Sea Power & Associates

Social / Environmental Quantitative Analysis

Social Entrepreneurship is a new field, and calculations of Social Return on Investment (SROI) are still being refined. We have developed a methodology for calculating the Social Internal Rate of Return (SIRR) that we believe meaningfully captures both the market and non-market costs and benefits of the project to society. To us, this defines an SROI.

General Methodology

Our SIRR is based on the International Finance Corporation's (IFC, a part of the World Bank Group) methodology for calculating Economic Rate of Return (ERR). The IFC calculates an ERR for each investment it is considering in addition to calculating a financial IRR. This methodology helps IFC determine which projects are the best for promoting development in client countries. Both IFC's methodology and ours follow the same four steps, described below:

1) Define two states of the world: the world with the project vs. the world with the project's next best alternative. The project's next best alternative is how the underlying need would be met if the project were never built. There is almost always an alternative that offers similar benefits to society.

2) Estimate the project's incremental costs and benefits to society. The incremental costs and benefits are the net increase in costs and benefits compared to the next best alternative.

3) Calculate the project's net benefits to society in each year. Net benefits are the incremental costs minus the incremental benefits estimated in the previous step. Typically, projects will involve net costs up front in return for net benefits in the future.

4) Calculate the project's SIRR and SNPV. See the definitions below.

Definitions

SIRR, the IRR of the project's net benefits to society

SNPV, the NPV of the project's net benefits to society, discounted at a discount rate that reflects the riskiness of the expected future net benefits

Project's net benefits to society, a comparison of society's welfare with the project compared to society's welfare with the project's next best alternative (diesel).

> Project's net benefits to society = (Incremental benefits as a result of the project) –
>
> (Incremental costs as a result of the project)

Project's incremental benefits to society, the net increase in benefits to society from the project, compared to the benefits of the project's next best alternative; composed of private benefits and external benefits. Avoided private or external costs, as in this case, can be seen as incremental benefits of a project.

Project's incremental costs to society, the net increase in benefits to society from the project, compared to the benefits of the project's next best alternative; composed of private costs and external costs.
Private costs or benefits, those costs or benefits that accrue to the project's owners but not to society. Examples of private costs and benefits are the project's operating expenses and revenues. Note that these expenses and revenues, while "new" are not necessarily incremental to society, because some other firm may be losing market share.
External costs or benefits, those that accrue to society but not to the project's owners. The most common example of external costs and benefits are environmental externalities, such as the social costs of air and water pollution.

Incremental Costs and Benefits of the Sea Power Project

Incremental Benefits as a Result of the Project	
Avoided private costs	Wave energy's lower price per kWh, compared to diesel
Avoided external costs	Project results in less pollution (CO_2, NO_x, SO_2)
Incremental Costs as a Result of the Project	
Project's operating costs	From income statement
Less: transfers (taxes, insurance, debt service)	Transfers are not a net cost to society
Project's capital costs	From statement of cash flows
Project's external costs	Costs imposed on society by the project (e.g. coastline blockage, visual impact)
PROJECT'S NET BENEFITS	**= (Incremental Benefits) – (Incremental Costs)**

SIRR and SNPV of the Sea Power Project

We calculate an SIRR of **177%**. We have de-emphasized calculation of the Social Net Present Value (SNPV), because we believe that there is no meaningful way to estimate the discount rate of non-market cost and benefit streams. Discount rates for private cost and benefit streams can be determined by observing the capital markets; but there are no efficient mechanisms to price the riskiness of non-market cost and benefit streams. We use the Weighted Average Cost of Capital (WACC) to discount the social benefit flows at a rate of 9.3% p.a.. We calculate an SNPV of $211 million.

Assumptions

Incremental Benefits: Avoided Private Costs: We make the assumption that the reduction in fuel costs from $0.18/kWh to $0.06-$0.08/kWh represents a reduction in the *systemic* costs of fuel production. We are not simply transferring value from the diesel manufacturer to the public.

Incremental Benefits: Avoided External Costs: Environmental externalities associated with conventional power production include acid rain damage, climate change, soil erosion, and water pollution, none of which are accounted for in the per-kilowatt

generation costs of electricity. Wave Rider is a non-polluting, renewable energy source that will replace diesel power generation in our target markets. We place a monetary value on the environmental damage caused by the life cycle of diesel fuel production and use, pricing the external costs in cents per kilowatt-hour. We are fortunate that a number of detailed studies have been developed in this area, [1] and are particularly grateful for the assistance of Merrill Jones, a student at the Haas School of Business, who wrote her Master's Thesis on this subject.[2] Most studies that monetize environmental damages focus on the most common air pollutants from power plant emissions: nitrogen oxides (NO_x) and ozone, sulfur dioxide (SO_2), particulates (TSP, or total suspended particulates), and greenhouse gases (mainly CO_2. Here we also include an additional cost associated with the front end of the fuel cycle- fuel production and delivery-which contributes to global warming through the emission of methane gas.

It is worth noting that there are a number of other negative environmental externalities that we have ignored, because they cannot be precisely quantified or monetized. For example, diesel fuel contains sizable quantities of sulfur as well as trace elements of arsenic, heavy metals and other toxic substances. Fossil fuel transport entails further hazards to coastal communities, particularly the high risk of oil tanker spills.

Incremental Costs: Project's External Costs: Potential external costs of Wave Rider include environmental damage caused by coastline blockage, laying of submarine cable, and drilling into the sea floor and shoreline to secure the device. Other external costs include the potential hazard to ship traffic and the visual impact from shore. We estimate the value of these externalities at zero (see below), but have included a line for external costs in our model for completeness.

We believe the construction impacts would be minimal, as Wave Rider is small-scale and simple in construction, involving only tethered floats and a buried cable running to shore. We believe the visual impact would be minimal, as Wave Rider would be positioned one mile offshore. Finally, we believe that the impacts on ship traffic would be minimal, as the arrays would have to be placed outside shipping channels and would be one mile offshore, posing no obstacle to small boats launched from shore. We would work to further mitigate these impacts in the design and construction of Wave Rider.

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[1] Two major studies, one prepared for the US government, one for the UK government, each incorporate a substantial number of studies. See Center for Social and Economic Research on the Global Environment (CSERGE, 1992), *The Social Cost of Fuel Cycles*, report to the UK Department of Trade and Industry (Department of Energy), September 1992; Pace University Center for Environmental Legal Studies (Pace, 1990), *Environmental Costs of Electricity*, New York: Oceana Publications.

[2] Published in a modified form as Merrill Jones, "Externalities of Power Production", in N.C. Williams and D.C. Pike, *Institutional Barriers in Europe to the Development of the Production of Electricity from Biomass*, a report for Directorate-General DGXII of the European Commission on a study carried out under the JOULE programme, January 1995.

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