Project Impacts

The SD Tech Fund allocates 80%t of funding to projects that have climate change mitigation and clear air as the primary environmental benefit. The remaining 20% is allocated to clean soil and clean water projects.

At the end of Fiscal Year 2017/2018, SDTC has approved $774 M in funding to projects that primarily address climate change and clean air where:

• 92% has been allocated to projects that address primarily climate change and 8% has been allocated to projects that address clean air.

Since expanding the scope of environmental benefits in 2006, SDTC has allocated $163 M to projects that primarily address water and soil environmental benefits.

While projects are classified by a primary benefit, most projects actually result in multiple environmental benefits. The attribution to a specific primary environmental impact should be understood in the context of the following. Of the total portfolio of portfolio of 357 funded projects:

89% have climate change benefits;

72% have clean air benefits;

42% have soil or water benefits; and,

85% of all SDTC funded projects have more than one environmental benefit.

The unique contribution of clean technologies is derived from the coupling of environmental benefits with productivity and economic growth. SDTC portfolio projects achieve positive economic and environmental impacts relating to clean air, clean water, reduced waste, soil protection, and climate change mitigation. In fact, 85% of SDTC projects have multiple environmental benefits. As the portfolio matures, SDTC is developing better ways to quantify and report these benefits in order to clearly and accurately capture the full environmental value derived from SDTC investments in clean technologies.

SDTC is required to report on environmental benefits relating to clean air, clean water, soil, and climate change. Due to the advancement and growth in climate change mitigation initiatives, sophisticated methods for greenhouse gas (GHG) emissions quantification and reporting have been established. SDTC applies these internationally accepted methods to estimate climate change mitigation benefits of its investments based on forecasted and actual market roll-out. This approach has been very successful, however, similar estimating methodologies based on a common unit (e.g., CO_2e) are not currently available or in common use for clean air, clean water, or soil projects—either domestically or internationally. Consequently, SDTC has developed approaches for quantifying and reporting the benefits of clean air, clean water, and soil projects that accurately capture the value of SDTC investments in these areas.

Environmental benefits are realized when clean technologies are commercialized and deployed. For this reason, environmental benefits are associated with product sales and revenue figures. The expected annual revenues for SDTC-funded technologies in market at the end of 2017 are $2.47 billion. The forecast for 2022, for the same pool of projects grows to $6.7 billion annually. These values include only those projects that are reported to be in-market or projected to be in the market by the start of fiscal year 2017/2018.

Revenue reports and forecasts are based on market rollout reports provided by the funded organization (preferably), or by publicly-available market data for companies that disclose their financial and sales figures publicly.

The preferred vehicle for these reports are ad hoc questionnaires submitted to SDTC after project completion. Those sales and revenue reports for past years are taken at face value. Future sales and revenues and projects not reported directly to SDTC are subject to a discount factor ranging from 10% to 65% to account for this uncertainty.

Climate change

The estimated GHG reductions from a total of 101 SDTC projects in the market and reporting GHG benefits, at the end of 2017 are 13.5 Megatonnes of CO_2 equivalents emission reductions (CO_2e). As market presence grows, the forecasted emission reductions for 2022 range between 56 Mt CO_2e and 100 Mt CO_2e. This forecast is calculated based on the expected emission reductions per unit multiplied by the number of units forecasted to be deployed in the year. These numbers are also discounted on two major uncertainties: market rollout and technology performance. Market rollout discount is based on the estimated probability of the sales forecasted by the funded technology becoming real, and ranges from 5% to 100% likelihood depending on the perceived market risk by SDTC. Technology performance discounting is based on SDTC's assessment of the likelihood of a technology achieving its claimed environmental performance. That discount is assessed to each specific technology application and ranges from no discount for proven market-ready units to 35% discount for technologies that are in advanced prototype phase and require more development for market entry by the time a project is concluded. Normally, SDTC doesn't fund technologies at earlier technological stages.

Clean Air

Assessing the clean air benefits of projects is usually more complex than evaluating GHG reductions, as proponents quantify and report on potential benefits from total Criteria Air Contaminants (CAC) emissions reductions in tonnes(CAC)/year.

With regard to clean air impacts, a total of 67 projects have been identified as providers of clean air benefits in 2017. The actual environmental and human health impacts of CACs depend on population density and air shed concentrations in areas where they are emitted, and so merely reporting the emission reductions in amounts of pollutant does not fully reflect the actual benefits from these projects.

Using the input and validation from external environmental experts, SDTC has established a conservative methodology to quantify the benefits from clean air projects in terms or abated health impacts on human populations. This is based on Environment Canada's airshed concentration measurements and modeling and Health Canada's model (AQBAT), which allows a determination of the risk of health incidents in populations based on airshed concentration exposure. A similar approach is used by the US EPA to quantify the benefits of certain clean air policies. Using industry sub-sector specific parameters, the change in smog exposure risk that would result from CAC emissions reductions achieved through the deployment of SDTC clean air technologies can be estimated and translated to a change in likely health related cost impacts. Based on this approach, SDTC has modeled the impact of the 67 projects with clean air benefits, which report a reduction of health-related costs of $39 million in 2017, and a forecasted reduction of $124 million in 2022. This forecast is discounted for market rollout and technology performance uncertainties as described in the GHG section above.

Soil / Water

Impact quantification in terms of soil and water benefits depends on a wide range of factors which make the estimation of environmental benefits more complex than evaluating GHG or CAC emissions reductions. SDTC requests that proponents identify total water conservation, contaminant removal, waste reduction, and land conservation as part of their application. SDTC compiles and tracks these as potential water and soil benefits.

The actual environmental and human health benefits and value to society of water and soil related projects depend on considerations such as the type of contaminant, environmental fate of pollutants, paths of exposure, location, existing use of land or watershed. Contaminated or degraded freshwater and soil resources represent a cost burden to the Canadian economy. Conversely, the availability and access to clean water and healthy, viable soil provide valuable ecological services to the Canadian economy that generally go undervalued. Simply presenting the net water conservation or contaminant removal from water or soil does not provide a clear and quantifiable representation of the actual benefits.

Working with external experts in this area, SDTC has developed methodologies to quantify and report the benefits from SDTC's investments in water technologies over the past few years. This exercise identified an approach for estimating the avoided costs from the displaced environmental impacts.

In 2017, a total of 26 projects reported water benefits. These were quantified to have a positive impact valued at $46.5 million. By the year 2022, the portfolio of SDTC projects with water impacts is estimated to achieve a benefit value of approximately $72.5 million.

SDTC has recently implemented methodologies for estimating the benefits of clean soil projects that are completed or in progress. The clean soil benefits are based on the avoided costs associated with several parameters including; landfill tipping fees, soil treatment and remediation for contaminated soils, and the environmental effects of diverse pollutants present in soils. Loss of agricultural productivity is considered, but population health effects of pesticide application are currently excluded from the methodology pending approval of a reliable quantification metric. Valuing soil quality is difficult so a conservative estimate of parameters is used. In 2017, 29 SDTC projects achieved soil benefits. These are quantified at $76.8 million. In the year 2022, the portfolio of SDTC projects with soil benefits is estimated to have benefits valued at $96 million. The discounting methodology for the forecast uncertainty is similar to the air pollutant methodology above.

Landfill avoidance is reported in terms of total tonnes of material and monetized value based on avoided landfill tipping fee costs (using a $40/tonne tipping fee). Soil treatment avoidance includes diverse technologies and projects with wide-ranging applications. Benefits are reported as cost savings using the appropriate metric for each project, including; tailing pond size reduction for oil sands projects, rehabilitation of brownfield sites, treatment of halogenated soils, and other chemical treatments. Soil pollutant emissions reductions are also monetized based on parameters for managing key pollutants including: lead, cadmium, chromium, mercury, selenium, arsenic, copper, zinc, and dioxins.

Annual GHG Reduction Forecast by Sector (ktonnes CO_2e)

SDTC Sector	2016	2017	2018	2019	2020	2021	2022	2023
Energy Utilization	3,508	2,946	3,249	3,942	4,644	5,536	6,612	7,963
Transportation	4,307	6,061	6,101	7,891	11,365	14,797	20,610	30,214
Power Generation	15	28	51	109	258	547	1,037	1,721
Agriculture	45	67	114	237	346	461	595	641
Waste Management	338	410	474	572	705	872	1,083	1,335
Forestry	714	738	756	788	816	896	976	1,052
Energy Exploration & Production	2,446	3,329	3,782	3,994	4,151	4,421	4,784	5,229
Total	**11,373**	**13,578**	**14,527**	**17,533**	**22,286**	**27,530**	**35,698**	**48,156**

Clean Air Benefits Forecast (CAD)

SDTC Sector	2017	2018	2019	2020	2021	2022	2023
Energy Utilization	$ 22,669,146	$ 23,367,552	$ 24,569,430	$ 26,616,730	$ 29,114,380	$ 31,266,871	$ 33,768,543
Transportation	$ 4,509,298	$ 5,637,258	$ 10,376,032	$ 18,884,840	$ 34,072,392	$ 56,561,093	$ 86,392,574
Power Generation	$ 2,879,619	$ 3,016,076	$ 3,664,374	$ 5,420,322	$ 7,841,610	$ 11,417,394	$ 10,463,625
Agriculture	$ 280,663	$ 463,850	$ 936,877	$ 1,130,023	$ 1,279,680	$ 1,597,026	$ 1,654,287
Waste Management	$ 13,696	$ 51,621	$ 104,249	$ 164,801	$ 260,166	$ 391,688	$ 547,553
Forestry	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Energy Exploration & Production	$ 8,988,818	$ 10,369,394	$ 12,404,104	$ 15,602,207	$ 18,391,263	$ 22,978,947	$ 28,214,789
	$ 39,341,240	**$ 42,905,750**	**$ 52,055,066**	**$ 67,818,924**	**$ 90,959,491**	**$ 124,213,019**	**$ 161,041,372**

Clean Water Benefit Estimates (CAD)

SDTC Sector	2016	2017	2018	2019	2020	2021	2022	2023
Energy Utilization	$ 535,955	$ 561,520	$ 619,215	$ 682,023	$ 807,337	$ 913,262	$ 1,018,503	$ 1,122,719
Transportation	$ -	$ 407	$ 407	$ 813	$ 813	$ 1,220	$ 1,220	$ 1,627
Power Generation	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Agriculture	$ 307,631	$ 356,262	$ 409,678	$ 2,899,443	$ 5,358,167	$ 7,866,586	$ 9,655,239	$ 11,190,492
Waste Management	$ 44,013,933	$ 45,269,131	$ 46,818,894	$ 49,567,555	$ 52,395,435	$ 55,492,558	$ 58,976,998	$ 62,893,512
Forestry	$ 75,470	$ 75,723	$ 104,379	$ 160,548	$ 207,602	$ 255,405	$ 303,285	$ 351,232
Energy Exploration & Production	$ 228,351	$ 303,466	$ 428,885	$ 1,424,074	$ 1,698,139	$ 2,057,453	$ 2,474,573	$ 2,968,644
	$ 45,161,340	**$ 46,566,509**	**$ 48,381,458**	**$ 54,734,457**	**$ 60,467,493**	**$ 66,586,486**	**$ 72,429,818**	**$ 78,528,225**

Clean Soil Benefit Estimates (CAD)

SDTC Sector	2016	2017	2018	2019	2020	2021	2022	2023
Energy Utilization	$ 467,104	$ 661,848	$ 713,925	$ 872,123	$ 2,341,849	$ 3,166,832	$ 3,340,843	$ 3,456,536
Transportation	$ -	$ 1,366	$ 1,366	$ 1,543	$ 1,543	$ 1,721	$ 1,721	$ 1,898
Power Generation	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Agriculture	$ 3,499,207	$ 4,349,692	$ 4,530,899	$ 5,061,240	$ 5,746,014	$ 6,573,251	$ 7,497,454	$ 8,451,174
Waste Management	$ 65,580,079	$ 71,658,532	$ 73,928,418	$ 77,045,834	$ 79,917,178	$ 80,951,145	$ 85,373,938	$ 91,096,278
Forestry	$ 37,080	$ 121,540	$ 136,276	$ 140,353	$ 140,952	$ 173,729	$ 232,619	$ 239,281
Energy Exploration & Production	$ -	$ 26,280	$ 29,049	$ 48,307	$ 56,559	$ 73,443	$ 81,955	$ 100,691
	$ 69,583,469	**$ 76,819,258**	**$ 79,339,932**	**$ 83,169,400**	**$ 88,204,096**	**$ 90,940,120**	**$ 96,528,530**	**$ 103,345,859**

Annual Revenue Forecast by Sector (CAD)

SDTC Sector	2016	2017	2018	2019	2020	2021	2022	2023
Energy Utilization	$ 527,440,466	$ 510,710,332	$ 567,780,587	$ 774,839,738	$ 966,470,052	$ 937,462,157	$ 1,111,660,236	$ 1,274,317,556
Transportation	$ 943,184,533	$ 1,308,468,613	$ 1,900,098,780	$ 2,206,696,003	$ 2,962,054,120	$ 3,357,937,917	$ 3,592,884,248	$ 3,806,953,199
Power Generation	$ 181,925,500	$ 215,365,000	$ 346,870,000	$ 390,220,000	$ 481,680,000	$ 654,265,000	$ 875,812,500	$ 1,142,703,750
Agriculture	$ 1,253,875	$ 1,752,840	$ 8,392,532	$ 22,614,597	$ 35,242,095	$ 50,666,824	$ 70,423,526	$ 83,941,149
Waste Management	$ 37,946,250	$ 54,097,165	$ 106,251,965	$ 162,910,165	$ 266,543,165	$ 298,974,165	$ 354,359,165	$ 403,478,165
Forestry	$ 31,568,750	$ 51,620,625	$ 40,080,000	$ 42,478,125	$ 43,593,750	$ 52,761,250	$ 68,511,250	$ 86,886,250
Energy Exploration & Production	$ 154,043,700	$ 346,384,228	$ 514,559,583	$ 530,248,647	$ 444,077,572	$ 487,115,677	$ 592,586,040	$ 690,550,975
	$ 1,877,363,074	**$ 2,488,398,803**	**$ 3,484,033,447**	**$ 4,130,007,275**	**$ 5,199,660,754**	**$ 5,839,182,990**	**$ 6,666,236,964**	**$ 7,488,831,044**

Only projects deemed by SDTC to have entered the market are included in this report. Forecasted annual project revenues are subject to a discount based on the level of uncertainty for each specific project. Past project revenues formally reported to SDTC or those obtained through financial reports to investors (or similar official sources) are not discounted. All other forecasts are subject to variable discounts depending on the reliability of the source material, time elapsed since the release of the original report, and whether a specific product line has previously successfully entered the market.

SDTC Methodology for Reporting on Emission Reductions

Methodology at the Statement of Interest (SOI) Level

Reporting at the SOI level is based on applicant self-reported and unverified GHG emission reductions estimates. Some of the proponents supply calculations of GHG emission reductions and these estimates are used in tabulations. The SOI form requires applicants to indicate GHG emission reductions estimates in kilotonnes CO_2 and CO_2 equivalents over a ten year period.

These GHG emission reductions estimates, when reported by SDTC, are always classified as undiscounted and considered optimistic.

Methodology at the Full Proposal Level

At the Full Proposal level, applicants are required to submit a table indicating their individual per-unit technology impact (as a baseline), along with their anticipated market roll-out over a period of ten years. To account for the variety of technologies, market factors, and quality of proposals, a discounting factor is applied by SDTC to figures reported by applicants. These numbers are stated as discounted GHG emission reductions estimates. To avoid violating confidentiality agreements, proponent data is only shared with the external community in aggregate form.

The GHG emission reductions factors and calculation methodologies used are those determined by the Government of Canada so that SDTC is consistent with federal department reporting. SDTC provides applicants with assistance in producing estimates of GHG emission reductions estimates. It may refer applicants to GHG measurement and reporting experts in ENGO's or Sustainability Consultants, to undertake the calculations on their behalf. Note that applicant reported GHG emission reductions values are evaluated by technical experts during Gate Two of the Funding Allocation Process.

Methodology for Discounting GHG Emission Reductions Estimates

Completed projects have well developed and demonstrated technology performance parameters. Therefore, there is no discount applied to the per-unit environmental benefits of these technologies.

The most accurate data sources include Post Project Completion Questionnaires (PPCQ's) completed by project proponents to retroactively report successful sales. These are not discounted and are used as reported.

There are, however, some uncertainties from the market rollout figures. projects do not report each and every sale and market deployment to SDTC as PPCQ's are only provided every two years on a voluntary basis. In the absence of these reports, SDTC will seek to find up-to-date information through media, marketing reports, financial statements, or other information sources where trustworthy sales figures can be tied to a specific SDTC project. For example, a company's annual financial statements may include product lines that are directly the result of the SDTC projects and so are considered "confirmed" sales. However, they also cite other sales that may be related to the SDTC funded project, but outside the direct scope of the funded project. Due to the uncertainty these are excluded in keeping with the principle of conservativeness.

In the absence of up-to-date, retroactive sales data, SDTC refers to project forecasts. The simplest sources are documents submitted to SDTC, such as company CA or market reports for final milestones. Forward-looking sales projections, including those for the current year, are discounted due to their uncertainty. Where a project has confirmed previous sales, the discount ranges from 25% to 75%, depending on the level of uncertainty perceived by SDTC. Non-completed projects with medium levels of uncertainty (standard) are discounted by 83% on their sales, while projects with high and very high risk are discounted from 90% to 99%.

In summary there are two different discount factors applied, one based on technology performance risk and the second based on market deployment. The technology performance risk for completed projects is zero, and therefore this parameter is undiscounted. With regard to the market rollout, projects that report successful market deployment in past years are not discounted. Unconfirmed sales (current or future years) are applied a discount between 25% and 99% based on SDTC's perception of likelihood.

Methodology for Discounting Future GHG Emission Reductions Estimates

These figures include adjustments for the uncertainty of projections by applying a discounting factor to individual projects. GHG emission reductions projections are inherently forward-looking statements. They involve risks and uncertainties that could cause actual results to differ materially from those contemplated. SDTC believes it has a reasonable basis for making such forward-looking statements by:

- Requiring every applicant to estimate future GHG emission reductions using a prescribed methodology based on accepted ISO and IPCC practices;
- Reviewing the reasonableness of projected GHG emissions reductions reported by applicants and, as new information is reported, adjusting projections and excluding projects on hold; and,
- Applying a discount rate. This discount rate is based on two major sources of uncertainty: technological performance and market deployment.

Technology Performance

SDTC funds unproven, high-risk technologies. Therefore, we apply an uncertainty factor to the expected performance of the technology. At the beginning of a project, we expect it to undergo numerous iterations and refinements; SDTC denominates this a non-validated technology, and, therefore an untested, "desktop" presentation of a technology will have its expected performance adjusted down by 35%.

As the project progresses, the performance discrepancy between the current version of the technology and the final product is expected to diminish. Normally, this stage also includes an adjustment to the original expected performance. Once a project presents significant technological progress on the field SDTC will change its status to validated, it is assessed by a third-party environmental consultant and its discount factor is reduced to 20%.

Finally, as a project is completed, SDTC receives a final assessment of the technology as it is expected to be deployed in the field. The performance of each unit is analyzed by an additional environmental consultant (two different experts), after all the iterations are finished. This technology is now considered to be confirmed, and is, thereby, termed undiscounted.

Market Roll-out

The second discount parameter refers to market rollout. This is similar to the methodology for completed projects presented above. SDTC funds projects with substantial risks and barriers to market entry. We consider four levels of market uncertainty:

Level of Market Uncertainty	Description
CERTAIN	This applies to confirmed sales (i.e., for completed projects). 0% discount—note that SDTC does not generally audit invoices, receipts, or other documentation that confirm sales. We trust that our proponents will report actual sales truthfully.
HIGH LIKELIHOOD	This applies to projects that SDTC deems to be very likely to deploy in the numbers forecasted. The discount ranges from 10% for completed projects with high reliability (e.g., standing orders reported) to 75% for non-completed projects that are perceived to be low risk. We apply the higher likelihood to short-term forecasts of projects that are already in the market (e.g., an increase in Westport's deployment in 2014 and 2015).
MEDIUM LIKELIHOOD	This applies to most of the forward-looking sales estimates. Our basic discount parameters are 50% for completed projects and 87% (only 13% likelihood of sales) for projects in progress, based on work done by SDTC and Robinson Research for portfolio performance in 2005-2010. This reflects the high-risk nature of SDTC projects.
LOW LIKELIHOOD	Some projects have even higher risks of failure. For these, we apply a discount factor of 75% for completed projects, up to 90% to 99% for projects deemed to be high-risk. This is reserved for unusually problematic problems, or those which presented a very ambitious market rollout that SDTC considers very unlikely to be met or difficult to verify. Ecosmart is a good example: the structure of the consortium has made it very difficult to trace the actual deployment of this ambitious technology in a manner that would allow SDTC to quantify the extent to which it is being used.

Summary

These two discount parameters are used to evaluate the annual benefits forecasted by each project. SDTC has historically used a 93.5% discount rate (low likelihood of sales, non-validated technology equivalent to 0.1 x 0.65 = 6.5% likelihood of benefits materializing) on a project's initial benefits estimate. However, current understanding tends to suggest that the market-entry risk is actually higher (i.e., less than one in ten of the sale units forecasted by a proponent at the initial presentation of a project take place as scheduled), while technology risk is lower since the SDTC team has a strong grasp on technological capabilities.

Methodology for Calculating and Discounting CAC Emission Reductions

SDTC-funded projects report clean air impacts in tonnes of criteria air contaminant (CAC) emissions reduced per year. This calculation includes the criteria air contaminants; particulate matter (PM), Nitrogen Oxides (NO_x), Sulfur Oxides (SO_x), and volatile organic compounds (VOCs).

The actual environmental and human health impacts of CACs depend on population density and air shed concentrations in areas where they are emitted. For example, the impact of smog precursors emitted in a high-population-density urban area is more significant than if they were emitted in a low-population-density area. Therefore, presenting the net CAC emissions reductions in "tonnes of X" alone does not give

the full picture of the actual benefits from SDTC clean air projects. To show the benefits of these projects at the national level, SDTC has fol- lowed industry best practices to calculate avoided health-related impact costs.

Using input and validation from external experts, SDTC has established a defensible and conservative methodology for presenting the ben- efits from clean air projects in a way that takes into account regional and industrial variations in impacts. This methodology is based on Environment Canada's regional air shed concentration measurements and modeling and Health Canada's Air Quality Benefit Assessment Tool (AQBAT), which allows a determination of the risk of health incidents in populations based on air shed concentration exposure.

The procedure is similar to the GHG benefit discount, but is adjusted by an extra parameter: the monetization of environmental damages caused by air pollutants. The methodology for this estimate is based on the Damage Function Approach (DFA) to monetize the impacts from individual pollutants. This approach follows a logical progression from emissions, through dispersion in the atmosphere and exposure, quantification of health impacts, and their valuation. This approach has been used consistently in Canada and globally to estimate damages associated with air pollution. For instance, Environment Canada used this method to quantify the benefits of the Regulatory Framework for Air Emissions.

These parameters have been devised by environmental experts, based on technology sector, exposure rates, and damage estimates. The most significant parameters are those related to morbidity and mortality, as these costs tend to constitute the majority of the unit-intensity effects calculated.

Similar to GHGs, these results have been discounted by a maximum 93.5% to account for market entry and uptake risk, subject to the same adjustments—when a project's technical capabilities are well understood its tech risk uncertainty is reduced, and the market rollout discount factors are adjusted or removed upon successful market entry.

Evaluation, Contracting, and Reporting

Projects approved for funding go through a rigorous contracting process which obligates the proponent to achieve set milestones before subsequent payment is issued. These milestones are indicators of progress towards creating GHG/CAC emissions impact—covering the performance of the technology, scaling of associated demonstration facilities, and ultimate rolling sales forecast based on actual units sold by region and year. Using internationally accepted standard methodologies (CAN/ISO 14064-1) for GHG emission reductions measure- ment, SDTC uses in-region baselines to determine the incremental improvement or acceleration of emissions reduction of a given approach. However, SDTC takes this baseline one step further by providing a rolling forecast based on sales projections. This bottom-up and sales- based approach enables SDTC to report GHG emission reductions impacts with a high degree of confidence. The source of error, therefore, is the confidence level placed in the benchmark itself. This benchmark data is typically provided in the form of tables from the industry in conjunction with Environment Canada and NRCan.