy Technologies

- Methane / Biogas
- Fuel Switching
- Waste
- Biomass
- Hydroelectricity
- Wind
- Solar

Table 1: Project Screening Checklist

- Project Location: Country, Locality
- Name of Project
- Name of Developer or Project Sponsor
- Contact Information: Name, Address, Phone, Fax, E-mail
- Type of Project and Technology(ies) Employed
- Size, Estimated Inputs and Outputs of the Project
- Customer(s) for Output
- Current Status of Project
- Current Status of Required Approvals and Permits and Projected Completion Dates
- Projected Commencement of Construction
- Projected Commencement of Operations
- Estimated Total Cost
- Financing Plan
- Status of Financing
- Environmental Impacts (positive and negative)
- Social and Community Impacts (positive and negative)

[1] *Methane (CH_4) has twenty times the greenhouse gas impact per unit (e.g., metric ton) than the same amount of CO_2*

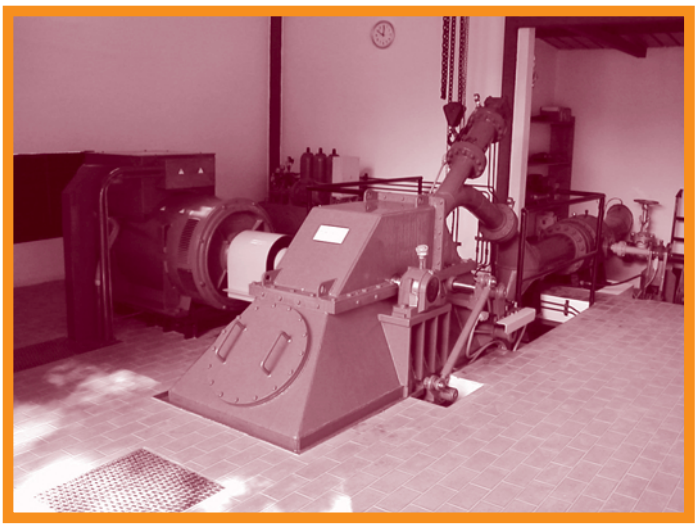
The project description need not be overly elaborate, as the following sample demonstrates.

Sample of a Project Description

Name and Detailed Location of Proposed Project: (insert information)
Developer(s) Name(s) and Detailed Contact Information: (insert information)
Date: (insert date)

The proposed hydropower project will have an installed capacity of 3,500 kilowatts (kW) and will be comprised of a water diversion structure, penstock, powerhouse and interconnection to the national grid. The distance water falls ("head") is 550 meters and its design flow is 0.9 cubic meters per second. A feasibility study was completed on (date) by (name of firm), which led to the development of a detailed business and investment plan. The total cost of the project including financing is US$5.2 million, expected to be financed with US$3.7 million of term debt (10 years, 9% annual interest, all dollar denominated) and US$1.5 million of owner's equity.

The project will generate 19,040,000 kilowatt-hours (kWh) of electricity, comprised of peak hour sales at 3,500 kW and lesser hourly amounts off-peak, which optimizes revenue and results in an average price of US$0.06 per kWh. The project will require twelve months to construct. With construction financing forecasted to be approved on (date) by (name of lender), construction can commence on (date) and operations commence on (date). Confirmation of construction financing approval is the only substantial item to be completed prior to commencement of construction. Construction will be undertaken by (name), general contractor and supervised by (name), owner's engineer. The project will be operated by (name of firm). Required local and national permits and contracts – environmental impact, power sales, construction and interconnection – have all been obtained. These include (list them).



Hydroelectric Turbine, La Nieve Project, Honduras

III. ESTIMATING CARBON EMISSION BASELINES

The aforementioned description provides basic information about the project but lacks information about the carbon reduction potential of this project or the national context of where the project is proposed. This national context is called a "baseline".

Baselines are the "estimates" as to what would occur in the absence of a proposed project. These "baselines" are a snapshot of a country's present and anticipated energy scene and are used to determine whether a project makes an additional contribution to carbon reduction. Baselines are necessary as a frame of reference in quantifying carbon emission reduction units (generally measured in metric tons – of carbon dioxide, abbreviated CO_2 or CO_2e) from a greenhouse gas reduction project.

There is no single precise baseline for a country. A country's energy "mix"[2] changes as energy projects are added and subtracted from its national capacity. These units of capacity are utilized differently from year-to-year, so even if the capacity mix remains unchanged its utilization will tend to vary.

Further complicating the issue, a baseline for a renewable energy project can be estimated a number of different ways.

For the purposes of this manual, a simple methodology will be followed that will allow an energy entrepreneur to produce a rough estimate that is of sufficient quality to determine the potential impact of a proposed project. This rough estimate uses readily available information on how a country presently produces its energy. For these purposes we will examine nine countries: Belize, Brazil, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, Panama and South Africa, using a two step process.

Step 1: Determine the relative mix of thermal (fossil fuel) energy to the total energy in a country

By going to an energy information website such as www.eia.doe.gov/iea, one can access useful data on electricity generation for each country. Table 2 presents information that is important for a few reasons. Column 1 indicates the total amount of electricity generated (in billions of kilowatt-hours) by year; column 2 indicates the amount of electricity that is generated from thermal sources (e.g., fuel oil, diesel oil, coal). By combining this information it is possible to determine the approximate percentage of the country's fuel mix that is attributable to greenhouse gas emissions.

Table 2: Electricity Data

Country	*Column 1* Total Electricity Billions kWh	*Column 2* From Thermal Billions kWh	Percent GHG Producing
Belize	0.199	0.100	50.3
Brazil	321.165	26.600	8.3
Costa Rica	6.839	0.100	1.5
El Salvador	3.729	1.600	42.9
Guatemala	6.237	3.200	51.3
Honduras	3.778	1.900	50.3
Nicaragua	2.549	2.100	82.4
Panama	4.039	1.500	37.1
South Africa	195.640	182.900	93.5

[2] *A country's energy mix is the relative contribution of different fuels used to produce its electrticity: coal, oil, natural gas, hydro wind, etc.*

What does this rough analysis demonstrate? First, that there are wide variations among countries concerning how energy is generated. Second, certain countries are more (South Africa) or less (Costa Rica) dependent on fossil fuels. Thus, a greenhouse gas reduction project will appear to have proportionately more impact in a country such as South Africa than it will have in Costa Rica. Therein lies the importance of determining the baseline of the country where a project is proposed because the national greenhouse gas impact can vary greatly (even though the global impact of every tonne of CO_2 is the same).

Step 2: Determine the average GHG impact of the fossil fuel (non-renewable) portion of the energy mix

This is a more technical analysis and requires having information on the different components of the energy system and their performance (load factors). It also requires knowing the relative contributions that each of these technologies makes in terms of greenhouse gas emissions.

Each MWh produced by the different fuels results in a different greenhouse gas emission. In the case of fossil fuels (other than natural gas) this varies between 0.6 metric tons (for diesel/combined cycle) and 1.0 tons (for coal) for every MWh[3] of electricity produced from these fuels. For natural gas, the number is closer to 0.6 tons per MWh. Since 93.5% of the MWh produced in South Africa comes from fossil fuels, then every MWh of energy produced averages between 0.841 and 0.935 tons of CO_2e (93.5%* .9 tons per MWh; 93.5%*1 ton per MWh). This simple calculation constitutes the roughest of all baseline estimates for South Africa and is enough for an entrepreneur to realize that greenhouse gas reduction projects will have significant impact in South Africa. This is true because such a large portion of its energy mix is from fossil fuels.

However, the utility of this approach declines in countries where fossil fuel is not dominant. Why? Because the generally accepted methodology calculates the GHG impact of the energy mix excluding renewable sources. Thus, in a country where renewable energy plays a larger role – e.g., Guatemala and Costa Rica – a quick analysis such as that for South Africa understates the baseline.

In the case of Guatemala, fifty-one percent of its electricity comes from fossil fuels in the baseline year (2001), according to recently available data on the US DOE website (www.eia.doe.gov/iea). This fossil fuel usage translates to a contribution of between 0.328 and 0.503 tons of CO_2e per MWh of electricity generated,

Table 3: Analysis of the Contribution of a Renewable Energy project in Guatemala

FUEL	A % of all fuel	B % of total fossil fuel usage	C Tons CO_2 per MWh	D (=A*C) Average CO_2 Contribution based on all fuels	E (=B*C) Average CO_2 Contribution based on non-renewables
NATURAL GAS gas turbines	20.5	39.8	0.644	0.132	0.256
DIESEL – gas turbine	20.0	38.8	0.895	0.179	0.347
COAL	11.0	21.4	0.987	0.108	0.211
	51.5%	**100%**	**Total**	**0.419**	**0.814**

[3] *Megawatt-hour, abbreviated MWh, is a million watt hours. A 60 watt household light bulb burning for one hour uses 60 watt hours. One thousand such light bulbs burning for one hour use 60,000 watt-hours or 60 kilowatt-hours (abbreviated kWh). If these one thousand light bulbs (each using 60 watts) burned not for one hour but for 17 hours, the electricity consumed would be slightly more than 1,000,000 watt hours or 1000 kilowatt-hours or 1 Megawatt-hour. 60w*1000 light bulbs*17 hours = 1,020,000 watt-hours = 1020 kWh = 1.02MWh*

if total energy rather than just non-renewable energy is used as the base. This understates the contribution a renewable energy project would make. When only non-renewable sources are analyzed, the contribution from these sources translates to over 0.8 tons per MWh. Table 3 sets forth this analysis.

Similarly, Costa Rica is a country with the vast majority of its electricity coming from hydropower—a source of energy with no associated greenhouse gas emissions. Since 98.5% of Costa Rica's electricity is from hydropower, then each MWh of electricity produced yields between 0.014 and 0.015 tons of CO_2e. When adjusted for the non-renewable operations only, the result is ten times greater.

Table 4 reflects a reasonable estimate of the baseline conditions in nine countries. It is of sufficient quality to serve the purposes of most small renewable energy projects (roughly any project below 15 MW installed capacity).

For each country, the figure below represents the metric tons of CO_2e of each MWh of electricity produced. Using a formula established by EcoSecurities[4], it is derived by calculating the weighted average of the fossil fuel sources in the country's operating energy mix and applying the appropriate carbon emissions factor for each source.

Table 4: Baseline Estimates

Country	Tons of CO_2e per MWh
Belize	0.759
Brazil	0.642
Costa Rica	0.128
El Salvador	0.514
Guatemala	0.820
Honduras	0.662
Nicaragua	0.739
Panama	0.688
South Africa	0.911

***NOTE** - the preceding Table 4 is adequate for the energy entrepreneur to make a rough estimate of the GHG benefits of a proposed project. It will also serve for initial presentation to bankers and other interested parties. However, there are circumstances where social, environmental and financial investors may seek a greater level of detail and precision with respect to baseline data. This section illustrates the steps for such a calculation. It is intentionally hypothetical because it is important that such detailed calculations reflect information that is current at the time it is presented. Some entrepreneurs will be able to prepare such a detailed presentation; others will need specialized assistance.*

Towards Greater Precision - Illustrative and Hypothetical Calculation

To arrive at current baseline estimates, it is necessary to determine the details of a country's present fuel mix. This entails contacting both the utilities in the country and the responsible government agencies. From the same sources, the proposed additions to the system in the immediate years ahead can be determined. This last piece of information is important because it may increase the estimate of the GHG contribution of the proposed project.

Consider, for example, a renewable energy project in a country where power generation comes from natural gas, diesel fuel, coal and large hydroelectric plants. Two pieces of data are needed to determine the GHG contribution from fossil fuel (non-renewable sources), the percentage distribution of each type of fuel (on an output basis, e.g., MWh) and the respective carbon emission burden of each fuel type. The GHG contribution from fossil fuel is also called the operating impact or operating margin.

[4] *EcoSecurities is a leading advisory firm that focuses on greenhouse gas and clean energy markets by assisting project developers and small business owners worldwide in capital raising, trading emissions credit, market analysis and risk mitigation.*

While it may require some effort, the percentage distribution among fuels is available in each country (utilities, ministries and specialized offices) and through other regional resources. In this illustrative example, the following distribution is used: 20.5% of the power comes from natural gas, 20% from diesel, 11% from coal and 48.5% from large hydro and other renewable energy sources. This translates to an average fossil fuel GHG contribution / operating margin of 0.814 tons per MWh (see Table 3). This is obtained by combining the data concerning the energy mix with the data on the amount of CO_2e for every MWh by Fuel (Box 2).

However, in the course of determining the preceding information you may also learn that the next proposed fossil fuel additions to the system all involve diesel gas turbines.

Since diesel gas turbines contribute 0.895 tons of CO_2e for every MWh of electricity produced it can be argued that the proposed renewable energy project is saving 0.895 tons of CO_2e for each MWh (this is called the marginal impact or build margin) rather than the 0.814 tons saved when calculating the operating impact or operating margin. However, since the build margin number (0.895 tons of CO_2e) may overstate the benefit of the proposed project, generally these two numbers (the operating margin and the build margin) are combined and averaged.

Thus, when looking at GHG benefits of a proposed project at least three conclusions are relevant:

- The marginal impact/build margin = the avoided new fossil fuel additions = 0.895 tons of CO_2e per MWh in our example because new diesel fueled gas turbines are avoided.
- The operating impact/operating margin = the GHG emissions of operating fossil fuel sources (non-renewable sources) = 0.814 tons of CO_2e per MWh, based on the mix of natural gas, diesel and coal.
- The average of these two numbers, called the average baseline = 0.855 tons of CO_2e, reflects the potential impact of the proposed project on both existing and future conditions.

Box 2
Tons CO_2e per MWh by Fuel

Diesel
Combined cycle = 0.605
Gas turbine = 0.895
Steam turbine = 0.735
Combustion turbine = 0.845
Coal
Conventional steam = 0.987
Natural Gas
Gas turbine = 0.644
Combined cycle = 0.406
Hydro = 0.000

(EM Model for Electricity Production, Oko Institute, 1998)

IV. ESTIMATING PROJECT CARBON EMISSION IMPACTS

Thus far we have described our proposed GHG reduction project located in Guatemala and determined the illustrative carbon emissions setting. What is being considered is a 3,500 kW (3.5 MW) hydroelectricity project in a country where the average fossil fuel energy mix (a combination of natural gas, diesel and coal) produces 0.814 tons of carbon dioxide equivalent (CO_2e) for every MWh produced and where the marginal impact is 0.895 tons of CO_2e per MWh.

What are the expected carbon emissions of the proposed 3,500 kW project? We begin by calculating the MWh output of the proposal. Sometimes this is a straightforward calculation like this:

> *"The proposed project will operate at capacity 62% of the time. There are 8,760 hours in a year (24*365), so the project will produce 3.5MW*62%*8760 MWh, which equals 19,040 MWh.".*

In reality, projects tend to be optimized to produce the maximum revenue; thus a reservoir will collect and hold water, which will be used during peak hours, then recharged off-peak while selling electricity produced at "run-of-river" rates during that time. The answer is the same 19,040 MWh but the revenue is substantially more because 5,100 MWh (27%) is sold in the peak four hours (17%) when the highest price is paid.

Hydroelectricity produces zero carbon emissions. Thus it can be argued that our proposed project improves the average fossil fuel carbon emission profile of the country by 15,500 tons of CO_2e per year (0.814*19,040) or 155,000 tons over the first ten years of the project.

However, we know there is a second way to look at the baseline and the impact of a proposed project. Instead of looking at the operating margin, we could determine the planned additions to the country's energy system during the timeframe of our proposed project. If, for example, the next three additions to the system all involve diesel fuel the potential impact of our project could be argued to be greater than the average benefit of 15,500 tons of CO_2e per year. Since diesel fuel generates almost 0.9 tons of CO_2e per MWh (0.895 tons) the construction and operation of our project may improve the system's performance on the margin by 17,041 tons per year (0.895*19,040) or 170,410 over its first ten years. This 9.7% increase in the impact of the proposed project may overstate its benefits, however, so it is general practice to average the operating margin and the build margin. In this case that equals 0.855 tons of CO_2e per MWh (16,250 tons per year or 162,500 over ten years), almost a 5% increase over the operating margin. Such an increase may have substantial weight in the review, approval and evaluation of the contribution of a project.

Biomass Project, Thailand.

V. PREPARING AND IMPLEMENTING A PLAN TO MONITOR, VERIFY AND DOCUMENT PROJECT IMPACTS

People and institutions that place a value on the carbon benefit estimate need to know how this estimate will be tracked as the project rolls out. Monitoring refers to the activities through which data is collected and recorded to support the assessment of the carbon emission reductions of the proposed project. Verification refers to an independent review of the monitored carbon emission reduction data.

A plan to monitor a project's carbon emission reductions must focus on the expected outputs from the project and may also focus on the baseline projections.

For renewable energy projects the important information is derived from the original assessment of the project's output and impact. If the project's estimated carbon reduction is based on MWh of energy produced and provided to the national electricity grid, then a monitoring plan must be developed that assures that this information is collected and recorded. For example, the project developer can propose to maintain daily records of electricity generation by the proposed project as measured by the project's output to the national grid and wholesale market. These records could be maintained in writing or electronically and kept for ten years. In reality this record keeping does not represent additional effort; this is the very information a developer maintains and checks to assure that payment from the national grid is accurate. A monitoring plan focused on a project's output, to compare to original project estimates against a static baseline, can be realistically presented in a brief table (see Box 3).

It may be desired, however, to not only maintain records of the project's performance but also to track its baseline. If a baseline evolves to be more carbon intensive, then the benefits of the project exceed the original forecast. The opposite is, of course, also true. This information would most likely involve the same type of data collected for the project but from a wider source. Thus, if the information to be collected is the MWh of the national electricity system on a daily basis by fuel mix (as this constitutes the original baseline), then a primary source of such information needs to be identified and records maintained on a regular basis. Most likely, this would involve the daily or periodic compilation of energy purchased and distributed by the national grid (often referred to as the Wholesale Market Administrator or similar term). A project's monitoring plan could specify the collection and retention of this information in parallel with the collection of project specific data.

Box 3
Essential Ingredients of a Monitoring Plan

- Type of Data: MWh delivered
- Source: measured output delivered to national grid
- Frequency of Collection: Daily
- Data to be Saved: Electronically for ten years
- Location of Data: Project administrative offices, with back-up copy retained by project auditors
- Responsible Party: Name and contact information

As noted, verification involves an independent review of the information collected and recorded. If such verification is desired, the project developer needs to retain a third party – much in the way an independent auditor is retained to present financial statements. This third party contractor will examine the system of data collection and retention and offer an opinion on the accuracy of the information gathered.

Implementing a plan to monitor and verify carbon emission reductions is no different than implementing any other important dimension of a project's operations. For example, a project incurs debt for construction. It must implement an accounting and recordkeeping (monitoring) plan for that information to organize periodic reporting and independent examination of the project's financial performance (audited statements). While carbon reduction represents a new dimension of project operations, it is quite similar to well established record keeping and reporting requirements.

VI. ADDING A FINANCIAL PRESENTATION

Thus far the emphasis in this document has been on describing the physical and greenhouse gas characteristics of a project and its setting. Having completed that body of work, it is important for the entrepreneur to synthesize the information in a way that properly presents the project's physical, institutional and environmental characteristics. To make such a presentation complete, it should include a financial presentation regarding the project. That way the final "Project Information Summary" will have a broad appeal to anyone who may have social, environmental or financial interests in the project's success.

A financial presentation typically has the following parts:

- Overview and Conclusions
- Financial Projections
- Construction Costs
- Operational Revenues
- Financial and Operational Costs

Overview and Conclusions

The purpose of this section is to demonstrate the project's financial feasibility based on its ability to meet its obligations to lenders and to produce required returns to equity investors (owners), considering several different scenarios. In a straightforward manner this section should describe why the project appears feasible from a technical, legal, environmental, social and market perspective. It is here that the "Base Case" financial results of the project are set forth. It is equally important to set forth the critical issues still in progress; for example, the status of construction financing still being negotiated and any other issues critical to the commencement of the project.

Financial Projections

The financial projections developed by management should be shown in some level of detail (explanatory notes can be added and are helpful). Showing ten years of what are detailed cash flow projections covering a 20-year period makes sense (five years does not present enough of a picture and twenty years clutters the pages). These projections are then supplemented with credit statistics typically important to lenders and others. Entrepreneurs should familiarize themselves with terms and ratios used in financial analysis (e.g., EBITDA = earnings before interest, taxes, depreciation and amortization).

Construction Costs

Much of a project's credibility rests on the thoroughness of its construction cost estimate. These are usually substantiated in a detailed feasibility study prepared by a professional engineering firm. This body of work, and any updates, should be cited in a description that covers such matters appropriate to the type of project. In this case – a hydroelectric project – this would include such categories as Civil and Structural; Diversion Dam; Penstock; Powerhouse; Mechanical & Electrical Equipment; Turbine & Generator; Transmission Line & Interconnection System; and, Indirect Costs (explained in detail).

Operational Revenues

Revenues from operations need to be described in some detail and summarized. Like construction costs, these represent a critical credibility test. References to detailed studies (e.g., Watershed Comparison Analysis and Energy Analysis) performed as parts of the Feasibility Study are very important. Topics to be described include Installed Capacity and Energy

Estimates; Electricity Production Estimates; Energy Sales Revenue Estimates; Other Revenue / Byproducts Estimates. These should be summarized in a table unless the summary financials already present sufficient detail.

Financial and Operational Costs

The last category to be explained involves the financial and operating costs of a project. These begin with a brief description of the financing plan ("A capital structure composed of approximately 71% debt and 29% equity has been assumed, with a yearly debt interest rate of 9% assumed for both the construction and long term, 10 year, financing.") followed by an explanation of Interest During Construction; Interest on the Permanent Financing; Financing Fees; Existing Loans and Obligations; Costs Related to Annual Electricity Production and Transmission; Operating and Maintenance Expenses, including provision for Major Replacements; Insurance; and, Administrative Costs. This section should also set forth the details of tax obligations and assumptions used in important calculations.

La Castalia Hydroelectric Project, Guatemala

VII. PROJECT INFORMATION SUMMARY

To obtain a rough estimate of the potential carbon benefits of a proposed project is a relatively straightforward process. Refining that estimate, though involving more work, is relatively easy with access to country specific current information. Putting it together in a way that may be of interest to social, environmental and financial parties involves combining a clear project description with carbon emission baseline data and estimated benefits and rounding the presentation out by presenting the significant financial features of the proposed project. The resulting document may only be 10 pages but its value – both in informing third parties regarding the project and in guiding the entrepreneur about next steps – may be far greater.

Sample - Project Information Summary

Part 1 – Project Description

Part 2 – Carbon Emission Reduction Baseline and Projected Savings

Part 3 – Financial

Part 1 – Project Description

Name and Detailed Location of Project:
(insert information)

Developer(s) and Detailed Contact Information:
(insert information)

The *Project*, with a planned installed capacity of 3,500 kW located in Guatemala, is an independent hydroelectric power plant. The *Project* will consist of a water diversion structure, a penstock, a powerhouse and the transmission interconnection to the national grid system and/or to a private distribution company, most likely (Name), which is the concessionaire for the area in which the *Project* is located.

The gross power head (distance of fall) for the *Project* is approximately 550 meters and the design flow is 0.9 cubic meters per second (m^3/s). The plant will also benefit from additional storage capacity from a new diversion dam located upstream, on the (Name of River).

The *Project* site (with an altitude ranging from 794 to 1342 meters above sea level) is located on in the buffer zone of the Biosphere Reserve; within this protected area, the *Project* meets all the regulations, given its limited environmental impact.

The *Project* will generate and sell electricity from a renewable energy source, in order to meet the growing local electricity demand. The *Project*'s construction will also stimulate the local economy and its operation will provide new ongoing employment.

Insert here the details regarding the sponsor's credentials and the professional work (e.g., independent feasibility studies) completed on the project.

Construction, operation and maintenance of the plant will be contracted to third parties through a competitive bidding process. Once construction financing is secured, the final construction designs for the *Project* could be completed in 3 to 4 months. The construction of the *Project* could then begin as early as the first/second quarter of (Year) with the *Project* in operation one year later.

The *Project* specifically and hydroelectric generation generally possess several important positive characteristics.

- After *Project* completion extremely low operating costs and maintenance capital expenditure requirements create an attractive high cash flow margin;
- Absence of detrimental environmental impacts such as air pollution;

- Ability to rapidly bring generation online and offline (in comparison with thermal plants, which require significant time to warm up) and to store energy in a reservoir, allowing generation to be skewed toward peak times;

- Ability to obtain other revenues and incentives, given that the energy is generated from a renewable source and that the national generation matrix is substantially based on thermoelectric power.

According to the base case financial projections, the *Project* shows strong financial characteristics, both in terms of credit statistics as well as returns to equity investors.

The *Project* benefits from the fact that it is expected to sell 4 hours of peak dependable capacity per day.

On the technical side, the *Project* shows favorable characteristics such as attractive geographic and topographic characteristics, including a head of 550 meters and a design flow of 0.9m^3/s and existing infrastructure that can be leveraged to reduce construction costs, such as existing road infrastructure.

The *Project* will result in significant social benefits. It will stimulate the local economy during the construction period and will provide new employment during operation periods. Furthermore, with additional electrical generation in the region, the agricultural support industries could expand, such as packaging and refrigeration for the fruits and vegetables grown in the fertile valley area. Housing and industrial park projects could also be developed that will enhance the area. The *Project* will also seek to benefit from the fact that it is a rural energy service company, which could attract local and multilateral investors and institutions that fund renewable energy projects in rural areas, where a substantial social impact can result.

The demand for electricity shows attractive growth prospects over the next decade. This trend is explained not only due to the normal demographic growth, but also due to the significant extension of grid coverage that has taken place by the distribution companies. Recent growth of consumption has been in the range of 8.9% per year and is projected to grow at a constant average growth rate of 5.5% between 2002 and 2015. Recent projections of the demand for capacity and energy are presented in the (Name of National Study and Authoritative Body). The average, but probable scenario shows rates of growth during the period 2000 to 2004, with an average increase in the need for capacity of 7.7% and an average increase in the need for energy of 8.0%. Rates decrease until they reach a value near 5.0% in the year 2010 in both variables.

Impacts during project construction will be located near the dam, penstock and powerhouse sites. Potential impacts during operation will remain in those areas, but could also affect the river segment between the dam site and powerhouse site.

The *Project* perimeter reaches the (Name) Village. The *Project* will improve the water supply system for this town. The existing system provides piped water, which is unreliable because of continued changes in river flow and frequent pipe clogging from debris. The *Project* will provide a reliable water system with constant pressure.

Land characteristics vary in the various sub-regions of the *Project* area. At the dam site, which embraces part of buffer zone, there are dense forests and dispersed coniferous trees on steep slopes and rocky outcrops. At the area where the penstock and powerhouse will be located, there are bushes, pastures and dispersed coniferous growth.

There is no loss of water, from the dam site to the powerhouse site, as no irrigation areas or other uses exist. However, upstream from the proposed powerhouse site, there is a water collecting system to supply a farm. The estimated water flow to this farm is about four liters per second (345 m^3/day) and is used to supply five people from Monday to Friday; during the weekend the demand increases to supply about 100 persons. A water volume of 20 m^3/day is required during the weekends, considering 200 liters per person.

Fauna in the zone is very scarce, due to indiscriminate hunting. The hunting is for family consumption and in some cases for trading. Some

fauna species have been forced to find new refuges and/or move to new habitats, fleeing from these more populated zones.

At the *Project* area there is not much floral diversity, as pine and oak dominate the landscape. This restricts the presence of others species of fauna in the area.

The closest community to project area is (Name) village, located 1.2 km south of the proposed powerhouse site. This Village encompasses an area of 29.4 km2 and is located inside the (name) Municipality boundaries, in the Department of (Name). The actual population of the village is about 3,500 inhabitants, whose main vocational activity is agriculture (corn and beans) and secondarily cattle raising (bovine and porcine). However, emigration to other northern countries has increased in the last years because of lack of employment in the region.

There are more than 300 houses, 70% of which are built with adobe and 30% with pumice stone blocks. Water is available for 90% of population, which is supplied from the (Name) River. This water is not treated and flows naturally downstream to the whole town.

Electricity is available to 85% of the population. According to interviews inside the community, there are no job opportunities available. Therefore, the *Project*'s construction and operation could represent an employment opportunity for many people.

Indirect environmental impacts are often associated with construction work, which can generate solid wastes (organic & inorganic) and waste waters; these could affect river water quality and the esthetics of the area.

The dam and powerhouse construction will be conducted on the bed of the (Name) River. The main activities contemplated include: groundwork construction, structure mounting, slab and columns forming and so on. In addition, personnel will be mobilized around the sites and equipment such as compressors, pneumatic drills, and heavy machinery (which can result in uncertain and adverse impacts such as noise, sediments, oils, grease overflows, etc.) will be utilized.

During dam construction some direct environmental impacts could result, such as changes in water quality downstream of the dam site. These impacts are expected to be minimal, as management will take the appropriate measures to protect the water supply as well as build a sedimentation pond downstream from the proposed dam site.

According to field reconnaissance, there is no significant aquatic life (fish or macro-invertebrates) upstream from the proposed powerhouse site. A sedimentation pond downstream from the dam site and appropriate measures to reduce oil spills and other pollutants will help to minimize changes in the water quality.

Upgrading and construction of the access road to the dam site will require excavation and soil repositioning along a stretch of more than 2.7 kilometers. The use of machinery and labor will result in dust generation, with direct impact upon vegetation and terrestrial fauna. Some new trees, which have since emerged on the old road due to its deterioration, will be cut, although these all have diameters of less than 10 cm and heights under 3 m.

The transport and installation of the penstock should not produce any significant environmental impact, due to its small diameter and the existing soil and subsoil conditions (massive rock). Deposition of surplus soil, if necessary, will be conducted in a proper way, seeking to minimize the transportation of soil down from the hills.

High indexes of poverty, unemployment and the scarcity of services create high expectations among the local population regarding the *Project*. Particularly during the construction phase, employment opportunities will be offered to inhabitants of surroundings communities.

Part 2 - Carbon Emission Reduction

The proposed *Project* will displace technologies using fossil fuels, such as natural gas, diesel fuel and coal. Under the business as usual scenario there would be continuing growth in efficient small-scale private diesel and petrol based electricity generation capacity.

Estimated Reduction and Choice of Baseline:
Total estimate of anticipated reductions over a ten-year crediting period is 162,500 tons of CO_2 equivalent.

There are at least two ways to assess projects such as this:

(a) The average of the "approximate operating margin" and the "build margin" in tons of CO_2e per MWh

OR

(b) The weighted average emissions of the current fossil fuel generation mix ("approximate operating margin").

Option (a) has been selected for this project because the project will displace fossil-fuel generating sources since they are at the margin of the electricity generation system. All future capacity additions are expected to be primarily fossil-fuel plants.

There are several supporting pieces of evidence to indicate that the *Project* will displace the use of fossil fuels:

- With the ratification of the new General Law of Electricity, the country has provided a framework for reforming its state-owned electricity sector. The Law provides a legal basis for privatizing state owned utilities that do not have the resources to add new capacity. The government is actively promoting private investments in the electricity sector. This transformation favors fossil fuel generated electricity that represents the quickest and least expensive way to fulfill the demand. Developers of thermal plants can guarantee to have a plant operational in a few months at a highly competitive price and offer capacity stability, whereas a hydro plant cannot. They can also place the plant where the demand exists and connection into the national grid is easy, as well as access financial recourses to install the plant.

- Currently, diesel generates 60% of the peak electricity in the country. The implementation of the *Project* – partly a peaking *Project* – thus results in emission reductions that would not have occurred in the absence of the *Project*, based upon an assumed continuation of this trend.

- This last assumption is affirmed by statistics on the installed electric capacity and electric supply in the last fifteen years. The amount of electricity by fossil fuels has increased in the last fifteen years, whereas the amount of hydro electricity has decreased in that same period. This is mostly due to the increased contribution of private power plants the last few years. The private sector in 1991 only produced 2.3% of the total electricity produced, but in September 1998 their contribution to the electricity sector raised to 48%. About 95% of this electricity produced by the private sector is thermal electricity.

- The 1998 expansion plan for the country indicates that about 80% of the total expansion consists of thermal electricity (mainly diesel and bunker oil as a fuel source). The other 20 % will be generated by hydro and geothermal electricity. The plan does not include the *Project*.

Description of the Project boundary for the Project activity:

The *Project* boundary for the baseline is defined at the grid level, which equals the national grid. The *Project* boundary for the baseline will include all the emissions related to the electricity produced by the facilities and power plants that will be replaced by the *Project*.

Detailed Methodology:

The methodology option (a) was used and includes the following steps.

Step 1: Determine annual electricity output of the *Project*. Equals 19,040,000 kWh comprised of Peak (CEF) Electricity of 5,100,000 kWh and Off-peak Electricity of 13,940,000 kWh. Equals multiplying the installed capacity – 3.5 MW – by the average plant capacity factor – 62% by the number of hours in a year – 8,760.

Annual Electricity Output (MWh/year)	= Plant Capacity (3.5 MW)	* Plant Capacity Factor (62%)	* Annual hours per year (8,760 hours/year)

Step 2: Collect data on the annual electricity generation of the national grid.

Step 3: Determine the relative fuel mix and the appropriate Carbon Emission Factors (CEF), see Table 5.

Table 5: Fuel mix and the appropriate CEF

FUEL	A % of all fuel	B % of total fossil fuel usage	C Tons CO_2 per MWh	D Average CO_2 Contribution based on all fuels (=A*C)	E Average CO_2 Contribution based on non-renewables (=B*C)
NATURAL GAS-gas turbines	20.5	39.8	0.644	0.132	0.256
DIESEL – gas turbines	20.0	38.8	0.895	0.179	0.347
COAL	11.0	21.4	0.987	0.108	0.211
Total	**51.5%**	**100%**		**0.419**	**0.814**	

		Planned Additions	CEF
1	Diesel	50 MW	0.895
2	Diesel	110 MW	0.895
3	Diesel	120MW	0.895
4	Diesel	60MW	0.895
	Total	340 MW	0.895

Step 4: Determine the next expected additions to the system:
It is expected that in the next two years 160 MW diesel power plants will come on line, as well as other thermoelectric units as they are the least cost and most efficient options according to the Expansion Plan (approximately 180 MW of Diesel).

Step 5: Average the operating margin and the build margin and multiply by the annual MWh output = (0.814 + 0.895) / 2 = 0.855 tons of CO_2e * 19,040 = 16,279 tons per year

Part 3 - Financial Presentation

The proposed *Project* appears feasible from a technical, legal, environmental, social, and market perspective. Based on the projections shown below, the *Project* also shows attractive financial returns to investors in relation to its characteristics.

There do exist, however, a few critical issues that need to be finalized to more precisely determine the return on the project.

These include:

- The price of electricity in the PPA
- The sale of byproducts
- The possible payment of a wheeling charge
- The interconnection option
- The cost of financing

The cash flow projections a 20-year period. The Table 6 shows ten years of summary projections and the key credit statistics.

Table 6: Summary Financials Projections

(US$ 000s unless noted)	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Energy Produced (MWh)	19,040	19,040	19,040	19,040	19,040	19,040	19,040	19,040	19,040	19,040
All-in Blended Tariff (US$)	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Electricity Revenues	1,142	1,142	1,142	1,142	1,142	1,142	1,142	1,142	1,142	1,142
Byproduct Revenues	67	67	67	67	67	67	67	67	67	67
Total Revenues	1,209	1,209	1,209	1,209	1,209	1,209	1,209	1,209	1,209	1,209
Net Rev. after VAT / Credit	1,346	1,346	1,299	1,235	1,235	1,236	1,236	1,237	1,237	1,238
National Grid Charge	(65)	(65)	(65)	(65)	(65)	(65)	(65)	(65)	(65)	(65)
Admin, Oper. & Maintenance	(202)	(206)	(210)	(214)	(219)	(223)	(227)	(232)	(237)	(241)
EBITDA*	1,079	1,075	1,024	956	952	948	944	940	936	932
Margin	89.3%	88.9%	84.7%	79.0%	78.7%	78.4%	78.1%	77.8%	77.4%	77.1%
Depreciation	(407)	(407)	(407)	(407)	(407)	(407)	(407)	(407)	(407)	(407)
EBITR	672	668	617	549	545	541	537	533	529	525
Royalties	(16)	(18)	(17)	(16)	(17)	(19)	(20)	(22)	(23)	(24)
EBIT	656	651	600	533	528	522	517	512	506	501
Interest	(311)	(275)	(238)	(201)	(165)	(128)	(92)	(55)	(18)	(0)
EBT	345	376	362	332	363	394	426	457	488	501
Income Taxes	0	0	0	0	0	0	0	0	0	0
Net Income	345	376	362	332	363	394	426	457	488	501
Total Debt (EOP)	3,490	3,222	2,930	2,612	2,265	1,886	1,474	1,024	534	0
Debt Amortization	(246)	(268)	(292)	(318)	(347)	(378)	(412)	(450)	(490)	(534)
Depreciation Add-Back	362	362	362	362	362	362	362	362	362	362
Free Cash Flow	482	476	332	359	354	348	343	337	331	325
CREDIT STATISTICS										
Debt Service Coverage Ratio*	3.3x	1.5x	1.5x	1.5x	1.6x	1.7x	1.8x	1.9x	2.0x	2.2x
EBITDA / Interest Expense	3.5x	3.9x	4.3x	4.7x	5.8x	7.4x	10.3x	17.1x	51.1x	NM
Debt / EBITDA	3.4x	3.0x	2.8x	2.6x	2.1x	1.7x	1.3x	0.9x	0.4x	0.0x

** Uses EBITDA (net of taxes) divided by sum of interest expense and debt amortizations.*

From a credit perspective, the financial projections show strong results. Leverage, as measured by Debt / EBITDA, is 3.4x after the first year of operation and declines to 2.1x by the fifth year. The debt service coverage ratio has a minimum value of 1.5x and an average value of 1.9x, both of which are reasonable for a hydroelectric plant.

The results of the base case equity investor IRR is shown in the Table 7 for 10, 15, and 20-year investment horizons. In this case, byproduct revenues were included, as was also a wheeling charge. It is also worth mentioning that no terminal value is included in these calculations. This is a conservative assumption, given that hydroelectric plants can continue to operate for longer periods of time with minimal maintenance capital expenditure requirements.

Table 7: Equity Investor IRR

EQUITY INVESTOR IRR	Time 0	2004	2005	2006	2007	2008	2009	2010	2011	2012
Initial Equity Investment**	(1,569)									
Net Income		345	376	362	332	363	394	426	457	488
+ Depreciation		407	407	407	407	407	407	407	407	407
- Principal Payments			(407)	(407)	(407)	(407)	(407)	(407)	(407)	(407)
= Levered Free Cash Flow	(1,569)	752	376	362	332	363	394	426	457	488
Equity IRR - 10 Year	27.3%									
Equity IRR - 15 Year	30.1%									
Equity IRR - 20 Year	30.6%									

*** Assumed to occur two years before cash flows begin*

The preliminary estimates of construction costs for the *Project* have been updated.

Wind Turbine

HYDROPOWER PROJECT
ESTIMATE OF PROBABLE CONSTRUCTION COSTS
3500 kW PROJECT - USING 0.35 TO 0.86 CM/S
SUMMARY OF DETAILED ESTIMATE

ITEM	TITLE	COST US$
	DIVERSION DAM	203,800
	PENSTOCK	1,055,756
	POWERHOUSE	986,400
	ACCESS ROAD	95,621
	TRANSMISSION LINE	435,143
	INTERCONNECTION SUBSTATION	147,473
	ENVIRONMENTAL MITIGATION/ENHANCEMENT	40,000
	GENERAL CONSTRUCTION; ADMINISTRATION, MOBILIZATION & DEMOBILIZATION; OVERHEAD AND PROFIT	655,114
	CONSTRUCTION CONTINGENCY (INCLUDED IN DETAILED ITEMS)	
	SUBTOTAL DIRECT CONSTRUCTION COSTS	3,619,307
	PROJECT ADMINISTRATION	144,772
	DESIGN ENGINEERING	158,460
	CONSTRUCTION ENGINEERING SERVICES	148,000
	DEVELOPMENT FEE	361,931
	PRE-INVESTMENT COST	200,000
	OWNER'S VEHICLES	20,000
	INSURANCE & TAXES	16,000
	CLOSING COST (Including byproduct documentation)	210,000
	STUDY GRANT CONTRACT	10,300
	PRE-INVESTMENT LOAN	60,500
	XYZ STUDY	10,000
	LAND RELATED EASEMENT COST	15,000
	CONSTRUCTION PERMITS	10,000
	SUBTOTAL INDIRECT CONSTRUCTION COSTS	1,364,963
	TOTAL	**4,984,320**

Revenue Projections:

The results of the Watershed Comparison Analysis and Energy Analysis performed during the Feasibility Study produced results for the estimates of installed/dependable capacity, and average annual energy generation. These results are presented in the table below:

Table 8: Estimated installed capacity

SITE CONDITIONS	INSTALLED CAPACITY (kW)	DEPENDABLE CAPACITY (kW)	AVERAGE ANNUAL ENERGY (kWh)
Peak Output	3,500	3,500	5,100,000
Restore	3,500	400	640,000
Run-of-River	3,500	800 to 3,500	13,300,000

The conceptual design of the *Project* was arrived at by using the natural flow of the (Name) River based on the spring flows that come from the mountains. The *Project* was initially conceptualized as a strict run-of-river project. Once it was determined that the spring-fed river would have reliable and consistent flows during the dry season, the concept was changed to provide additional storage upstream of the required diversion dam, by increasing the height of the diversion dam by 3 meters. This provides the ability to operate The *Project* as a peaking plant for 4 hours per day, restoring the reservoir for an average of 6.5 hours per day (based on minimal river inflows), and operating it as a run-of-river project the remaining average of 13.5 hours per day.

With the deregulation of the utility industry passed under the General Electricity Law the new market began operating. The electricity generated by this *Project* is expected to be sold via a Power Purchase Agreement (PPA) to a distribution company or to a power broker (marketer). An appropriate average electricity price for use in the projections has been calculated based on analysis of current spot market prices as well as from preliminary conversations with potential purchasers.

Based on current published rates for the sale of energy by the wholesale market administrator and the existing rates of spot market sales by other private developers in Guatemala, it has been determined that the prices of energy vary from $0.023/kWh in the early hours of the morning to $0.13/kWh at peak hour certain days. Because it is a spot market, there is a great deal of variation of prices of energy depending on the time of day and on a series of exogenous factors. The capacity market is treated separately; any stakeholder in the market has to have capacity to be able to operate. The capacity adjustment transactions are now priced at $8.90 per kW-month. It is estimated that at this time, negotiating prices for a hydropower project would range from $0.07 to $0.55, including both the energy sold and the capacity guarantied. The financial projections were calculated using a blended rate of $0.06/kWh, which pays for both energy and capacity. Recent privately negotiated PPAs in Guatemala begin with a blended rate of $0.062/kWh.

Financing and Operating Costs:

A capital structure composed of approximately 71% debt and 29% equity has been assumed, with a debt interest rate of 9% assumed for both the construction and long term financing.

It is expected that debt financing for both the construction and operating periods will come from the same source. Contacts with the financial community indicate that both commercial lenders and multilateral

and bilateral agencies will be likely to provide the required funds.

The interest rate charged by the lenders will be a function of their cost of funds, plus the country and project risk spreads associated with the *Project*. The interest rate further depends on whether it is fixed or floating (i.e. spread above LIBOR). As previously stated, the financial feasibility analysis assumes an interest rate of 9 percent for both the construction and term loan. The interest cost for the 12-month construction period has been estimated at $247,285.

Hydropower projects are capital-intensive investments with no fuel costs and comparatively low operating expenses. Due to the high capital costs, it is essential to obtain long-term financing to make The *Project* economically viable. Historically, while private projects in the United States have been financed for 20 years or more and public projects around the world have 30 year plus debt, it is very unlikely that the *Project* could secure debt with a tenor in excess of 12 years, given the current credit market conditions and financial risks. The multi-lateral institutions that might finance the *Project* currently limit the term of their loans to 12 years, and local banks would be expected to provide no more than 10 years. For the purpose of the financial feasibility analysis, the projections adopt a 10-year financing scenario, with a grace period of one year.

In addition of the standard bank fees (e.g. commitment), a 1.5% capital raising fee has also been assumed in the projections.

There are several costs that will be incurred on an annual basis by the *Project*. The major categories are described herein.

The operation and maintenance costs were estimated based on similar experience on other mini-hydropower projects. A detailed summary of the estimate of O&M costs is presented in the feasibility study.

The annual insurance premium for this type of property and casualty loss, general liability and business interruption is estimated at $16,000 yearly.

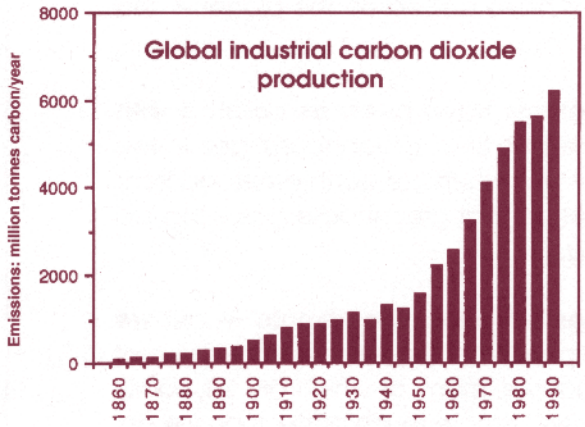
The administrative cost, which includes accounting, legal, and miscellaneous is estimated at $145,000 yearly.

The income tax rate used in the analysis consists of the 31% corporate income tax and the 12% that apply to VAT. A new renewable energy tax incentive law was approved in November 2003 by Congress, which contemplates the following incentives: 100% deduction of income tax for the first 10 years of operation, no import duties on machinery and equipment or on materials for the construction of the *Project*. All of this applies to Guatemala, which is the country used in the example.

El Bote Hydroelectric Project, Nicaragua

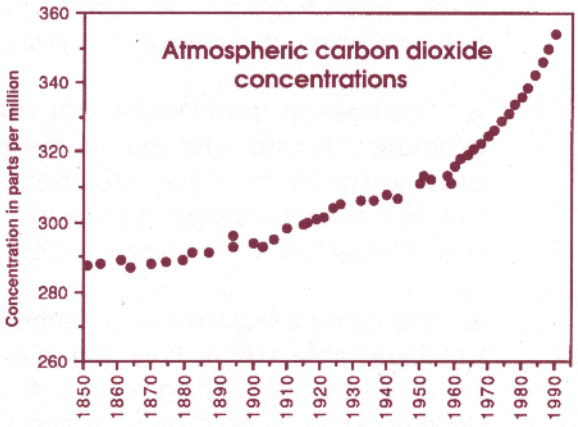
ANNEX 1

Production and Concentrations of Carbon Dioxide



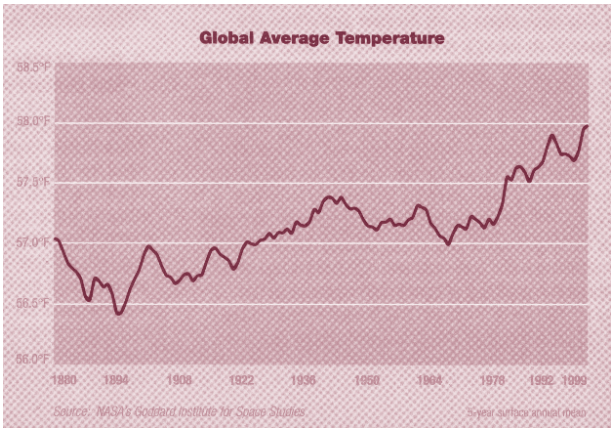
Global Industrial Carbon dioxide emissions from fossil fuel combustion and cement manufacturing for the period 1860-1990.

Source: EPA: Global Warming and our Changing Climate, April 2000



Atmospheric concentrations of carbon dioxide, the most important greenhouse gas, from 1850-1990.

The Earth's temperature



Source: EPA: Global Warming and our Changing Climate, April 2000

¿Who are we?

E+Co
energy through enterprise

E+Co is a ten-year old public purpose investment company with offices in Africa, Asia, Europe, Latin America and the United States, E+Co is a US 501(c)(3), tax exempt corporation. Its sole focus is to empower local small and medium sized enterprises that supply modern energy to households, businesses and communities in the rural, peri-urban and urban areas of developing countries. It pioneered and is the leading practitioner of the enterprise-centered model of investing in the small scale, clean energy sector.

E+Co was the first organization to combine business development services and seed capital for the clean energy sector in developing countries. These services include technology assessment, market assessment and validation, financial analysis and structuring, sales and management, development and preparation of business plans, investment documents and monitoring and evaluation.

BUN-CA

BUN-CA is a regional non-governmental organization establish in 1991 in San Jose, Costa Rica. Its mission is to improve the production and rational use of natural resources, in a way that promotes energy efficiency and the use of renewable energy sources, as a means to achieve economic development, and social well being, especially in rural areas.

The major focus areas of BUN-CA are: Renewable Energy; Energy Efficiency; and Clean Production.

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