



DISTRIBUTED GENERATION TECHNOLOGIES

Social Return on Investment Analysis

Global Social Venture Competition
2004 SROI Winner

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EXECUTIVE SUMMARY

DGT seeks to replace inherently flawed power systems around the world with distributed power generation products developed from new and disruptive technologies. DGT seeks to use the engines of business and scientific innovation to catalyze a future of distributed and renewable power generation that improves the social, environmental and economic self-reliance of communities world-wide.

DGT's first exclusive technology license is based on breakthrough technology from Cornell University that converts organic waste to up to 99.9% usable, compressed methane fuel. This technology allows the development of the DGT Reactor - a product that will compete in the marketplace against technologies that produce on average only 50% usable fuel from the same sources. This technology will be the platform for two key products.

First to hit the market will be a high pressure DGT Reactor that produces valuable pressurized methane gas for municipalities while safely treating organic wastewater, using a closed-loop, zero energy system. Municipalities are faced with a combination of demands that will facilitate market entry for this product: mandated requirements to use renewable energy sources, high fuel costs, and an increasing use of compressed natural gas to fuel fleet vehicles.

Our mass market product is a low pressure DGT Reactor that applies the same core technology to a small-scale, modular, and less capital-intensive product. This product is aimed squarely at the electricity demands of consumer, commercial, and industrial customers world-wide. This second DGT product takes advantage of the purity of the methane gas output as a source of hydrogen for fuel cells and can be used to generate distributed energy at the community level around the world.

The social return on investment (SROI) analysis presented in this document monetizes the social and environmental returns associated with the first municipal DGT product. The introduction of this product to municipalities around the world will have three primary social and environmental benefits:

1. Reduction in gasoline use as a fuel for municipal buses
2. Reduction in the release of methane (a powerful greenhouse gas) into the atmosphere
3. Increase in municipal income leading to increased social, safety and public health services

Together the benefits above are estimated to return \$1.21 for every dollar of economic cost invested by DGT over a ten year period. The economic return for the business is estimated to be \$5.74 per dollar of cost invested over the same ten year period.

In addition to outlining the social and environmental benefits of DGT's first product, this document also introduces two new ideas to the field of social return analysis. Social Return Beta is introduced as an evolution of a metric to measure the variability of social and environmental estimates and a new definition is proposed for the calculation of Blended Value that avoids the double counting of project costs. These ideas are presented as preliminary solutions to perceived limitations of current social return analysis. DGT recognizes that additional research and collaboration is required to further improve the analysis of social return for ventures across multiple industries.



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DEFINITION OF SOCIAL VALUE PROPOSITION

Although DGT is a for-profit enterprise, the company has an underlying social mission:

Commercialization of distributed generation technology that promotes social, environmental, and economic self-reliance for communities worldwide

As a part of this mission, DGT promotes renewable energy production and local energy efficiency through commercialization of distributed generation technology.

The three primary social and environmental impacts of DGT's first product are listed below:

1. **Reduction in gasoline use as a fuel for municipal buses** – DGT's first product produces compressed natural gas from renewable locally available sources of organic waste. This compressed natural gas can be cost effectively substituted for the use of gasoline for both municipal transit buses and smaller fleet vehicles. The external social and environmental costs of gasoline use are calculated and connected to the cubic feet of DGT Reactor space sold to municipalities.
2. **Reduction in the release of methane into the atmosphere** – traditional handling of organic waste by municipalities releases methane gas into the atmosphere which directly contributes to global warming. The DGT Reactor captures this methane for use as fuel which prevents its release to the atmosphere. The burning of the methane does however release CO₂ which is 21 times less powerful as a global warming agent. The DGT SROI calculates the social cost of the difference between the release of methane and the release of CO₂ as an environmental return of the business.
3. **Increase in municipal income through the use of DGT products** – every municipality that purchases and uses the DGT Reactor to generate renewable fuel will be turning a waste water treatment cost center into a revenue center by treating waste and generating a high value fuel. The DGT Reactor pays back it's initial cost after seven years. After this period the product generates revenue for municipalities which frees money to be used to improve society through the social, safety, and public health services.

Each of the three benefits listed above are described in detail in the following sections.



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REDUCTION IN GASOLINE USE

The initial target market for the DGT Reactor is U.S. municipalities that have a steady supply of organic waste and a need for compressed natural gas to fuel fleet vehicles and transit buses. The DGT Reactor improves the economic case for municipalities to adopt CNG transportation options, therefore it is anticipated that all compressed natural gas generated by DGT Reactors in this initial target market will be used to replace gasoline fuel that would ordinarily have been used for transportation.

Each cubic foot of DGT Reactor capacity installed by the company will generate a known amount of natural gas per year. This quantity of natural gas can be converted using the known energy density of natural gas to a total annual energy yield of 634.89 millijoules of energy per cubic foot of Reactor. This calculation is shown in detail in Table I.

Table I - Total Annual Energy Units of Natural Gas per Cubic Foot of DGT Reactor

Description	value	Units	Notes / source
Size of generator	1	cubic feet	
CNG production per cubic foot of Reactor	1.66	cubic feet	DGT lab prototype test results
CNG production per generator per day	1.66	cubic feet	generator size times CNG production per cubic foot
Days per year	365	Days	
Cubic feet CNG per generator per year	605.9	cubic feet	
Cubic meters of CNG per generator per year	17.16	cubic meters	calculated using conversion rate of 0.03 cubic meters per cubic foot
Energy density of natural gas	37.00	millijoules/cubic meter	"Energy." <i>Science & Technology</i> . Gale Research Inc., 1993. (http://hypertextbook.com/facts/2002/JanyTran.shtml)
Energy of natural gas generated per year	634.89	Millijoules	



To calculate the gasoline use replaced by each cubic foot of DGT Reactor it is first necessary to calculate the energy contained in each gallon of gasoline. This calculation is shown in detail in Table II.

Table II - Energy Units per Gallon of Gasoline

Description	Value	Units	notes / source
energy density of gasoline	34.20	MJ/liter	Nommensen, Arthur, List of common conversion factors. (http://www.ior.com.au/ecflist.html)
liters per gallon	3.79	conversion rate	
energy per gallon of gasoline	129.45	millijoules/gallon	

Using a Table of 634.89 millijoules of energy produced each year by a cubic foot of DGT Reactor and 129.45 millijoules per gallon of gasoline it can be calculated that each cubic foot of DGT Reactor replaces 4.9 gallons of gasoline use per year ($634.89/129.45 = 4.9$).

The environmental impacts of renewable natural gas use are much lower than the environmental costs of gasoline. Compressed natural gas use has the following direct environmental benefits:

- 25% reduction in greenhouse gas emissions
- 20% reduction in tailpipe emissions of carbon dioxide
- Up to 95% reduction in fine airborne particle pollution
- Up to 60% reduction in emission of oxides of nitrogen (NOX), a contributor to smog
- Reduction of carbon monoxide emission by as much as 20% (Source: U.S. DOE 2000)

While these environmental benefits of natural gas over gasoline are significant, it is important to note that use of natural gas for transportation fuel does have some associated environmental costs. The average of the reduction percentages of all pollutants identified above for natural gas vs. gasoline equals 44%. While these costs are dramatically lower than the environmental costs of traditional gasoline use they can not be completely discounted in this SROI analysis. Where applicable, the environmental and social costs of gasoline use mitigated by the DGT Reactor have been adjusted down by this 44% Table to account for the possible negative effects of renewable natural gas use as a transportation fuel.

The true social and environmental costs of a gallon of gasoline fall into four applicable areas described by the Center for Technology Assessment (www.ctwa.org), including 1) tax subsidization of the oil industry, 2) government program subsidies, 3) protection costs involved in oil shipment and motor vehicle services, and 4) environmental, health, and social costs of gasoline usage. A detailed analysis of these cost categories to determine the social return for each cubic foot of DGT Reactor capacity is provided in the following subsections.



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Tax Subsidization of the Oil Industry

Both federal and state governments in the United States heavily subsidize the price of gasoline for the American consumer. The full cost of these subsidies can be included as a social cost of each gallon of gasoline not used because of the DGT Reactor. Every gallon of gas in the United States includes tax subsidies shown in Table X.

Table III: Estimated Tax Subsidies per Gallon of Gasoline in the U.S.*

Description	midpoint of estimated value per gallon	notes / source
Percentage depletion allowance	0.0089	ILSR/Greenpeace, based on data from U.S. Treasury Department and the Joint Committee on Taxation
Non-conventional fuel production credit	0.0084	ILSR and FOE
Expensing of exploration and development costs	0.0023	ILSR; Greenpeace; FOE
Enhanced Oil Recovery Credit	0.0006	ILSR; FOE
Foreign tax credits	0.0226	Jenny Wahl, Institute for Local Self Reliance, 1996; Koplw and Martin, Greenpeace, 1998
Foreign income deferral	0.0025	ILSR; Greenpeace
Accelerated depreciation allowances	0.0276	ILSR; Greenpeace; FOE
State piggyback tax effect	0.0022	Greenpeace; ILSR
State and local under taxation	0.0241	Loper; UCS
New tax subsidies	0.0207	Greenpeace
Total estimated tax subsidies per gallon of gasoline	12 cents	

*Calculated from applicable data reported by the Center for Technology Assessment

Table III demonstrates that each gallon of gasoline represents 12 cents in external social costs. Since each of these external costs do not apply to natural gas produced renewably by a DGT Reactor, the entire external cost can be considered a social return of the DGT product. Each cubic foot of DGT Reactor produces the energy equivalent of 4.9 gallons of gasoline; therefore each cubic foot of DGT Reactor avoids external gasoline industry tax subsidies of 58.8 cents (4.9 x 12 = 58.8).



Government Program Subsidies of the Gasoline Industry

The U.S. government heavily subsidizes infrastructure, research and other systems that support the U.S. oil industry. All of the costs shown in Table IV can be avoided by substituting renewable generation of natural gas by DGT Reactors for traditional gasoline distribution systems.

Table IV: Estimated Government Program Subsidies of the Gasoline Industry*

Description	midpoint of estimated value per gallon	notes / source
Government R&D programs supporting petroleum technology	0.0021	OMB budget estimates 1997/98
Export financing subsidies	0.0031	Greenpeace and UCS
Army Corp of Engineers subsidies	0.0052	U.S. Army Corp of Engineers, Waterborne Commerce of the U.S.; Greenpeace
Department of Interior management programs to support access to oil resources	0.0032	Greenpeace
Regulatory oversight, response to oil contamination and liability prevention	0.0271	Greenpeace; EPA
Total estimated program subsidies per gallon of gasoline	4 cents	

*Calculated from applicable data reported by the Center for Technology Assessment

This calculation shows an external social cost of 4 cents per gallon of gasoline from government program subsidies in support of the oil industry. Each cubic foot of DGT Reactor produces the energy equivalent of 4.9 gallons of gasoline. Therefore each cubic foot of DGT Reactor avoids external gasoline industry program subsidies of 19.6 cents (4.9 x 4 = 19.6).



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Protection Costs Involved in Oil Shipment and Motor Vehicle Services

A variety of social costs are associated with the protection of U.S. access to oil reserves and the protection and storage of oil within domestic U.S. borders. The social costs of oil protection are estimated in Table V.

Table V: Estimated Protection Costs of U.S. Oil Industry*

Description	Midpoint of estimated value per gallon	notes / source
Cost of oil defense subsidies	0.7583	ILSR; Greenpeace; Ravenal, and Defense Technical Information Center.
Maintenance cost of U.S. Strategic Petroleum Reserve	0.0571	IISR; Greenpeace; U.S. Department of Energy
Other estimated protection costs (Coast Guard shipping lane protection, applicable shipping subsidies, etc.)	0.0057	Greenpeace
Total estimated applicable protection costs per gallon for U.S. oil industry	82 cents	

*Calculated from applicable data reported by the Center for Technology Assessment

This calculation shows an external social cost of 82 cents per gallon to support the protection of the U.S. oil industry. Using the calculation of 4.9 gallons of gasoline equivalent energy produced per cubic foot of DGT Reactor it can be estimated that each cubic foot of DGT Reactor avoids external oil industry protection costs of \$4.02 ($4.9 \times .82 = 4.02$).



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Environmental, Health, and Social Costs of Gasoline Usage

A wide variety of social externalities of gasoline use are included in this category of environmental and health costs of gasoline use. When calculating the social cost of gasoline usage some sources include the social cost of highway transportation costs and suburban sprawl. For the purpose of this SROI analysis these costs have not been included as social returns of the DGT product as renewable natural gas substitution for gasoline fuel is not likely to reduce the total number of vehicles in use.

Examples of external costs in this category that do apply to this SROI analysis include increased injuries caused by gas spillage and fires, increased hospital admissions linked to asthma from ozone pollution, and other external costs of air pollution related to human health. Numbers reported in Table VI reflect an adjustment down to account for low levels of similar externalities that can be reasonably expected to be caused by natural gas transportation fuel. For the purposes of this SROI natural gas is conservatively considered to be 44% less polluting than gasoline based on the average of pollution reductions reported by the U.S. Department of Energy.

This Table of \$2.01 can also be combined with earlier calculations to yield a reduction in environmental, health and social costs of \$9.85 per cubic foot of DGT Reactor (4.9 x 2.01 = 9.85).

Table VI - Estimated Environmental, Health, & Social Costs of Gasoline Usage*

Description	midpoint of estimated value per gallon	notes / source
Increased annual health costs from gasoline vs. renewable natural gas pollution	1.7942	reduced by 44% to account for possible similar social costs caused by natural gas use; sources: Union of Concerned Scientists; Delucchi, 1998
Crop damage due to gasoline use vs. renewable natural gas pollution	0.0208	reduced by 44% to account for possible similar social costs caused by natural gas use; sources: ILSR; EPA; Delucchi, 1998
Building damage due to gasoline use vs. renewable natural gas pollution	0.0714	reduced by 44% to account for possible similar social costs caused by natural gas use; source CTA
Annual cost of climate change due to gasoline use vs. renewable natural gas pollution	0.1009	reduced by 44% to account for possible similar social costs caused by natural gas use; sources IPCC; EESI; Paul Rauber, 1997; ILSR; Delucchi; UCS
Annual cost of oil spills	0.0221	Litman; Greenpeace; Chernick and Caverhill; Lee
Total estimated applicable environmental and social costs per gallon of gasoline use	2.01	

*Calculated from applicable data reported by the Center for Technology Assessment



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Summary of Reduced Gasoline Social Costs

The data provided by the analysis in the previous sections are summarized in Table VII, which provides the total social costs of gasoline reduced by each cubic foot of DGT Reactor space installed at customer locations. The net social return per cubic foot of DGT Reactor due to gasoline substitution is \$14.65 per cubic foot of DGT Reactor. This total has been adjusted down to remove the social costs of using the natural gas in place of gasoline. This Table is used in calculations shown in the SROI proforma presented further in this analysis..

Table VII: Summary of Reduced Gasoline Social Costs due to DGT Reactor Use

Description	estimated cost savings per cubic foot of Reactor
Tax Subsidization of the Oil Industry	0.59
Government Program Subsidies	0.20
Protection Costs Involved in Oil Shipment and Motor Vehicle Services	4.02
Environmental, Health, and Social Costs of Gasoline Usage	9.85
Total estimated savings per cubic foot of DGT Reactor	14.65



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REDUCTION IN METHANE RELEASE

Handling of organic waste by municipalities using traditional technologies eventually leads to the release of methane gas into the atmosphere. This methane contributes to global warming by trapping heat from solar radiation within the earth's atmosphere. The U.S. EPA and the Department of Food and Rural Affairs in London estimate that Methane is 21 times more effective as a green house gas than is CO₂ which would be the byproduct of the DGT reactor process of capturing and burning methane for energy creation.

To calculate the true social and environmental savings of capturing methane and releasing CO₂ as an alternative to direct methane release it is first necessary to estimate the social and environmental harm caused by CO₂ release. Multiple researchers and international agencies have estimated the true cost of CO₂ release at various levels per ton of CO₂. Estimates collected for use in DGT's SROI are listed in Table VIII below.

Table VIII – Estimated Cost of CO₂ Release (per ton)

midpoint of estimated value per ton	notes / source
8.50	European Commission DG Environment - Frankhauser
6.00	Tellus Institute 1998
4.00	European Commission DG Environment – Frankhauser2
44.00	ACT - Advanced Control Technologies
18.00	MCT - Mixed Control Technologies
21.80	Chernick 1989
18.35	Nordhaus 1989
56.00	Steinberg and Cheng 1985
22.08	Average Estimate of CO₂ Cost per Ton

If methane is 21 times more effective as a greenhouse gas compared to CO₂, then each unit of methane captured yields savings of \$4.64 (21 times 22.08 cents). If a unit of CO₂ is released for each unit of methane captured, then the savings caused by the DGT Reactor is equal to \$4.42 per ton of methane captured (\$4.64 minus 22 cents). Each cubic foot of DGT reactor captures 0.012 tons of methane per year which leads to a social and environmental savings of 5.4 cents per cubic foot of DGT Reactor space per year (\$4.42 times 0.012 tons).



MUNICIPAL EXPENSE REDUCTIONS DUE TO DGT REACTOR

DGT seeks to replace municipal expenses with income generated from waste treatment by the DGT Reactor. This income for the first seven years of ownership by a municipality will reimburse the municipality for the cost of the system. After this payback period the income from the DGT Reactor will reduce the need for municipal expenditures and the associated social cost to taxpayers. Increased municipal income will either reduce the taxation burden on society or will free funds to be used to increase health, education, and social services.

Municipalities around the world are not 100% efficient in delivering social return. A dollar saved by a municipality does not necessarily yield a dollar of social return. Multiple social scientists have estimated municipal efficiency around the world. These estimates are shown in Table IX.

Table IX – Estimated Municipal Efficiencies

Country	midpoint of estimated value	source
Belgium	66	Bosmans/Fecher, 1995
France	75	Dervaux, et al, 1994
USA	85	Burges/Wilson, 1993
Denmark	73	Holvad/Hougard, 1993
Belgium	91	Donni, 1994
Sweden	89	Bjurek et al., 1992
Belgium	94.5	Bouveroux et al., 1995
USA	74	Sexton et al., 1993
Netherlands	87	Kooreman, 1994
Belgium	81.5	Distexhe et al., 1994
USA	83.5	Wickoff/Livigne, 1991
Average Estimate	81.7	

Using these estimates, DGT calculates that on average every dollar saved by a municipality generates 81.7 cents of social return. The DGT business plan has initial systems installed as subsidized pilot projects in the first two years of the company's operation. 81.7% of the economic value generated for municipalities receiving these subsidized systems is included in the DGT SROI proforma from date of system installations. Social returns through increased municipal revenues for non-subsidized systems begin to accrue after an initial seven year period where economic returns are paying back the customer for the cost of the system.



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OTHER SOCIAL RETURNS

DGT recognizes that there are other social and environmental returns associated with distributed energy products. At this time the SROI analysis only contains monetization of social returns associated with the first DGT product, the DGT high pressure Reactor. Over time other benefits of distributed energy will become part of the company's SROI analysis as new products come on-line. Over time DGT hopes to catalyze other social and environmental returns described below:

Consumer Benefits

- More reliable power & lower, more predictable energy costs
- Choice of energy supply options
- Energy and load management
- Combined heat and power capabilities
- Environmental benefits – cleaner, quieter operation, and reduced emissions
- Faster response to new power demands – modularity allows capacity to be matched with demand

Grid Benefits

- Reduced Energy losses in transmission lines and upstream congestion on transmission lines
- Reduced or deferred infrastructure (line and substation) upgrades
- Optimization of existing grid assets – free up transmission assets for increased wheeling capacity
- Reduce capital tied up in unproductive assets – system modularity facilitates matching capacity with existing demand, reducing construction of centralized plants to meet future demand
- Higher energy conversion efficiencies
- Faster permitting than transmission line upgrades
- Ancillary benefits – voltage support and stability, contingency reserves, and black start capability

In addition to these benefits, local production of energy will also generate a social return by reducing the flow of financial resources out of local communities. The traditional energy infrastructure requires communities to effectively rent their energy from large producers and corporations rather than investing in their own energy independence. Capital spent by communities to invest in local energy production stays in the community to create long-lasting value. Every dollar saved by a community through the ongoing use of DGT products is a dollar that stays in the community to be invested in local economies and local programs. Money saved by communities can be reinvested to further improve public programs and social welfare.



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MONETIZATION OF SOCIAL VALUE

The analysis in the previous sections has been combined with projections for company growth to produce a proforma of estimated social return on investment for DGT. The proforma shown below as Table 10 estimates social and environmental returns for DGT through the first 10 years of company operation.

Table X – DGT Social Return on Investment Proforma

Line Number	Title	Year 1	Year 2	Year 3	Year 4	...	Year 10
1	New Cubic Feet of Reactor Space	500	2,000	10,000	50,000	...	1,250,000
2	Cumulative Cubic Feet of Reactor Space	500	2,500	12,500	62,500	...	4,032,500
3	Capital Cost of Reactor Installed	70,882	283,529	1,417,647	7,088,235	...	177,205,875
4	Economic Return to Municipalities	74,000	444,000	444,000	444,000	...	2,294,000
	Social and Environmental Benefits						
5	1. Social Value of Reduction in Gasoline Use	7,325	36,625	183,125	915,625	...	59,076,125
6	2. Social Value of Methane Reduction	5	9,912	59,445	307,114	...	19,972,006
7	3. Municipal Social Return	60,680	364,080	364,080	364,080	...	1,881,080
8	Total Social and Environmental Benefits	68,010	410,617	606,650	1,586,819	...	80,929,211
	Operating and Capital Costs						
9	Total operating expenses	394,800	818,820	1,192,480	1,436,200	...	26,386,400
10	Capital expenditures			2,000,000	10,000,000	...	3,000,000
11	Total Operating and Capital Costs	394,800	818,820	3,192,480	11,436,200	...	29,386,400
12	Social Purpose Benefit Flow	(326,790)	(408,203)	(2,585,830)	(9,849,381)	...	51,542,811
13	Economic Discount Rate	12%					
14	Social Return Beta	6.08%		number of sources = 42			
15	Social Return Discount Rate	18.08%					
16	NPV of Social and Environmental Benefits	50,935,799					
17	NPV of Project Costs	40,739,488					
18	Benefit-Cost Ratio	1.25					
19	NPV of Social and Environmental Benefits	50,935,799					
20	Enterprise Value	222,423,306					
21	Long Term Debt	0					
22	Blended Value	273,359,105					

Lines 1 through 4 of the proforma show estimates of product volume installed at municipalities worldwide, the capital cost of these systems, and the full economic return to municipalities.

The social and environmental benefits follow in lines 5, 6 and 7. These values are all calculated based on the cumulative cubic feet of reactor space installed (line 2) and the estimates of return in each category that were outlined in earlier sections of this document. Line 8 (Total Social and Environmental Benefits) is the sum of lines 5,6 and 7 and is a representation of the total social revenue generated by DGT each year.

Lines 9 through 11 estimate operating and capital costs of the business and are based on detailed financials from the full DGT business plan. Line 12 (Social Purpose Benefit Flow) is the equivalent of net social benefit and is calculated by subtracting costs (line 11) from social revenue (line 8).



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The economic discount rate chosen for this proforma (line 13) is 12%. This rate was selected because it is the low point of the 12% to 20% range expected by social investors. Multiple discount rates can be used in the model depending on the return expected by the investor evaluating the company as shown in able XI.

Table XI – Sensitivity Analysis of Economic Discount Rate

10 Year Blended Value						
Discount Rate	EBIDTA Multiples					Benefit Cost Ratio
	5	6	7	8	9	
14.00%	177M	204M	231M	257M	284M	1.23
13.00%	193M	222M	251M	280M	309M	1.24
12.00%	210M	242M	273M	305M	337M	1.25
11.00%	228M	263M	298M	332M	367M	1.26
10.00%	249M	287M	325M	363M	401M	1.27

Social Return Beta

The calculation of social return often relies on multiple references that estimate the external cost of certain environmental or social harms. In DGT’s case eleven different sources are cited for the estimates of municipal efficiency. These figures range from 66% to 94.5%. While it is tempting to rely solely on the average value of these estimates for the calculation of social return for DGT, doing so will not fully quantify the variability in estimates and associated increased risk that future social returns may be lower than estimated.

In an attempt to quantify this increased variability of social returns, DGT proposes the evolution of a metric known as Social Return Beta. This metric equates the increased variability of estimates to an increased discount rate for social returns. This metric further discounts future social returns that are based on widely varying estimates of social value or harm. DGT’s definition of Social Return Beta is an evolution of a Beta term first introduced by the Roberts Foundation (REDF) in 2000 to measure the difficulty of serving different target populations with social services (*Social Return on Investment: Exploring Aspects of Value Creation in the Nonprofit Sector, 2000, pg. 149, www.redf.org/download/boxset/REDF_Vol2_8.pdf*).

DGT proposes a definition of Social Return Beta as the percent range of estimates divided by the number of estimates available.

$$SR(\beta) = \frac{\% \text{ range of estimates}}{\# \text{ of estimates}}$$

For DGT’s estimate of municipal efficiency the Social Return Beta is calculated as 30.16% (the range of all estimates) divided by 11 total estimates to yield a Social Return Beta of 2.7%. This figure is then combined with the other Social Return Betas for DGT and a weighted average calculation based on the total social returns for each metric yields an overall Social Return Beta for DGT of 6.08%. This calculation is shown below in Table XII.



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Table XII – DGT Overall Social Return Beta

	SR Beta	Benefits	Weighted Value
Gasoline Use	4.32%	153,136,450	73.01%
Methane Reduction	11.61%	51,752,894	24.67%
Municipal Social Return	2.74%	4,854,400	2.31%
		Overall Social Return Beta	6.08%

This value of 6.08% is a quantification of the amount of variability in the estimates of social value associated with DGT's product. This value is added to the economic discount rate used in the proforma analysis to yield a total Social Return Discount Rate of 18.08%. This value is used in the Net Present Value calculations of social return shown in the proforma. The Social Return Beta therefore reduces the estimates of future social return based on the amount of variability in the estimates that went into calculating the social return.

The motivation for the use of this or a similar term to quantify social return risk is for investors to have a tool to compare social return estimates across multiple ventures and multiple industries. SROI analysis is fundamentally the measurement estimates built upon quantitative financial analysis. Social Return Beta is an attempt to add increased quantifiable financial metrics to social return analysis.

This metric has limitations that require further analysis. Chief among them is the ability for an analysis that includes only one social return reference point to have a Social Return Beta of zero (zero variability divided by one source = zero). Further research and a redefinition of the Social Return Beta or a similar term is needed to account for this limitation. A stop-gap measure would be for each social venture to include in their proforma a listing of the number of references used in the analysis as a way to compare the robustness of analysis across different ventures. In the case of DGT, there were 42 references used to calculate the social returns and the associated Social Return Beta.

Further research is also required to indicate whether the Social Return Beta is an accurate measurement of increased social return risk. An analysis of multiple previous SROI's and actual returns as they relate to calculated Social Return Beta's would be required.



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Benefit Cost Ratio

The ratio of social benefits to social costs for DGT is calculated in lines 16, 17 and 18 of the SROI proforma. This calculation is a measurement of the ratio of the total social and environmental benefits (line 16) to the total project costs (line 17). This yields a benefit to cost ratio of 1.25 for DGT over a ten year time frame. This ratio changes with different assumed economic discount rates as shown in the sensitivity analysis of table XII.

Blended Value Calculation

DGT estimates the total blended value of the organization at 273 million dollars on a ten year time horizon. This is calculated using the following definition of blended value:

	NPV of Social and Environmental Benefits
+	Enterprise Value
-	Long Term Debt
=	Blended Value

Previously published definitions of blended value found by DGT added the social purpose value to enterprise value before taking out long term debt to arrive at a blended value. This definition double counts the costs associated with a venture and underestimates blended value. Double counting occurs because costs are taken out of both Social Purpose Value (Social Benefits – Costs) and enterprise value either through cash flow based valuation or multiples of earnings valuations.

For DGT’s analysis enterprise value was calculated as year ten earnings before interest and taxes times a 7x multiple discounted back to year zero at a 12% rate. A 7x multiple was used because analysis of mergers and acquisitions valuations showed that energy technology companies are generally trading hands at a value of from 7 to 10 times earnings. A cash flow based enterprise valuation could also have been calculated.



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CONCLUSION

DGT produces social and environmental returns by decreasing the use of non-renewable gasoline, reducing methane release and increasing municipal revenue. The net present value of these returns is shown in the following table.

Table XIII – Summary of DGT Social and Environmental Returns

Summary of Returns	Total Return	Return on \$1
NPV Gas Benefits	36,831,189	\$0.90
NPV Methane Benefits	12,442,072	\$0.31
NPV Municipal Social Return	1,662,539	\$0.04
Enterprise Value	222,423,306	\$5.46

These return calculations are based on multiple estimates of environmental and social returns and reduced in a quantifiable way by a Social Return Beta that accounts for the variability caused by multiple estimates.

ACKNOWLEDGEMENTS

DGT would like to thank the Global Social Venture Competition for the opportunity to present our analysis in London in April of 2004. Special thanks to Hass School of Business, Columbia Business School, London Business School, the Goldman Sachs Foundation and all of the student organizers of the 2004 competition. DGT also would like to thank the Entrepreneurial and Personal Enterprise program at Cornell University, the Center for Sustainable Enterprise at the Johnson School as well as the entire Johnson School community at Cornell University for their support and encouragement.

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