

Final Report

2017 Interim Evaluation of the
NextGen Biofuels Fund

Sustainable Development
Technology Canada

Prepared for

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List of Abbreviations Used in Report

AECN	AE Côte-Nord RTP™ Project
AFF	Application for Funding
BDC	Business Development Bank of Canada
BDMT	Bone dry metric tonne
Capex	Capital expenditure
CO _{2e}	Carbon dioxide equivalent
DOE	US Department of Energy
ecoABC	ecoAgriculture Biofuels Capital Initiative
ecoEBF	ecoEnergy for Biofuels
EDC	Export Development Corporation
EPA	US Environmental Protection Agency
GC	Government of Canada
GHG	Global greenhouse gas
IOI	Indication of Interest
ISED	Innovation, Science and Economic Development Canada
MDVB	Mascoma Drayton Valley Biorefinery
MSW	Municipal solid waste
NGBF	NextGen Biofuels Fund
NRCan	Natural Resources Canada
PAP	Project Assurance Process
PFC	Project Finance Committee
PRC	Project Review Committee
RFO	Renewable fuel oil
RFS	Renewable Fuel Standard
RTP™	Rapid Thermal Processing
SDTC	Sustainable Development Technology Canada

Executive Summary

Background

In September 2007 the Government of Canada signed a funding agreement with Sustainable Development Technology Canada (SDTC) that established the NextGen Biofuels Fund (NGBF), with a funding level of \$500 million. The main objective of the Fund is to facilitate the establishment of first-of-kind commercial demonstration-scale facilities for the production of next-generation renewable fuels and co-products from non-food feed feedstocks. The Fund operates as a repayable contribution, to be repaid by recipients from free cashflow once a facility is fully operational. The contribution to each project was capped at 40% of the total project cost, up to a maximum of \$200 million. Applicants progressed through a stage-gate approval process called the Project Assurance Process (PAP).

The ten-year NGBF sunset on March 31, 2017 as planned. Two projects (both SD Tech Fund graduates) successfully completed pre-construction planning in accordance with the PAP and received approval for final funding commitments by the SDTC Board of Directors. The Enerkem Alberta Biofuels Project (Enerkem) in Edmonton, Alberta converts municipal solid waste to cellulosic ethanol, replacing gasoline or first-generation ethanol in fuels in the transportation sector. The AE Côte-Nord (AECN) RTP™ project in Port Cartier, Quebec converts forestry mill white wood residuals and forestry waste materials to Renewable Fuel Oil (RFO), replacing fuel oil from fossil fuels used in industrial boilers and furnaces.

Two other Applications for Funding (AFFs), the Mascoma Drayton Valley Biorefinery (Drayton Valley, AB) and the Vanerco Project by Enerkem and Greenfield Ethanol (Varennes, QC) also made progress under the PAP but were discontinued.

Over the period covered by the evaluation, i.e., from January 2012 to March 31, 2017, total expenditures of the NGBF were \$87.9 million. Of this total, \$81.2 million was associated with the four projects noted above, while the balance, \$6.7 million, consisted of administrative expenses.

The 2017 Interim Evaluation

The NGBF Funding Agreement identifies the need for interim evaluations at specific periods during the life of the fund. The Foundation agreed to conduct and submit to the Government of Canada three evaluations to be carried out by an independent third party, by November 30, 2012, November 30, 2017 and November 30, 2022.

The first interim evaluation was completed by Robinson Research on November 21, 2012. The 2017 interim evaluation covered the period following the 2012 interim evaluation to the present. The focus was on assessing the project delivery process, the short-term results

achieved and to identify any lessons learned. Activities related to the repayment and close out of the NGBF will be examined by the final evaluation in 2022.

The 2017 Interim Evaluation involved a review of NGBF documents and project files; interviews with various stakeholder groups including SDTC management and staff (current and former); Innovation, Science and Economic Development Canada; members of the Project Review Committee and the Board; an external expert adviser; and, representatives of the NGBF project proponents. Case studies of the Enerkem and AECN projects were prepared (summaries are included in Appendix D).

Findings

1. Delivery of the NGBF

a) The proposal review and selection process featured a high level of due diligence

There is consensus that the level of scrutiny (due diligence) associated with the NGBF proposal review and selection process was extensive and very thorough, and comparable to what would be expected had proponents attempted to raise private financing instead. Two of the project proponents noted that the NGBF process involved a considerable amount of “back-and-forth”, many additional questions, and heavy data demands. A related factor was the NGBF organizational model that was in place until late 2015 that involved two program managers; having one manager in charge might have expedited the process.

b) The PAP was an appropriate project management system

The PAP stage-gate process was adapted from the front-end engineering approach used for large capex projects by engineering, procurement and construction (EPC) firms in the process industries (e.g., oil and gas, chemical processing). The stage-gate process is considered to be the industry standard for the management of large capital, complex projects of the type supported by the NGBF. Interviews conducted as part of the present evaluation confirmed that the stage-gate process was appropriate. The decision by the SDTC to use the PAP was well justified, given the Fund had resources to support only a handful of high-risk projects and the fact that the Board was highly cognizant of its responsibility for the stewardship of public funds.

c) The PAP process was protracted but became more flexible over time

The PAP process successfully identified and excluded from further support technologies that were not ready for full-scale demonstration or were not commercially viable. But for technologies that were selected for support, the PAP process could become protracted. The previous 2012 evaluation stated that smaller companies with no prior experience with a stage-gate process may have found it unduly complex and daunting. One of the smaller project proponents interviewed as part of the present evaluation agreed that a larger company with a large team might have found the process easier to deal with. For this smaller company, the problem was not with the PAP itself; the problem was more with the amount of time required to proceed through the process.

One of the project proponents that did not proceed all the way through the PAP process indicated that the process should have been shorter. The problem was that the proponent and SDTC staff tended to get stuck on each phase, which raised the level of uncertainty and created some doubt about whether the end point would be reached.

One of the larger project proponents found the PAP approach to be very conservative. Originally, SDTC staff had displayed a lack of flexibility with the PAP, but as the project continued and the need for flexibility became more evident, SDTC staff and the process became more flexible.

d) SDTC managers and external advisers are highly competent and professional

The interviews with NGBF project proponents revealed that they have a high regard for the competence and professionalism of the Fund's managers. They noted that while there has been some turnover in SDTC senior management and NGBF managers over the years, this turnover did not affect the quality of support provided to project proponents. In the early years of the NGBF, the Fund was co-managed by two managers, one with a financial background and the other with a technical background. In October 2015, this dual-manager team was replaced by a single manager who had a combined financial/technical background. The overall view of project proponents is that they preferred the single manager structure.

SDTC management and project proponents made nothing but positive comments about the Fund's external advisers who were involved in such activities as the AFF due diligence process and in reviewing claims for payment associated with the two approved projects.

e) Processing of claims for payment became more efficient over time

The processing of claims for payment submitted by the two project proponents became more efficient over time. Claims were audited by an external accounting firm. Instead of reviewing all invoices related to a claim, at one point a modified procedure was established to streamline the audit process, to audit invoices on a sample basis. This change did not increase the level of financial risk. As an added layer of insurance, upon completion each project was subject to a full financial audit.

f) The NGBF administrative expense ratio was 7.7%, which is much lower than federal government clean tech innovation programs

Over the evaluation period, the NGBF's administrative expense ratio was 7.7. This is much lower than for federal government clean tech innovation programs, which average 29%.¹ For SDTC as a whole (i.e., including both the NGBF and the SD Tech Fund), the administrative expense ratio is 11%.

¹ <https://www.canada.ca/en/treasury-board-secretariat/corporate/reports/inventory-federal-business-innovation-clean-technology-programs.html>

2. Results of the NGBF

a) The NGBF supported the construction of fewer next generation biofuels plants than originally hoped for

Over the complete history of the NGBF (2007 to March 31, 2017), a total of 17 Applications for Funding (AFFs) were received, most of which had received prior support from the SD Tech Fund.

In addition to the two fully-funded projects described above, two other projects, Vanerco and Mascoma Drayton Valley, made some progress under the PAP but were terminated along the way (Enerkem switched its focus from Vanerco to Enerkem Alberta Biofuels, and Mascoma withdrew its application due to a number of factors including changes in strategic direction among the project partners). A third project (a plasma gasification from municipal solid waste project led by Plasco Energy Group in Ottawa) was presented to the NGBF's Project Review Committee (PRC), but was finally rejected by the Board in January 2015.

b) The lower than intended output and expenditures of the NGBF are due to factors beyond the control of the SDTC

SDTC management has done considerable analysis over the years regarding the challenges faced by the NGBF in attempting to support qualified applicants. Even if the total of \$500 million in funding had been committed, it would have been possible to support only a handful of projects.

SDTC staff invested considerable effort in publicizing the NGBF within the biofuels community. Interviews with former NGBF managers confirmed that the Fund tracked over 100 companies in the early years. It is probable that any company with a potentially viable technology was aware of the Fund.

The Fund was constrained by being narrow in scope. "Second-of-kind" plants were excluded, even though commercial lenders view these plants as still being risky. The Government of Canada decided not to expand the scope of the NGBF to support other types of renewable energy projects, although new technology areas did emerge over the years.

Overall, the evidence indicates that the Fund's due diligence process worked exactly as intended: projects that did not demonstrate that their technologies were ready to move to full-scale demonstration or were commercially viable were not approved.

The overall view is that the NGBF was probably several years "ahead of its time." Had the Government of Canada allowed for, say, another five years, then additional AFFs might have come forward and been approved for full funding.

c) Both of the approved projects appear to be on track to successfully achieve their short-term objectives

In September 2017, Enerkem announced that its plant had begun commercial production of cellulosic ethanol, becoming the first commercial-scale plant in the world to produce cellulosic ethanol made from non-recyclable, non-compostable mixed municipal solid waste. Ramping up to full-scale production will take about a year. While the results of this project are somewhat tentative at this time, it appears that the plant likely will achieve its planned output, production efficiencies and expected environmental benefits.

The AECN project is on schedule to begin production of renewable fuel oil in early 2018. Contracts are in place to supply this fuel oil to facilities in the US, displacing fossil fuel derived oil in industrial boilers and furnaces. This project will receive US RFS-2 incentives through its use of forestry waste as a feedstock and production of renewable fuel.

d) The results achieved by the two approved projects are at least partly attributable to the NGBF

Of the two funded projects, it appears that any results to be achieved by the AECN project will be fully attributable to the NGBF, while the results from the Enerkem project will be partly attributable to the Fund.

For Enerkem, a most likely scenario in the absence of NGBF funding would have seen construction of phase 1.5 only (methanol), since process engineering and purchase orders for equipment were already in place when the funding decision was made. Halting development at the end of phase 1.5 would have meant that only some (those related to methanol) of the benefits of the full project likely would be achieved. In addition, without NGBF support, phase 2 of the project likely would have proceeded but would have been delayed. Kelly Sears suggests that the delay would have been in the range of three to five years.

For the AECN project, all evidence suggests that the project would not have proceeded without NGBF support.

e) The two NGBF projects will lead to longer-term impacts

The next project for Enerkem will be to revive the Vanerco project in Varennes, Quebec. In addition, plans are underway for Enerkem to build a plant at the Port of Rotterdam in the Netherlands, which will provide methanol from waste. Plans are also underway to develop a plant in Dakota County, Minnesota, which will be modelled on the Enerkem facility, turning municipal solid waste into ethanol.

For the AECN technology, the proponent's longer-term plans are not confirmed as of October 2017, although the company is intent in building additional new facilities. The key challenge continues to be securing financing. The proponent stated that even having demonstrated the success of its first large-scale facility, private lenders will remain unwilling to invest in the next project.

3. Lessons Learned

a) The global experience has shown that the initial expectation for the rapid development of the next generation biofuels industry was unrealistic

The ten-year timeframe for the NGBF was too short. The NGBF reviewed a total of 17 applications for funding. However, from 2007 to 2013, no company was ready for commercialization. Given the Fund had to stop accepting applications by the end of 2014, in hindsight it is not surprising that only two projects were approved for full funding.

Other factors inhibited the NGBF deal flow. Compared to the US, limited government funding was available to support the necessary R&D and demonstration projects. In Canada, the main funding source was the SD Tech Fund, which covers all cleantech technologies and not just advanced biofuel technologies.

Canada also lacked the comprehensive policy suite, particularly regulatory drivers, which would have helped to spur the development of the advanced biofuels sector.

b) The NGBF application review and selection process yielded the desired results

The NGBF application review and selection process worked as intended: in the end, two projects were funded for plant construction and all indications are that their facilities will be successful in moving into commercial production. Taxpayer dollars were not wasted: SDTC made a prudent decision to not support additional projects that in all likelihood would not have been successful, either technically and/or commercially.

c) The NGBF incorporated solid governance

The NGBF incorporated a solid governance structure and process. The Project Review Committee (PRC) was composed of experts from a variety of disciplines and was heavily involved in assessing project applications. Similarly, the SDTC Board members reflected a wide range of disciplines and took their project approval responsibilities seriously.

d) The unrealistic expectations for rapid sector growth resulted in a NGBF delivery model that needed to be streamlined over time

While project proponents viewed the PAP method as being appropriate for NGBF projects, its implementation was “heavy-handed” and overly rigid over most of the Fund’s ten-year history. The SDTC made a concerted effort to streamline the program delivery process in later years.

e) The NextGen Biofuels Fund can provide a model for future government-funded programs devoted to supporting the commercialization of cleantech

In summary, the NGBF was well designed; several of its key features could be considered in the design of future government funded programs focused on the cleantech sector. Its strengths include: a systematic proposal review and selection process; a project management process that is considered the industry standard for large capex projects in the resource sector; staff with

strong management and technical skills supported by external experts where needed; a governance structure and process that ensured that successful projects would be approved for funding; and its attractive financial terms (i.e., a repayable cash contribution rather than a loan or loan guarantee along with favourable repayment provisions).

The NGBF filled a critical void by providing funding to support Canadian next generation biofuels companies to advance their technologies from demonstration-scale to first-of-kind commercial scale, thereby enabling these companies to deliver significant environmental benefits to Canadians. The ten-year experience revealed that commercializing a next generation biofuels technology is a long and difficult journey. Indeed, as demonstrated by the AECN project, even with a successful commercial scale facility about to enter into production in early 2018, the financial services sector will still be reluctant to invest in the company's next commercial-scale facility. SDTC, with its long history and strong capabilities and processes, is well positioned to continue to support the growth of Canada's cleantech sector.

I Introduction

A. The Foundation

In 2001, the Government of Canada (GC) created and financed a foundation, Sustainable Development Technology Canada (SDTC), to “act as the primary catalyst in building a sustainable development technology infrastructure in Canada.” The SDTC operates at arm’s-length from the federal government under the guidance of a Board of Directors, a majority of whom are drawn from the private sector. The SDTC reports to Parliament through the Minister of Innovation, Science and Economic Development Canada (ISED).

Upon inception, the GC and the Foundation created the Sustainable Development Technology Fund (SD Tech Fund) to support demonstration projects for new sustainable development technologies that address climate change and the quality of air, water and soil.

B. The NextGen Biofuels Fund

In September 2007 the GC signed a funding agreement with the SDTC that established the NextGen Biofuels Fund (NGBF), with a funding level of \$500 million. The main objective of the Fund, as set out in the agreement, was to facilitate the establishment of first-of-kind commercial demonstration-scale facilities for the production of next-generation renewable fuels and co-products from non-food feed feedstocks.

The Fund was identified as one of four pillars to Canada’s Renewable Fuels Strategy announced in 2007. The strategy introduced mandated requirements for the use of ethanol and biodiesel, guaranteeing a market for renewable fuels, which burn cleaner than petroleum-based alternatives. Federal regulation requires 5% renewable fuels content in gasoline and 2% in diesel and heating oil; some provinces have reached even further, increasing the percentage of fuel that must be renewable content.

The NGBF currently is in its wind-down phase, having disbursed \$81.2 million to four projects over the period January 2012 to March 31, 2017. Two projects, the Enerkem Alberta Biofuels Project (Enerkem) in Edmonton, Alberta and the AE Côte-Nord (AECN) RTP™ project in Port Cartier, Quebec successfully completed pre-construction planning in accordance with the NGBF Project Assurance Process (PAP) and were approved for final funding commitments by the SDTC Board of Directors. The Enerkem project converts municipal solid waste to cellulosic ethanol, replacing gasoline or first-generation ethanol in fuels in the transportation sector. The AECN project converts forestry mill white wood residuals and forestry waste materials to Renewable Fuel Oil (RFO), replacing fuel oil from fossil fuels used in industrial boilers and furnaces.

Two other Applications for Funding (AFFs), the Mascoma Drayton Valley Biorefinery (Drayton Valley, AB) and the Vanerco Project by Enerkem and Greenfield Ethanol (Varennes, QC) also made progress under the NGBF PAP but were discontinued, for reasons outlined later in this report.

C. The 2017 Interim Evaluation

The NGBF Funding Agreement identifies the need for interim evaluations at specific periods during the life of the fund. An evaluation framework which provides the basis for the required monitoring was first provided in the Foundation's *Corporate Plan: April 2004*. The Foundation agreed to conduct and submit to the Government of Canada three evaluations to be carried out by an independent third party by November 30, 2012, November 30, 2017 and November 30, 2022.

The first interim evaluation was completed by Robinson Research on November 21, 2012, which was accompanied by a SDTC Management Response dated November 2012, a letter from the Minister of Environment dated January 10, 2013, and a Follow-up to the Management Response in January 2013.²

A logic model for the NGBF was developed which provides the underlying “program theory” for the NGBF, i.e., how the program’s activities link to its intended outcomes. The logic model is contained in Appendix A of the 2012 Interim Evaluation report.

The 2017 interim evaluation focused on the period following the 2012 interim evaluation to the present. The focus was on a subset of the activities listed in the logic model, pertaining to the review of applications for funding through to the build of the plants by the two project proponents (the Enerkem Alberta Biofuels and AECN projects). The main goal of the evaluation was to assess the short-term results achieved by these two projects and to identify their future likely developments. Other activities such as the level of awareness of the Fund among companies in the biofuels sector were examined by the first interim evaluation and were not examined again by the present study. Activities related to the repayment and close out of the NGBF will be examined by the final evaluation, planned for 2022.

D. Findings of the 2012 Evaluation

The main findings of the previous interim evaluation completed in November 2012 are outlined in the Overall Management Response:

- **The relevance of the Fund was confirmed** – There would be no NextGen projects without the support provided by the Fund. The need for the Fund was even greater due to equity and debt markets being more risk adverse due to broader economic

² At the time of the 2012 interim evaluation, SDTC (the Foundation) reported to Parliament via the Minister of Natural Resources and maintained a working relationship with Natural Resources Canada and Environment Canada. Today, it reports to Parliament via the Minister of Innovation, Science and Economic Development.

uncertainty. The Renewable Fuels Strategy continued to be government policy. The Fund did not overlap with other federal or provincial government initiatives.

- **The performance of the Fund was acknowledged** – The stage gate process for project management and commitment is best in class. A variety of technologies were being supported to mitigate risk. The Foundation received high marks for working with applicants and stakeholders to develop opportunities wisely.
- **Achievements and expected outcomes were recognized** – The Fund was well-known to the biofuels community; however, it appeared that “the fund has made no progress to the casual observer.” Progress in the early years was slow in all jurisdictions due to the industry over-promising and under-delivering, as well as being impacted by the 2008 financial crisis. The Fund was heading towards its potential for full commitment, with four projects in 2012 receiving Board approval for funding and for the SDTC to participate in early-stage development work. In addition, there were at least three more consortia undertaking fund eligibility discussions with the Foundation and likely more to follow. Progress of the Fund compared favourably to the US Department of Energy Bio-refinery program. A cost-benefit analysis projected a \$218 million net benefit to society, which would increase to \$1.4 billion with expected follow-on projects.

E. 2017 Evaluation: Issues and Methodology

1. Evaluation Issues and Questions

An evaluation matrix was developed to guide the three planned evaluations of the Fund, and was used in the 2012 evaluation. As the Fund is now closed, SDTC management directed that only portions of the matrix relating to the current status of the Fund be assessed by the 2017 interim evaluation. As such, it was decided that questions related to rationale/relevance and longer-term outcomes would not be assessed; they will be examined as part of the final summative evaluation scheduled for 2022.

The evaluation issues and questions selected for examination by the 2017 evaluation are listed in Table 1. Appendix A contains the evaluation matrix, i.e., the list of evaluation questions and the corresponding measurement indicators.

Table 1: Evaluation Issues and Questions Covered by 2017 Interim Evaluation

Evaluation Issues and Questions	Included or Excluded from 2017 Interim Evaluation?
Rationale/Relevance	
1. What is the rationale for the NGBF?	Excluded – covered by 2012 evaluation
2. How is the environment in which the NGBF operates changing?	
Delivery	
3. Are potential applicants and potential investors aware of the NGBF?	Excluded – relates to intake period, which ended in 2015
4. Are NGBF services delivered appropriately?	Included

Evaluation Issues and Questions	Included or Excluded from 2017 Interim Evaluation?
5. Are administrative resources adequate to meet the current/future demands for services?	Included
6. To what extent is there overlap or duplication with other programs?	Excluded – covered by 2012 evaluation
Results	
7. Short term results during project development and construction period	Included
8. Medium-term results, after the Commissioning Phase has been completed and the plant has begun operating,	Excluded – to be covered by 2022 evaluation
9. Longer -term results, when the plant has stabilized and established a record of its performance	Excluded – to be covered by 2022 evaluation
Lessons Learned/Potential Improvements	
10. What are the lessons learned?	Included
11. How can the NGBF be improved?	Excluded – no longer relevant as the fund has sunset

2. Methodology

The evaluation employed the following lines of evidence:

- **Review of NGBF documents:** SDTC provided the consulting team with key documents pertaining to the design and delivery of the Fund, including documentation on key business processes, the Project Assurance Process (PAP) and the assessment and scoring of Applications for Funding (AFF); internal and external presentations on the design of the Fund; application guidelines and forms; eligibility criteria; etc.
- **Interviews:** Kelly Sears worked with SDTC to identify a list of individuals who would be knowledgeable about the delivery of the Fund over the 2012 to 2017 timeframe. The breakdown of interviews by the various stakeholder groups is as follows:
 - SDTC management and staff (current and former), Project Review Committee and the Board (n=6).
 - NGBF external expert adviser (n=1).
 - Federal government (Innovation, Science and Economic Development Canada (n=1).
 - Representatives of NGBF project proponents, including the two projects that receive full funding approval (Enerkem and AECN) and another project (MDVB) that progressed part of the way through the Project Assurance Process (PAP) (n=3).
 - Representatives of companies that applied to the Fund but whose project applications were not approved (n=1).

- Interviews with individuals located in Ottawa were conducted in person while telephone interviews were conducted elsewhere across Canada. SDTC first emailed an introductory email and then Kelly Sears followed up to schedule the interview. A semi-structured interview guide (consisting of open-ended questions) was emailed to each key informant in advance of the scheduled interview. (The interview guides are included in Appendix C.) Interviews lasted anywhere from 30 to 60 minutes.
- **Case studies of the two projects that received full funding commitments:** Kelly Sears prepared case studies for the Enerkem Alberta Biofuels and AECN projects. Each case study involved an interview with the project proponent, a review of the NGBF project files and a review of available literature on the Internet. The case studies covered most of the evaluation questions, with a particular focus on the role of NGBF funding on the proponent's decision to undertake the project; assessment of the projected incremental environmental impacts (i.e., compared to baseline values for petroleum and first-generation fuels); and projections of future developments. Summaries of the two case studies are provided in Appendix D.

2. Limitations

There are some minor limitations with the approach conducted as part of the evaluation. Interviews could not be completed with some former SDTC managers who were involved in the delivery of the NGBF during the first part of the evaluation period (2012 to 2015); however, Kelly Sears did interview one member of the two-member NGBF management team that operated during this period. There was a change of leadership in 2015 initiated by SDTC in recognition that changes to the administration of the Fund were required. Also, the evaluation did not attempt to interview companies that had submitted Indications of Interest (IOIs) to the NGBF but which did not subsequently submit Applications for Funding (AFFs.) However, many of these companies had interacted with SDTC prior to 2012 and thus were interviewed as part of the previous interim evaluation. Also, the evaluation did interview two companies that had submitted AFFs: one that was not approved and the other that was withdrawn part-way through the PAP process.

The evaluation did succeed in conducting interviews with representatives of the two companies that received full NGBF contributions and thus the evaluation did accomplish its central goal which was to assess the success of these two projects and identify their future developments.

II Profile of the NGBF

This section presents a concise overview of the NGBF in order to provide the context for the evaluation findings presented in section III. Further details on the rationale, design and delivery of the Fund may be found in the 2012 interim evaluation report.

A. History and Rationale

1. The Business Case for Biofuels in Canada

The development of a new technology, including a new “cleantech”, passes through several stages from fundamental research to commercialization and market entry. When the SDTC Foundation was established in 2002, it entered into an agreement with the Government of Canada that established the Sustainable Development Technology Fund (SD Tech Fund). The SD Tech Fund was designed to support technologies to achieve successful demonstrations.

SDTC observed at the time that about one-third of SD Tech Fund projects involved biomass, including renewable fuels, co-products, bioenergy and enabling technologies. In 2006 the SDTC published a study that examined opportunities in this area, entitled *Renewable Fuel – Biofuels – SD Business Case* (SDTC, 2006). The analysis outlined a major development opportunity for Canada, establishing a biofuels industry largely based on forest resources. The report noted that the technologies to develop biofuels brought to the demonstration stage with support from the SD Tech Fund would involve large capital expenditures. When these and other large “capex” technologies complete the demonstration phase, they then face substantial scale-ups to reach a commercial scale of plant. Traditional sources of loan and equity financing had always been extremely reluctant to accept the risk in supporting new technologies that had not previously operated at a commercial scale. The business case commented that institutional lenders were not yet inclined to support the next-generation biofuels industry because it had not yet been market proven. This situation was expected to improve as successful projects came on line.

2. Advanced Biofuels in the US

Several of the interviews conducted as part of the 2017 interim evaluation emphasized the importance of advanced biofuels policy in the United States to the future success of Canada’s biofuels sector. The US identified two main reasons to develop its biofuels capability, energy independence and reduction of greenhouse gases. These policy drivers coupled with the availability of stimulus funds has allowed the government to provide a significant array of support to the biofuels industry, expanding the production capacity for grain ethanol and supporting the development of the first commercial scale biorefineries. The Renewable Fuel Standard program and the first regulations (RFS1) were created in 2005 under the *Energy Policy Act*. Under the *Energy Independence and Security Act* of 2007, the RFS program was

expanded (RFS2) to create a demand for cellulosic ethanol as well as a system of tax credits to set a floor price for cellulosic ethanol of \$3.00 per gallon if volume targets were not met.

The *Energy Policy Act* called for the Department of Energy (DOE) to conduct a competition to construct next-generation biorefineries. The goal was to demonstrate that integrated biorefineries could operate profitably once their construction costs are covered and can be replicated. Four projects were supported by the DOE in 2007 at a total investment of \$272 million.³

As noted in the 2012 NGBF interim evaluation report, it appeared that in 2006 the US government shared the perception that next-generation biofuel technologies were ready for commercialization. However, proposals for funding revealed that more development work was required. US federal government funding for R&D and pilot and demonstration-scale facilities has continued to this day.

By 2022, the RFS requires 36 billion gallons of biofuels in transport fuels, of which 21 billion gallons must be advanced biofuels. To achieve these goals, the US Environmental Protection Agency (EPA) sets out annual targets. For 2017, 4 billion of 18.8 billion gallons of renewable transport fuels are to come from advanced fuels.

For every year since 2010, the EPA has lowered the target volume for cellulosic ethanol production. This has affected investors' confidence in the sector. As of January 2017, there were 14 operating cellulosic ethanol plants in the US, 9 of which are producing at commercial scale. Although the total capacity of these 14 facilities is approximately 104 million gallons per year, production for all of 2016 only reached 3.8 million gallons of cellulosic ethanol, much lower than the EPA's target of 123 million gallons for 2016 (which was much lower than the original target). The EPA's target for 2017 is 311 million gallons.⁴

3. Canada's Renewable Fuels Strategy

In 2006, Canada began to examine ways to reduce the consumption of fuels derived from finite non-renewable crude oil in favour of biofuels derived from renewable resources. This move was expected to reduce lifecycle emissions from fuel production, considering extraction/feedstock, production/refining, distribution and consumption. In other words, it should reduce the greenhouse gas (GHG) intensity of the fuels consumed in Canada. As well, reliance on biomass feedstocks should contribute social and rural development benefits.

The federal government was aware of the shortcomings associated with first-generation renewable fuels, principally grain-based ethanol. While the production process had achieved significant efficiency improvements, growing feedstock requires substantial volumes of fuel and fertilizer and first-generation ethanol production consumes energy and releases significant

³ The list of DOE Bioenergy Technologies Office funding announcements is available at: https://energy.gov/eere/bioenergy/bioenergy-technologies-office-closed-funding-opportunities#Integrated_Cellulosic_Biorefineries

⁴ <https://www.epa.gov/renewable-fuel-standard-program/final-renewable-fuel-standards-2017-and-biomass-based-diesel-volume#additional-resources>

volumes of GHGs. Since the feedstocks could be used as food, their use to produce fuel became controversial.

Next-generation biofuels promise to address many of these issues. The comparison is complex because a wide variety of feedstocks and conversion technologies could be used to produce about a dozen different fuels. In general, because they rely on non-food feedstocks, next-generation fuels avoid the food versus fuel controversy. Projections of life-cycle GHG emissions indicated superior performance compared to first generation fuels.

Throughout the policy discussions, it was clear that development and use of first generation fuels was seen as an appropriate first step in the movement toward biofuels. But achieving the anticipated benefits requires that next-generation fuels be developed and used. Canada committed to a strategy to expand the Canadian production and use of renewable fuels. The NGBF was identified as one of the four pillars of Canada's renewable fuels strategy. The other three pillars are:

- **Increase the retail availability of renewable fuels through regulation** – Federal regulation requires 5% renewable fuels content in gasoline and 2% in diesel and heating oil. The regulations do not differentiate between first and next-generation renewable fuels as had been done in the US.
- **Assist farmers to seize new opportunities in the renewable fuels sector** – The ecoAgriculture Biofuels Capital Initiative (ecoABC) provided \$200 million in repayable contributions for construction or expansion of transportation biofuels facilities.
- **Support the expansion of Canadian production of renewable fuels** – To stimulate domestic biofuels production, Natural Resources Canada established ecoEnergy for Biofuels (ecoEBF) to provide up to \$1.5 billion of operating incentives to biofuel plants.

B. Key Features of the NGBF

1. Purpose and Scope

The purpose of the NGBF was to:

- Facilitate the establishment of first-of-kind large demonstration-scale facilities for the production of next-generation renewable fuels and co-products.
- Improve the sustainable development impacts arising from the production and use of renewable fuels in Canada.
- Encourage retention and growth of technology expertise and innovation capacity for the production of next-generation renewable fuels in Canada.

The Fund was aimed at near-full or full-scale production plants of biomass-based feedstock to produce next-generation bio-ethanol and at biodiesel plants that are at the stage of development where there remains some technological risk.

The Fund was to provide up to 40% of the eligible project costs through a contribution to be reimbursed from free cash flow over a ten-year period starting at the end of plant commissioning.

Figure 1 illustrates the positioning of the NGBF along the development and capital chain, i.e., filling the high capex gap that exists for projects proceeding from technology demonstration to full-scale commercial production.

Figure 1: Funding Gap for First-of-Kind High Capex Projects



2. Eligible Projects

To be eligible, a project must:

- Be a first-of-kind facility that primarily produces a next-generation renewable fuel at large demonstration-scale.
- Be located in Canada.
- Use feedstocks that are or could be representative of Canadian biomass.

3. Funding Criteria

The SDTC exercised its discretion in the allocation of funding to eligible recipients, in accordance with the following criteria:

- The eligible recipient’s access to the necessary technical, financial and management capacity to successfully undertake the eligible project.
- The level of funding required from the Foundation to ensure that the eligible project proceeds.

- The potential of the production pathway to deliver sustainable development benefits (social, economic and environmental) by:
 - Sustainably expanding renewable fuel production in Canada.
 - Improving the environmental benefits arising from the production and use of renewable fuels including the life-cycle fossil energy balance and life-cycle emissions of greenhouse gases; reducing the overall financial costs of Renewable Fuels.
 - Generating economic benefits for a wide range of communities.

4. Funding Available to Projects

The Funding Agreement with the GC originally provided for a conditional grant of \$500 million, with this amount to be transferred to the NGBF over a number of years. The initial amount of \$200 million was to be followed by amounts up to specified limits per fiscal year, \$25 million in fiscal years 2008-09 and 2009-10, and \$50 million in each of the next five fiscal years (to March 31, 2015).

The SDTC was required to disburse up to March 31, 2017 its share of project costs incurred or to be incurred by recipients.

Due to lower program uptake than originally expected, \$275 million were returned to the federal fiscal framework over several years. The final value of the GC's contribution to the Fund was \$225 million (NRCan, 2017). Note that not all of this funding is forecast to be disbursed over the life of the Fund to 2027; unused monies will be returned to the federal fiscal framework. The NGBF's expenditures are summarized in section II.D.

The funding agreement limits the total amount available for a single project to the lesser of 40% of eligible costs, or \$200 million. Given the anticipated scale and cost of next-generation biofuel plants, it was expected that the Fund would be able to support only a relatively small number of projects.

5. Project Application and Management Processes

a) Indication of Interest (IOI)

The first step in the application process was for the project proponent to complete an Indication of Interest (IOI), which served as an expression of interest for eventually filing an application for funding. Applicants provided information on the company, the nature of the next generation renewable fuels technology development achieved to date, a brief description of the proposed project, the capital cost/investment parameters, the anticipated environmental/GHG performance and the anticipated timeline for project development and construction and for submission of the application for funding.

b) Application for Funding (AFF)

Gate 1 of the Project Assurance Process (PAP) was the first decision gate for entry of projects to apply to the NGBF. SDTC screened and evaluated the application for funding (AFF) against the eligibility criteria and all of the AFF sections outlined below:

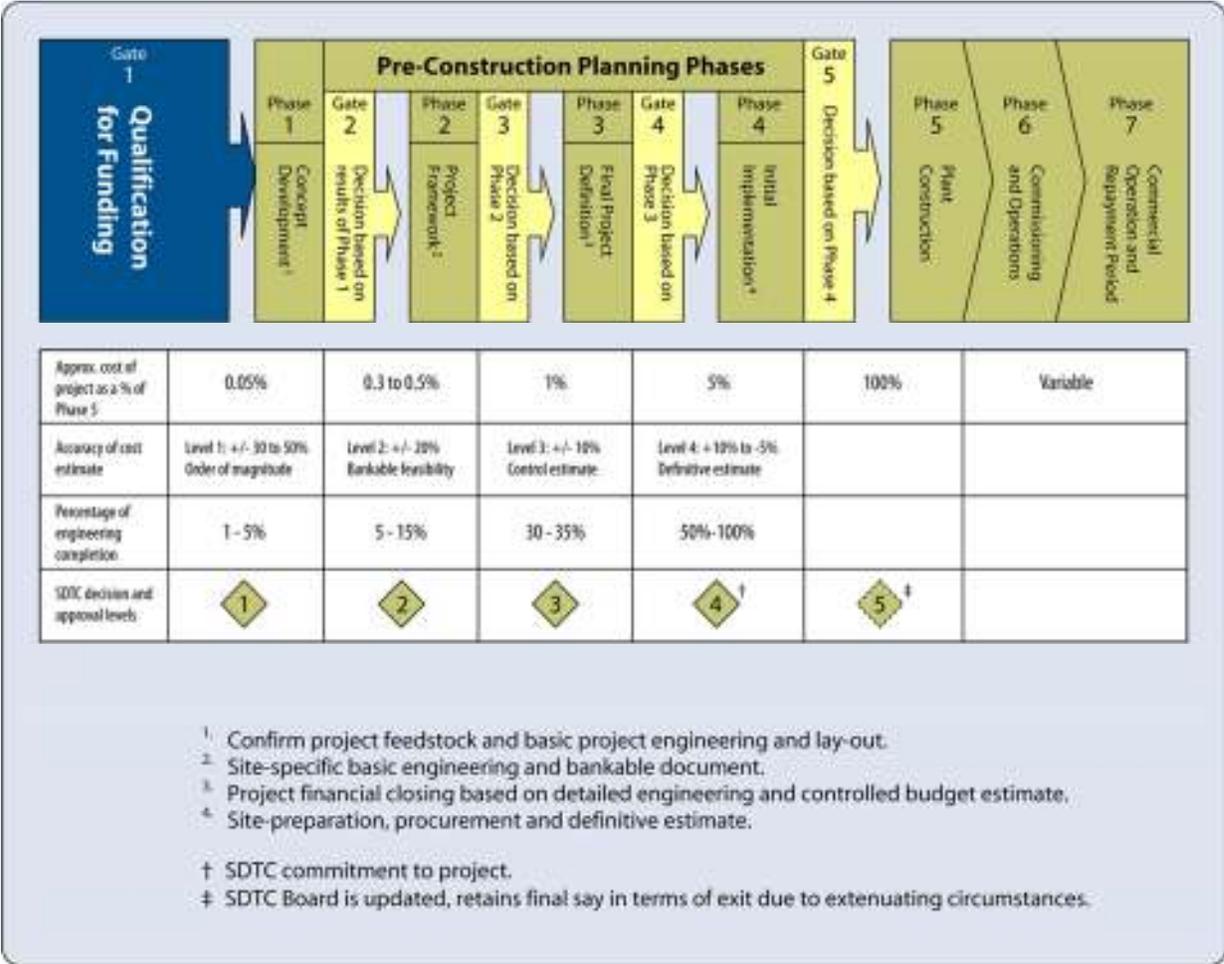
1. Pre-commercial pilot.
2. Technology and process.
3. Stage of development.
4. Business parameters.
5. Engineering and construction.
6. Financial.
7. Regulatory permitting and approvals.
8. Sustainable development results.
9. Timeline/project plan.

Gate 1 determined whether the applicant met the eligibility criteria and established the project's current stage of development. This, in turn, determined the level of documentation and due diligence required.

c) Project Management Process

As it was being established, the SDTC decided that the NGBF would employ a project management system known as the "stage gate" approach, which was adapted from the front-end engineering approach used for large capex projects by engineering, procurement and construction (EPC) firms in the process industries (e.g., oil and gas, chemical processing). SDTC called this approach the NGBF Project Assurance Process (PAP). In broad terms, an engineering design approach is used to control project expenses and thoroughly plan a project before execution. The PAP moves the project from a very general concept to a detailed design, to establish a price for the execution phase of the project, and to evaluate and manage potential risks. The NGBF PAP is illustrated in Figure 2. It indicates the development of cost estimates for the project as the planning progresses from the Application for Funding through phases 1 to 4 when the decision is made to grant full release of funds for construction.

Figure 2: NGBF Project Assurance Process (PAP)



At each decision gate, the proponent and SDTC review all aspects of the project to identify any risks or weaknesses that have emerged. The review provides the basis for a decision whether to proceed to the next phase. If all partners agree to proceed, the Fund would support its share of costs of the next phase. The decision at the end of Phase 3 allows the first stages of construction to begin, and at the end of Phase 4, the final investment decision is addressed, which authorizes construction to proceed.

6. Governance

As outlined above, the PAP stage-gate process was adapted from the front-end engineering approach used for large capex projects by engineering, procurement and construction (EPC) firms in the process industries (e.g., oil and gas, chemical processing). This process was subject to in-depth review by a Project Finance Committee and Project Review Committee, which presented funding recommendations to the SDTC Board.

For due diligence, the Fund assembled a team of external experts covering all aspects of a project, e.g., feedstock supply, technology, engineering, operations and finance and life cycle analysis.

For fully contracted projects the proponents provide monthly technical and financial progress reports. Monthly status calls and quarterly site visits are conducted by SDTC and the independent engineer. Claims for payment were audited by an accounting firm.

C. Evolution of NGBF Applications and Approved Projects

As outlined in section I, Budget 2007 announced the allocation of \$500 million to the SDTC to establish the NGBF. It also highlighted Ottawa-based Iogen as one of Canada's leading biotechnology firms, which was operating the world's only demonstration-scale facility to convert biomass to cellulosic ethanol using enzyme technology. The first NGBF call for proposals was issued in August 2008, and Iogen was the first applicant. As of December 31, 2009, this initial application was going through the project assurance process (PAP). However, the Iogen project never received approval by the NGBF.

The *SDTC 2009 Annual Report* notes that “the global deployment of the next generation renewable fuels industry has been unfavourably impacted by gaps pertaining to technology readiness, the worldwide financial crisis, and the economic downturn.” The Fund was tracking over 100 companies during 2009.

The *2010 Annual Report* states that the SDTC saw increased interest and potential deal flow for the NGBF, with “twenty high potential candidates aligned with promising technology roll-outs.”

The momentum continued in 2011, as the NGBF had a shortlist of 24 project-ready candidates. Four consortia had filed an Application for Funding (AFF) and two others had filed Indications of Interest (IOI), which were expected to convert to AFFs in 2012. Of these four active AFFs, one NGBF funding decision was made for project front-end development. This was the Varennes-Generation (later renamed “Vanerco”) Project in Varennes, QC led by Enerkem Inc. in partnership with Greenfield Ethanol Inc. This project intended to convert 100,000 metric tonnes per year of urban waste into 38 million litres of cellulosic ethanol.

In 2012, nine consortia were active, with three having filed an AFF, and six submitting IOIs. Two new funding decisions were made that year. The first was the Mascoma Drayton Valley Biorefinery (MDVB) in Alberta. This cellulosic ethanol facility was expected to convert 115,000 metric tonnes per year of urban waste into 40 million litres of cellulosic ethanol. The second project was the AE Côte-Nord RTP™ project in Port Cartier, QC. This project was to employ Ensyn's Technologies fast pyrolysis process to convert wood and woody materials into a liquid fuel product. Renewable fuel oil (RFO) would be substituted for fossil fuel derived furnace oil in industrial and institutional applications. The project was to be located on the existing Arbec Port Cartier Sawmill site. This project was expected to convert 132,000 metric tonnes of sawmill residues and wood chips annually into 76 million litres of renewable fuel oil.

In 2013, global development and deployment of next-generation biofuel technologies was slower than expected. While the NGBF had a number of strong technology opportunities in process, the pace of development had constrained disbursements. Both the Vanerco and MDVB projects were progressing through the NGBF PAP. A funding decision was made to continue to support phase 3 project development for the Vanerco Project. Six new IOIs were received, bringing the total to 8 IOIs in hand.

In 2014 the slow deployment of next generation biofuel technologies at commercial scale continued. During the first part of 2014, Enerkem decided to idle the development of the Vanerco project in Quebec and switch its attention to a second project in Alberta, the Enerkem Alberta Biofuels Project. This project planned to convert 100,000 metric tonnes of sorted municipal solid waste (MSW) into 38 million litres of cellulosic ethanol annually.

As of January 30, 2015, the Enerkem Alberta Biofuels and the AE Côte-Nord (AECN) RTP™ projects were approved for final funding commitments. Ultimately the AECN project was to convert 72,000 BDMT of feedstock annually into 42 million litres of RFO annually.

Effective December 3, 2014, the NGBF was no longer accepting applications. A total of five AFFs were received that year.

In early 2014, Mascoma decided to discontinue the MDVB project due to a number of factors, including a change in the company's strategic direction and issues concerning the availability of feedstock.

As of March 30, 2017, NGBF funding was fully disbursed (see section II.D) and was focused on supporting the construction and start-up phases of the two fully funded projects, Enerkem Alberta Biofuels and AECN. During 2017-18, the SDTC continues to actively monitor these two projects and prepare for the repayment phase.

Table 2 summarizes the four projects that are covered by the evaluation.

Table 2: Summary of NGBF Project Portfolio

i) Approved Projects	
Enerkem Alberta Biofuels Project (Enerkem Inc.)	
Total Project Costs: \$162,043,554	Enerkem Inc. intends to build, own, and operate a commercial next generation cellulosic ethanol plant capable of converting 100,000 Bone Dry Metric Tonnes (BDMT) of sorted Municipal Solid Waste (MSW) into 38 million litres of cellulosic ethanol. The project utilizes a thermochemical gasification process technology developed by Enerkem and is sited adjacent to the City of Edmonton Integrated Waste Management Centre. The facility will have the capability to provide bio-methanol as an interim product.
Approved SDTC NGBF Contribution: \$63,600,000	
SDTC NGBF Contribution to March 31, 2017: \$53,250,000	
AE Côte-Nord RTP™ Project (Ensyn Bioenergy Canada Inc. and Arbec Forest Products Inc.)	
Total Project Costs: \$71,700,000	This project will employ Ensyn’s fast pyrolysis process to convert wood and woody materials into a liquid fuel product. Renewable Fuel Oil (RFO) produced by the project will be substituted for fossil derived fuel oil in industrial and institutional applications. The project will be located on the existing Arbec Port Cartier Sawmill site in Quebec and will be capable of processing 72,000 BDMT of feedstock into 42 million litres of RFO annually.
Approved SDTC NGBF Contribution: \$27,000,000	
SDTC Contribution to March 31, 2017: \$27,000,000	
ii) Projects that Progressed Under the NGBF PAP but did not Receive Final Funding Approval	
Vanerco (Enerkem Inc. and Greenfield Ethanol Inc.)	
Total Project Costs: \$127,200,000	The \$127.2 million cellulosic ethanol facility was to be located in Varennes, QC, on a brown field site where Greenfield Ethanol currently operates a corn ethanol plant. The facility was to convert 100,000 metric tonnes per year of urban waste into 38 million litres of cellulosic ethanol. The Enerkem thermo-chemical process which was demonstrated in Westbury, QC with support from SDTC’s SD Tech Fund included feedstock preparation, gasification of biomass, syngas conditioning and catalytic synthesis of ethanol.
Potential SDTC NGBF Contribution: \$39,800,000	
SDTC NGBF Contribution to March 31, 2017: \$296,787	
Mascoma Drayton Valley Biorefinery (Mascoma Corp., Catchlight Energy and Xylitol Canada)	
Total Project Costs: \$385,100,000	The \$385.1 million cellulosic ethanol facility was to be located in Drayton Valley Alberta, on a brown field site in the Bio Mile biotechnology industrial cluster. MDVB proposed to convert woody biomass into 83 million litres of cellulosic ethanol and co-products annually. The MDVB process included fibre preparation, feedstock pretreatment, consolidated bioprocessing, distillation and drying, isopropanol production, xylose purification, and power generation via the production of fuel-grade lignin. Pre-commercial demonstrations were run in Rome, NY.
Potential SDTC NGBF Contribution: \$138,000,000	
SDTC NGBF Contribution to March 31, 2017: \$643,000	

Source: SDTC annual reports for 2016-17 and 2015.

D. NGBF Expenditures

A summary of NGBF administrative expenses and project expenditures over the evaluation period (calendar 2012 to FY 2016-17 inclusive) is shown in Table 3. Total expenditures were \$87.9 million, consisting of \$81.2 million in project expenditures and \$6.7 million in operating expenses and investment/banking fees. The vast majority of project expenditures, \$81.2 million, were associated with the two approved projects that received full funding commitments, Enerkem Alberta Biofuels and AECN (the breakdown of contributions to these two projects is shown in Table 2 above).

Table 3: NGBF Expenditures

	2012	2013	2014	2015	2016 (Jan-Mar)	2016-17	TOTALS
Operating Expenses	1,877,000	1,826,000	1,068,000	990,784	132,000	654,000	6,547,784
Investment Fees	58,000	46,000	61,000	26,000	2,000	0	193,000
Total Admin. Expenses	1,935,000	1,872,000	1,129,000	1,016,784	134,000	654,000	6,740,784
Project Expenditures	114,479	193,725	584,149	39,385,390	9,104,000	31,808,431	81,190,174
Total Program Expenditures	2,049,479	2,065,725	1,713,149	40,402,174	9,238,000	32,462,431	87,930,958
Admin. Expense Ratio							7.7%

Note: From 2012 to 2015, the fiscal year was the calendar year. FY 2016 consisted of 3 months only. Starting April 1, 2017, the fiscal year ends on March 31.

III Evaluation Findings

This chapter presents the main findings of the 2017 interim evaluation, organized by the evaluation issues and questions (outlined in the evaluation matrix in Appendix A).

A. Delivery of the NGBF

1. The proposal review and selection process featured a high degree of due diligence

There is consensus among all key informants that the level of scrutiny (due diligence) associated with the NGBF proposal review and selection process was extensive and very thorough, and comparable to what would be expected had proponents attempted to raise private financing instead. The two successful project proponents noted that the NGBF process involved a considerable amount of “back-and-forth”, many additional questions, and heavy data demands. A related factor was the NGBF organizational model that was in place until late 2015 that involved two program managers; having one manager in charge likely would have expedited the process (this issue is discussed further below). On the other hand, one of the unsuccessful applicants interviewed stated that the proposal review process was very well managed and they had no issues with it, even though their project did not proceed past gate 1.

Table 4, overleaf, lists the amount of elapsed time that it took for the four projects to proceed through the proposal review and approval process, the end result being an executed agreement. It should be noted that each of the NGBF projects was unique and thus it is not surprising that each took a different length of time to proceed from application to a signed agreement.

For the Enerkem Alberta Biofuels project, the total time from application to a signed agreement was approximately ten months. For this project Enerkem’s application to the NGBF covered the later phases of a plant development that was already underway.

For the AECN project, the project did process through the entire process which took about 30 months, as there were some changes along the way. For example, the original application submitted in June 2012 proposed that the produced renewable fuel oil (RFO) would be sold to industrial applications within 70 km of the plant; however, the project had to be put on hold when the key off-takers in the immediate vicinity of the plant closed. The project proponent (Ensyn) submitted a supplement to its proposal in November 2014, almost 2 ½ years later. An executed agreement was in place about 13 months later.

For Vanerco, the entire process took about 17 months. For the revised application, the process took about 13 months. Disagreements arose between the company and SDTC about the stage of development of the project, which resulted in delays.

For the Mascoma project, the entire process took about 17 months. This project was off-ramped as it progressed through the PAP process due to a number of factors.

Table 4: Elapsed Time for the Application Review and Approval Process

Project	Submission of AFF	Board Approval	Executed Agreement	Total Elapsed Time from AFF to Signed Agreement
Enerkem Alberta Biofuels	June 16, 2014	Nov. 28, 2014	April 22, 2015	~10 months
AECN	Original: June 20, 2012 Supplement: Nov. 17, 2014	Original: Oct. 17, 2012 Supplement: Jan. 30, 2015	Supplement: Dec. 22, 2015	Total: ~30 months For addendum: ~13 months (for the supplement)
Mascoma	Original: June 8, 2011 Amended: Dec. 9, 2011	June 13, 2012	Nov. 12, 2012	Total: ~17 months For addendum: ~11 months
Vanerco	Original: Oct. 26, 2010 Addendum: Feb. 11, 2011	Phase 2: Nov. 23, 2011 Phase 3 Review of Phase 2: May 17, 2013	Phase 2: March 21, 2012 Phase 3: Dec. 12, 2013	Total: ~17 months For addendum: ~13 months

2. The Project Assurance Process (PAP) was an appropriate project management system

As outlined in Section II, as the Fund was being established, the SDTC decided to employ a project management system known as the “stage gate” approach, which it called the “Project Assurance Process” (PAP). The stage-gate process was adapted from the front-end engineering approach used for large capex projects by engineering, procurement and construction (EPC) firms in the process industries (e.g., oil and gas, chemical processing). As noted in the previous 2012 evaluation, the stage-gate process is considered to be the industry standard for the management of large capital, complex projects of the type supported by the NGBF.

Interviews conducted as part of the present evaluation confirmed that the stage-gate process was an appropriate project management system for the NGBF. As one of the project proponents noted, *“the process provides exit ramps along the way. A complex and long project can be overwhelming at first; the PAP breaks the process into manageable steps.”*

The decision to use the PAP was supported by two additional factors that are discussed in the 2012 evaluation:

- **The NGBF had the resources to support only a handful of high risk projects:** Given the Fund could only support a few projects that would by definition be high risk in nature, the consequences of a bad investment decision would be severe. The initial estimate of the capital requirements for the first NGBF project was at a level that could require the Fund to invest the maximum allowable under the agreement with the GC, \$200 million, which would have accounted for 40% of the Fund's total resources. In contrast, the SDTC's other program, the SD Tech Fund, was expected to support a large volume of projects of varying sizes and thus had the ability to diversify its portfolio, i.e., to fund a range of projects of varying levels of technical risk.
- **The SDTC Board was highly cognizant of its responsibility for the stewardship of public funds:** The Board carried out its responsibilities with full knowledge that it must exercise prudent stewardship of public funds. The fact that the Board was directly involved in NGBF approval decisions is evidence that it successfully discharged its responsibilities.

3. The PAP process was protracted but became more flexible over time

The PAP process successfully identified and excluded from further support technologies that were not ready for full-scale demonstration or were not commercially viable.

But for technologies that were selected for support, the PAP process tended to become protracted. The previous 2012 evaluation stated that smaller companies with no prior experience with a stage-gate process may have found it unduly complex and daunting. One of the smaller project proponents interviewed as part of the present evaluation agreed that a larger company with a large team might have found the process easier to deal with. For this smaller company, the problem was not with the PAP itself; the problem was more with the amount of time required to proceed through the process. From this company's perspective, SDTC staff were entirely focused on process, while the company was more concerned about being able to survive, i.e., getting decisions made quickly so that the project could be completed and the company could continue to operate.

One of the project proponents that did not proceed all the way through the PAP process indicated that the process should have been shorter. The problem was that the proponent and SDTC staff tended to get stuck on each phase, which raised the level of uncertainty and created some doubt about whether the end point would be reached. This may have been a factor particularly for projects involving multiple funding sources. A delay or uncertainty related to any one funding source had the potential to create a cascading effect on the availability or certainty of other funding. In the proponent's view, the PAP should be more oriented towards solving problems and not in creating uncertainty.

One of the larger project proponents found the PAP approach to be very conservative. Originally, SDTC staff had displayed a lack of flexibility with the PAP, but as the project continued and the need for flexibility became more evident, SDTC staff and the process became more flexible.

4. SDTC managers and external advisers are highly competent and professional

The interviews with NGBF project proponents revealed that they have a high regard for the competence and professionalism of the Fund's managers. They noted that while there has been some turnover in SDTC senior management and NGBF managers over the years, this turnover did not affect the quality of support provided to project proponents. In the early years of the NGBF, the Fund was co-managed by two managers, one with a financial background and the other with a technical background. In October 2015, this dual-manager team was replaced by a single manager who had a combined financial/technical background. The overall view of project proponents is that they preferred the single manager structure, as it was more efficient dealing with one individual who had the expertise necessary to answer their questions. During the two-manager era, there sometimes were delays in obtaining responses.

One of the evaluation questions is whether the SDTC has adequate resources to manage the Fund in future years. Minimal resources are required to monitor the Fund in the coming years. A single SDTC manager continues to monitor the two projects. The repayment clause of each company's contribution agreement will need to be enforced. A final assessment of the longer-term environmental impacts of the projects will be required.

Turning to the performance of the NGBF's external advisers, SDTC management and project proponents made nothing but positive comments. These advisers were involved in such activities as the AFF due diligence process and in reviewing claims for payment associated with the two approved projects. In keeping with the SDTC's high standards for due diligence, the Foundation ensured that the appropriate external experts were engaged to support the review of project applications and to support the work of the PRC. (One of the external advisers did note that sometimes insufficient advance notice was given about upcoming deadlines which meant it was very difficult to accomplish the work required to support the PRC in a timely fashion.)

5. Processing of claims for payment became more efficient over time

The processing of claims for payment submitted by the two project proponents became more efficient over time. Claims were audited by an external accounting firm. Instead of reviewing all invoices related to a claim, at one point a modified procedure was established to streamline the audit process, to audit invoices on a sample basis. Reviewing all invoices had taken a lot of time and resulted in long processing times for claims initially. By switching to auditing on a sample basis, the SDTC was able to process claims more quickly. This change did not increase the level of risk. As an added layer of insurance, upon completion each project was subjected to a full financial audit.

6. The NGBF administrative expense ratio was 7.7%, which is much lower than federal government clean tech innovation programs

A common measure of operational efficiency is the ratio of program operating expenses to total expenditures. In the case of the NGBF, operating expenses included the costs associated with

such items as board and executive governance, project appraisal and development, project management, partnership development and project support and general administration, as well as investment/banking fees. Over the evaluation period, the administrative expense ratio was 7.7%, as shown in section II, Table 3. This is much lower than for federal government clean tech innovation programs, which average 29%.⁵ For SDTC as a whole (i.e., including both the NGBF and the SD Tech Fund), the administrative expense ratio is 11%.

It is appropriate to point out that the NGBF's administrative expense ratio would in all likelihood have been even lower if the expected deal flow for the NGBF had materialized as expected. If the NGBF had instead allocated \$200 million or \$500 million using the same administrative structures, the administrative expense ratio would have been even lower.

B. Results of the NGBF

This section assesses the overall success of the NGBF in terms of its role in supporting the development and construction of next generation biofuels plants and the likely future developments of the two projects that received full funding commitments.

1. The NGBF supported the construction of fewer next generation biofuels plants than originally hoped for

The previous 2012 interim evaluation provides a detailed history of the NGBF deal flow from the Fund's inception in 2007 until November 2012. During this period, the Fund interacted with a total of 17 proponents. As of November 2012, three projects with total potential commitments of about \$297 million had completed the due diligence review phase of the PAP. An additional two projects, representing \$170 million in potential commitments, were preparing an AFF. Thus it appeared that these total commitments for the five plants would account for the total amount available from the Fund (\$500 million).

SDTC management stated that over the complete history of the NGBF (2007 to March 31, 2017), a total of 17 Applications for Funding (AFFs) were received, most of which had received prior support from the SD Tech Fund. As outlined in Section II, two projects, Enerkem Alberta Biofuels and AE Côte –Nord RTP™, were fully contracted, receiving a total SDTC NGBF allocation of \$90.6 million. Two other projects, Vanerco and Mascoma Drayton Valley, made some progress under the PAP but were terminated along the way (Enerkem switched its focus from Vanerco to Enerkem Alberta Biofuels, and Mascoma withdrew its application due to a number of factors including changes in strategic direction among the project partners). SDTC managers noted that a third project (a plasma gasification from municipal solid waste project led by Plasco Energy Group in Ottawa) was presented to the PRC, but was finally rejected by the Board in January 2015.

⁵ <https://www.canada.ca/en/treasury-board-secretariat/corporate/reports/inventory-federal-business-innovation-clean-technology-programs.html>

2. The lower than intended output and expenditures of the NGBF are due to factors beyond the control of the SDTC

SDTC management has done considerable analysis over the years regarding the challenges faced by the NGBF in attempting to support qualified applicants. They noted that the NGBF success rate, i.e., the number of fully-contracted projects in relation to the number of applications, is about 12% (2 fully contracted projects out of 17 AFFs). This compares favourably with the selection ratio of the SD Tech Fund (10.4%). As outlined earlier, even if the total of \$500 million in funding had been committed, it would have been possible to support only a handful of projects (the initial application from Iogen alone was expected to involve a \$200 million contribution from the NGBF).

SDTC staff invested considerable effort in publicizing the NGBF within the biofuels community. Interviews with former NGBF managers confirmed that the Fund tracked over 100 companies in the early years. They were also visible at major industry conferences. The previous 2012 interim evaluation confirmed that the NGBF was well known throughout the biofuels community. Thus it is probable that any company with a potentially viable technology was aware of the Fund.

SDTC management also invested considerable effort in attempting to broaden the Fund's eligibility criteria to be able to fund other technologies. The Fund was constrained by being narrow in scope. For example, "second-of-kind" plants were excluded, even though commercial lenders view these plants as still being risky (this was confirmed by one of the NGBF project proponents.) The GC decided not to expand the scope of the NGBF to support other types of renewable energy projects, although new technology areas did emerge over the years (such as renewable electric power, standalone biochemicals, novel biochemical from traditional feedstock, etc.).

A question might be asked whether the NGBF's "heavy" due diligence process prevented any eligible companies from applying or caused any of the companies that submitted AFFs to withdraw prematurely. Overall, the evidence indicates that the Fund's due diligence process worked exactly as intended: projects that did not demonstrate that their technologies were ready to move to full-scale demonstration or were commercially viable were not approved.

The overall view is that the NGBF was probably several years "ahead of its time." From 2007 through 2013, no company in the biofuels space had completed a pre-commercial demonstration of its technology at a level allowing for development and financing of a commercial facility. This view is also supported by experience related to the *Energy Policy Act* of the Department of Energy in the US as cited in Chapter II. Given that the NGBF was required to allocate 100% of its funding by March 31, 2017, and given that it would require a minimum of 3 years to construct a first-of-kind commercial facility, it was necessary to close the Fund to applications by the end of 2014, at the latest. Had the Government of Canada allowed for, say, another five years, then additional AFFs might have come forward and been approved for full funding. As SDTC management noted, the climate for the biofuels sector today is more positive than in the past. Indeed, Enernkem's Varennes QC project is scheduled to start construction in 2018, and the company is pursuing several opportunities around the world. Similarly, following

the bankruptcy of Plasco Energy Group in 2015, the company was revived (now called Plasco Conversion Technologies) and plans to start construction on a plasma gasification plant in Wales in 2018, where the much higher landfill tipping fees help make the project financially viable.

3. Both of the approved projects appear to be on track to successfully achieve their short-term objectives

The case study summaries of the two approved projects (Appendix D) outlined the results achieved. In September 2017, Enerkem announced that its plant had begun commercial production of cellulosic ethanol, becoming the first commercial-scale plant in the world to produce cellulosic ethanol made from non-recyclable, non-compostable mixed municipal solid waste.⁶ Ramping up to full-scale production will take about a year. Thus while the results of this project are somewhat tentative at this time, it appears that the plant likely will achieve its planned output, production efficiencies and expected environmental benefits.

As of October 2017, the AECN project is on schedule to begin production of renewable fuel oil in early 2018. Contracts are in place to supply this fuel oil to facilities in the US, displacing fossil fuel derived oil in industrial boilers and furnaces. This project will receive US RFS-2 incentives through its use of forestry waste as a feedstock and production of renewable fuel.

4. The results achieved by the two approved projects are at least partly attributable to the NGBF

An evaluation study of a government-funded intervention such as the NGBF attempts to determine whether the results of supported projects are due to the program or would have occurred in the absence of funding. To make the assessment, the evaluator attempts to construct a counter-factual scenario, i.e., estimating what would have happened to a project in the absence of program funding.

Of the two funded projects, it appears that any results to be achieved by the AECN project will be fully attributable to the NGBF, while the results from the Enerkem project will be partly attributable to the Fund. The evidence supporting these findings is provided in the case study summaries (Appendix D) and summarized below.

For Enerkem, a mostly likely scenario in the absence of NGBF funding would have seen construction of phase 1.5 only (methanol), since process engineering and purchase orders for equipment were already in place when the funding decision was made. Halting development at the end of phase 1.5 would have meant that only some (those related to methanol) of the benefits of the full project likely would be achieved. Additional benefits to the environment and to Enerkem through conversion from methanol to higher-valued ethanol would not have occurred without the phase 2 development.

⁶ <http://www.newswire.ca/news-releases/enerkem-begins-commercial-production-of-cellulosic-ethanol-from-garbage-at-its-state-of-the-art-edmonton-biofuels-facility-644688363.html>.

In addition, without NGBF support, phase 2 of the project likely would have proceeded but would have been delayed. The length of the delay is not known. However, it is likely to have only occurred after phase 1.5 was in production and producing positive returns (although smaller) relative to a plant that also included phase 2. Kelly Sears suggests that the delay would have been in the range of three to five years.

This conclusion is supported by the evidence of the Vanerco project which was originally to have been constructed with NGBF support before the Enerkem Alberta Biofuels project but is only now planned for construction starting in 2018. The company could not conduct the Vanerco project as its resources were shifted to the Enerkem phase 1.5 and later phase 2 developments. However, now that Enerkem is starting production, the proponent is better able to support Vanerco.

For the AECN project, all evidence suggests that the project would not have proceeded without NGBF support. Indeed, delays in procuring equipment needed for the plant are likely the result of delaying purchase decisions to ensure NGBF funding was going to be available. The proponent did not have the resources to conduct the project without support and therefore needed the commitment from NGBF to procure equipment for the plant. As a result, our conclusion is that the project would not have proceeded in the absence of NGBF support. Other considerations supporting the view that the project would not have gone ahead without NGBF support are the small size of the proponent and its lack of full-scale commercial development experience.

5. The two NGBF projects will lead to longer-term impacts

As noted above, the next project for Enerkem will be to revive the Vanerco project in Varennes, Quebec. In addition, plans are underway for Enerkem to build a plant at the Port of Rotterdam in the Netherlands, which will provide methanol from waste. Plans are also underway to develop a plant in Dakota County, Minnesota, which will be modelled on the Enerkem facility, turning municipal solid waste into ethanol. These and other potential facilities will take advantage of the modularized construction techniques developed for the Enerkem facility, whereby components were manufactured in Ontario and Manitoba. For future facilities, the core components will be built in Canada, with some local content used for the foreign facilities. This will result in the creation of fabrication jobs in Canada.

For the AECN technology, the proponent's longer-term plans are not confirmed at present, although the company is intent in building additional new facilities. The key challenge continues to be securing financing. The proponent stated that even having demonstrated the success of its first large-scale facility, private lenders still will remain unwilling to invest in the next project. The proponent may turn to BDC/EDC or one of the provincial funding agencies. Another option may be a US loan guarantee program. Future developments may take place in the US or another country.

6. The NGBF has had other important results

In addition to the project results outlined above, project proponents identified other important benefits from the financial support provided by the Fund. In the case of Enerkem, NGBF

support (as well as SD Tech Fund support) facilitated the ability of the company to attract private sector financing. In the case of AECN, the SDTC's high level of due diligence helped to lower the perceived risk of lenders. SDTC support is a signal to the investment community that the Government of Canada supports the company and believes that its technology is worthy.

Project proponents noted that the design of the NGBF was more attractive compared to the US Department of Agriculture loan guarantee program. The NGBF provided cash rather than a loan guarantee; the NGBF's repayment terms were attractive because the Fund is subordinate to other debt financing on agreement with SDTC and is based on the availability of "free cash flow" over a maximum of ten years. The NGBF's favourable repayment terms helped make private investors more willing to be involved.

The Enerkem project also is helping to raise the profile of Enerkem. This project is their flagship and has been the focus of several media events, helping to raise the national and international exposure of the firm.

Project proponents noted that SDTC has been proactive in the past in facilitating the international reach of their companies. SDTC has organized trade missions and participated in conferences, thereby increasing the international exposure for Canadian cleantech companies.

An important step taken by SDTC is the sharing of company information with the EDC and BDC. This reduces the burden on companies in supplying information to these other agencies and facilitates the access to financing.

C. Lessons Learned

The main lessons learned from the history of the NGBF are presented below.

1. The global experience has shown that the initial expectation for the rapid development of the next generation biofuels industry was unrealistic

As outlined in this report, the ten-year timeframe for the NGBF was too short. The NGBF reviewed a total of 17 applications for funding, many of which had received prior support from the SD Tech Fund. However, from 2007 to 2013, no company was ready for commercialization. Given the Fund had to stop accepting applications by the end of 2014, in hindsight it is not surprising that only two projects were approved for full funding.

Other factors inhibited the NGBF deal flow. Compared to the US, limited government funding was available to support the necessary R&D and demonstration projects. In Canada, the main funding source was the SD Tech Fund, which covers all cleantech technologies and not just advanced biofuel technologies.

The US government has continued to pour funding into support for research and development, demonstration-scale facilities and construction of large-scale biorefineries. Even as recently as September 2017 the US DOE continues to provide funding for further R&D to address the scale-up challenges of advanced biorefineries.

Canada also lacked the comprehensive policy suite, particularly regulatory drivers, which would have helped to spur the development of the advanced biofuels sector. For example, as well demonstrated by the AECN project, the US Renewable Fuel Standards (RFS2) is the main reason for the company being able to sell its next-generation renewable fuel oil to markets in the northeast US. The US RFS2 requires mandatory blending of corn-starch ethanol and cellulosic biofuels and related credit trading; Canada does not have similar regulatory drivers.

2. The NGBF application review and selection process yielded the desired results

The NGBF application review and selection process worked as intended: in the end, two projects were funded for plant construction and all indications are that their facilities will be successful in moving into commercial production. A total of \$90.6 million was committed by the SDTC to these two projects; the balance of the NGBF's original funding allocation was returned by the Government of Canada to the federal fiscal framework. Taxpayer dollars were not wasted: SDTC made a prudent decision to not support additional projects that in all likelihood would not have been successful, either technically and/or commercially.

3. The NGBF incorporated solid governance

There was a consensus among key informants that the NGBF incorporated a solid governance structure and process. The Project Review Committee (PRC) was composed of experts from a variety of disciplines and was heavily involved in assessing project applications. Similarly, the SDTC Board members reflected a wide range of disciplines and took their project approval responsibilities seriously. Applications presented for approval to the Board sometimes were sent back to the PRC in order to address issues and fill gaps.

4. The unrealistic expectations for rapid sector growth resulted in a NGBF delivery model that needed to be streamlined over time

As noted above, the PAP stage-gate process was adapted from the front-end engineering approach used for large capex projects in the process industries. While project proponents viewed this method as being appropriate for NGBF projects, its implementation was “heavy-handed” and overly rigid over most of the Fund's ten-year history. The SDTC made a concerted effort to improve the program delivery model in later years. For example, it streamlined the reporting and claims approval process. This flexibility was appreciated by project proponents. The SDTC also improved the efficiency of the project claim approval process without increasing the level of financial risk.

5. The NextGen Biofuels Fund can provide a model for future government-funded programs devoted to supporting the commercialization of cleantech

In summary, the NGBF was well designed; several of its key features could be considered in the design of future government funded programs focused on the cleantech sector. Its strengths include: a systematic proposal review and selection process; a project management process that was streamlined over time; staff with strong management and technical skills supported by

external experts where needed; a governance structure and process that ensured that successful projects would be approved for funding; and its attractive financial terms (i.e., a cash contribution rather than a loan guarantee along with favourable repayment provisions).

The NGBF filled a critical void by providing funding to support Canadian next generation biofuels companies to advance their technologies from demonstration-scale to first-of-kind commercial scale, therefore enabling these companies to deliver significant environmental benefits to Canadians. The ten-year experience revealed that commercializing a large capex next generation biofuels technology is a long and difficult journey. Indeed, as demonstrated by the AECN project, even with a successful commercial scale facility about to enter into production in early 2018, the financial services sector will still be reluctant to invest in the company's next commercial-scale facility. The same issue is being faced by Canada's broader cleantech sector. SDTC, with its long history and strong capabilities and processes, is well positioned to continue to support the growth of Canada's cleantech sector.

Appendix A: Evaluation Matrix

Evaluation Matrix: 2017 Interim Evaluation of the NGBF

Issue and Evaluation Question	Indicators	Interview Questions	Additional Case Study Questions
Delivery			
<p>3. Are NGBF services delivered appropriately? (Activity 3, Select Qualifying Projects, Activity 4 Participate in Project Assurance Process for Pre-Construction Phases, Activity 5, Contribute to Structuring of the Project Financing, Activity 6 Participate as an Active Investor in Construction.</p>	<p>Opinions, trend over time for:</p> <ul style="list-style-type: none"> - Contribution to project quality through PAP - Contributions to bridge financing gap - NGBF efficiency, strengths and weaknesses - Applicant and participant satisfaction - Facilitation, brokering of financing - Advice, identification of potential barriers, contribution to solutions 	<ul style="list-style-type: none"> ▪ What are the strengths and weaknesses of the Project Assurance Process (PAP)? ▪ To what extent has the NGBF program been delivered efficiently, e.g., timeliness of process; cost of program delivery on the part of recipients and SDTC? ▪ What is your overall level of satisfaction with the NGBF delivery process? ▪ What role has the NGBF played in assisting recipients to broker the required financing? ▪ Do you have any suggestions to improve the NGBF delivery process? 	
	<p>Opinions on selection criteria and funding gates:</p> <ul style="list-style-type: none"> - Rigor of proposal review and selection process - Appropriateness of selection criteria - Proponents' view of cost and benefit of NGBF support - Balance between rigour and cost - Time required to complete requirements of decision gates, for approval and release of funds, relative to private sector capital projects, who is responsible for delays - Comparison to due diligence exercised by private sector - Applicant and participant satisfaction 	<ul style="list-style-type: none"> ▪ Was the level of rigour of the proposal review and selection process appropriate? ▪ Were the criteria used to select NGBF projects appropriate? ▪ How does the due diligence of the NGBF project approval process compare to the process used by the private sector for similar projects? ▪ How much elapsed time was associated with the project application and approval process? Was this amount of time appropriate? What were the reasons for any delays? ▪ How does the timing to process reports and to pass decision gates with NGBF compare to your experience with private sector projects and other public sector programs? ▪ Overall, what is your level of satisfaction with the project application and selection process? 	
	<p>Suggestions for changes</p>	<ul style="list-style-type: none"> ▪ Covered above 	
	<p>Performance Indicators:</p> <ul style="list-style-type: none"> - Overhead ratio, administrative costs vs. funding for the year and total funding. (trends over time, if available, comparison 	<ul style="list-style-type: none"> ▪ NA 	<ul style="list-style-type: none"> ▪ NA

Issue and Evaluation Question	Indicators	Interview Questions	Additional Case Study Questions
	<p>with other similar funding bodies that use similar financial instruments)</p> <ul style="list-style-type: none"> - Leverage ratio - Approval ratio – first applications and re-applications - Diversity of projects - Time to process reports, clear decision gates relative to private sector and other public financing programs 		
<p>Are administrative resources adequate to meet the current/future demands for services?</p>	<p>Opinion on adequacy of administrative resources, competitiveness of employment arrangements for senior staff</p> <p>Opinion on the experience and qualifications of NGBF staff and advisors to deal with complexities and risks associated with major capital projects</p> <p>Stability of staffing</p>	<ul style="list-style-type: none"> ▪ What manager and staff resources have been devoted to administration of the NGBF? ▪ Was the level of resources sufficient for the administration of the NGBF? ▪ Have the managers/staff possessed the required skills and experience? ▪ What has been the level of turnover in management and staff? Why did managers/staff leave the organization? ▪ Does SDTC offer competitive employment arrangements for managers and staff? ▪ Have the outside advisors provided the required expertise to deal with the complexities and risks associated with major capital projects? 	
Results			
<p>Short term results during project development and construction period:</p> <ul style="list-style-type: none"> - Attribution of results to NGBF funding - Project progress against objectives - Actual and projected results - Evidence of technical progress, patents, licenses <p>Opportunities for replications</p>	<p>Direct funding and leverage of the NGBF investment</p> <p>Attribution of level/change to the NGBF in terms of the existence of the project, timing and scale of the project, and share of responsibility for other outcomes</p>	<ul style="list-style-type: none"> ▪ ▪ What have been the major changes to the NGBF since its inception? ▪ To what extent have the two projects (Enerkem and AE Côte -Nord) achieved their objectives to date? ▪ Looking ahead, are the two projects likely to achieve their ultimate objectives? ▪ Please describe the history and evolution of the two projects that were not completed (Vanerco and Mascoma Drayton Valley Refinery). 	<ul style="list-style-type: none"> ▪ Note: Review project costs and funding sources during interviews. ▪ Please describe how your NGBF project has evolved, noting any major changes along the way. ▪ To what extent has your NGBF project achieved its objectives to date? Looking ahead, what is the likelihood that the project will achieve ultimate objectives?

Issue and Evaluation Question	Indicators	Interview Questions	Additional Case Study Questions
			<ul style="list-style-type: none"> ▪ Note: Review projected environmental benefits from project file. ▪ Suppose for a moment that your NGBF project had not been approved by SDTC. What would have been the impact on this project? a) the project would have proceeded with no changes; b) the project would have proceeded but at a smaller scale; c) the project would have proceeded but at a later date; or d) the project would not have proceeded at all. ▪ Does support by NGBF affect your ability to attract private sector funding? If so, how?
	Time from project approval to signed contract and to pass the 5 decision gates, relative to industry norms (reasons for delays)	<ul style="list-style-type: none"> ▪ For the two projects, was the amount of elapsed time from project approval to signed contract and to go through the 5 decision gates within industry norms? ▪ What were the reasons for any delays? 	<ul style="list-style-type: none"> ▪ For your NGBF project, what was the amount of elapsed time from project approval to signed contract and to pass the five decision gates? ▪ What were the reasons for any delays? ▪ How do these elapsed times compare to industry norms?
	Number of patents awarded, licenses granted	<ul style="list-style-type: none"> ▪ 	<ul style="list-style-type: none"> ▪ For your NGBF project, have any patents been obtained? Have any licences been granted?
	Domestic and international partnerships, degree of encouragement for other financial partners, national and provincial organizations	<ul style="list-style-type: none"> ▪ What role has SDTC played in helping to form partnerships for the approved projects? 	<ul style="list-style-type: none"> ▪ For your NGBF project, please describe the partnerships that were formed. ▪ What role did SDTC play, if any, in the formation of these partnerships?

Issue and Evaluation Question	Indicators	Interview Questions	Additional Case Study Questions
			<ul style="list-style-type: none"> ▪ How useful have these partnerships been to the success of your NGBF project?
	Ability to raise funding for future projects	<ul style="list-style-type: none"> ▪ 	<ul style="list-style-type: none"> ▪ Looking ahead, what is the future outlook for your NGBF project? ▪ What is the future outlook for the technologies associated with your NGBF project? ▪ What is the likelihood that you will be able to raise funding for future developments?
	Media coverage	<ul style="list-style-type: none"> ▪ What has been the extent of media coverage for the NGBF? 	<ul style="list-style-type: none"> ▪ Please describe the extent of media coverage for your NGBF project.
Lessons Learned/Potential Improvements			
10. What are the lessons learned?	Opinion on possible improvements/partnership opportunities	<ul style="list-style-type: none"> ▪ Finally, what are the main lessons learned from the NGBF? 	<ul style="list-style-type: none"> ▪ Given everything you experienced with your NGBF project would you do it again? What changes would you make, and why?

Appendix B: Documents Reviewed

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<https://www.sdtc.ca/uploads/2015/RenewableFuel-Biofuels.pdf>.

Appendix C: Interview Guides

Interview Guide – Interim Evaluation of the SDTC Next Generation Biofuels Fund (NGBF) – Interviews with Proponents of Fully-Contracted Projects

A. Introduction

Thank you for agreeing to be interviewed as part of the Evaluation of the Next Generation Biofuels Fund (NGBF) which is being conducted by Kelly Sears Consulting Group in Ottawa (www.kellysears.ca).

The purpose of the interim evaluation is to assess SDTC's program delivery, the short-term results of funded projects and to identify any lessons learned.

The evaluation will focus on the period from 2012 to the present.

Your interview is expected to last up to 60 minutes. Your views will be kept confidential and will be aggregated with all of the responses received.

Once approved by SDTC, the final evaluation report will be posted on the SDTC website.

B. Questions

Please review the following questions in advance of your interview. If you have no opinion on a particular question, it can be skipped during the interview.

Background

1. Please briefly describe your role and responsibilities with respect to your NGBF project.

Evolution

2. Please briefly describe the evolution of your NGBF project to date. Did any major changes occur along the way?

NGBF Delivery Process

3. What are the strengths and weaknesses of the Project Assurance Process (PAP)?
4. To what extent has the SDTC delivered the NGBF efficiently (e.g., timeliness of the process; costs of delivery on the part of your company)?
5. What is your overall view of the project delivery process? Do you have any suggestions to improve the overall delivery process?
6. What role did the NGBF play in helping your company to broker the required financing for your project?

Proposal Review and Selection Process

7. Focusing on the proposal review and selection process, how does the due diligence of the NGBF project approval process compare to the process used by the private sector for similar projects? For other public-sector funding programs for similar projects?
8. How long did the project application and approval process take? Was this timing appropriate? If not, what were the reasons for any delays?
9. All things considered, what is your view of the project application and selection process?

Phase Gate Approach

10. During the pre-construction phases, how did the timing to process reports and to pass decision gates compare to when there is only private-sector funding?
11. Was the amount of elapsed time from project approval to signed contract and to go through all of the phases (from 1-concept development to 6-commissioning and operations) within industry norms? What were the reasons for any delays?
12. How did the SDTC perform in processing claims for payment during all of the phases?

SDTC Human Resources Devoted to the NGBF

13. Have the SDTC managers/staff assigned to your NGBF project possessed the needed skills and experience for their roles?
14. Has there been any significant turnover in management and staff?
15. In your opinion, have the SDTC's outside advisors provided the required expertise to deal with the complexities and risks associated with your project?

Results

16. During the interview, we will briefly review the project costs and funding sources.
17. During the interview, we will briefly review the projected environmental benefits from your project.
18. Suppose for a moment that this NGBF project had not been approved by SDTC. What would have been the impact on the project in terms of timing and scale:
 - a) the project would have proceeded with no changes;
 - b) the project would have proceeded but at a smaller scale;
 - c) the project would have proceeded but at a later date; or
 - d) the project would not have proceeded at all.
19. Did support from the SDTC NGBF affect your ability to attract private sector financing? If so, how?

20. To what extent has your NGBF project achieved its objectives to date? Looking ahead, what is the likelihood that this project will achieve its longer-term objectives?
21. What is the future outlook for the technologies associated with this project?
22. What is the likelihood that you will be able to raise financing for future developments?
23. What role has SDTC played in helping to form partnerships for your project? How useful have these partnerships been to the success of your project?
24. What has been the extent of media coverage for your project?

Summary

25. In your view, what are the main lessons learned from the NGBF?
26. Should we interview anyone else to obtain their perspectives on your NGBF project (such as financial intermediaries)?
27. Finally, do you have any other comments that have not been covered above?

* * * * *

Thank you for your participation in the study.

Interview Guide – Interim Evaluation of the SDTC Next Generation Biofuels Fund (NGBF) – Interviews with Proponents of Projects that were not Fully Contracted

A. Introduction

Thank you for agreeing to be interviewed as part of the Evaluation of the Next Generation Biofuels Fund (NGBF) which is being conducted by Kelly Sears Consulting Group in Ottawa (www.kellysears.ca).

The purpose of the interim evaluation is to assess SDTC's program delivery, the short-term results of funded projects and to identify any lessons learned.

The evaluation will focus on the period from 2012 to the present.

Your interview is expected to last up to 60 minutes. Your views will be kept confidential and will be aggregated with all of the responses received.

Once approved by SDTC, the final evaluation report will be posted on the SDTC website.

B. Questions

Please review the following questions in advance of your interview. If you have no opinion on a particular question, it can be skipped during the interview.

Background

1. Please briefly describe your role and responsibilities with respect to your NGBF project.

Evolution

2. Please describe the history and evolution of your NGBF project. What is its current status?

NGBF Delivery Process

3. What are the strengths and weaknesses of the Project Assurance Process (PAP)?
4. What is your overall view of the project delivery process? Do you have any suggestions to improve the overall delivery process?
5. What role did the NGBF play in helping your company to broker the required financing for your project?

Proposal Review and Selection Process

6. Focusing on the proposal review and selection process, how does the due diligence of the NGBF project approval process compare to the process used by the private sector for similar projects? For other public-sector funding programs for similar projects?

7. How long did the project application and approval process take? Was this timing appropriate? If not, what were the reasons for any delays?
8. All things considered, what is your view of the project application and selection process?

Results

9. During the interview, we will briefly review the project costs and funding sources.
10. During the interview, we will briefly review the projected environmental benefits from this project.
11. Suppose for a moment that this NGBF project had not been approved by SDTC. What would have been the impact on the project in terms of timing and scale:
 - e) the project would have proceeded with no changes;
 - f) the project would have proceeded but at a smaller scale;
 - g) the project would have proceeded but at a later date; or
 - h) the project would not have proceeded at all.
12. What is the future outlook for the technologies associated with this project?

SDTC Human Resources Devoted to the NGBF

13. Did the SDTC managers/staff assigned to your NGBF project possess the needed skills and experience for their roles?
14. In your opinion, did the SDTC's outside advisors provide the required expertise to deal with the complexities and risks associated with your project?

Summary

15. In your view, what are the main lessons learned from the NGBF?
16. Finally, do you have any other comments that have not been covered above?

* * * * *

Thank you for your participation in the study.

Interview Guide – Interim Evaluation of the SDTC Next Generation Biofuels Fund (NGBF) – Interviews with Current and Former SDTC Managers and Advisors

A. Introduction

Thank you for agreeing to be interviewed as part of the Evaluation of the Next Generation Biofuels Fund (NGBF) which is being conducted by Kelly Sears Consulting Group in Ottawa (www.kellysears.ca).

The purpose of the interim evaluation is to assess SDTC's program delivery, the short-term results of funded projects and to identify any lessons learned.

The evaluation will focus on the period from 2012 to the present.

Your interview is expected to last between 30 and 60 minutes. Your views will be kept confidential and will be aggregated with all of the responses received.

Once approved by SDTC, the final evaluation report will be posted on the SDTC website.

B. Questions

Please review the following questions in advance of your interview. If you have no opinion on a particular question, it can be skipped during the interview.

Background

1. Your role and experience with the NGBF: Please briefly describe your roles and responsibilities with respect to the NGBF.

Evolution of the NGBF

2. What have been the major changes to the design and delivery of the NGBF?

Delivery of NGBF Projects

3. What are the strengths and weaknesses of the Project Assurance Process (PAP)?
4. To what extent has the NGBF been delivered efficiently (e.g., timeliness of the process; costs of program delivery on the part of recipients and the SDTC)?
5. What is your overall view of the delivery process? Do you have any suggestions to improve the overall project delivery process?
6. What role has the NGBF played in helping recipients to broker the required financing for their projects?

Proposal Review and Selection Process

7. The next questions focus more specifically on the proposal review and selection process. First, was the level of rigour associated with the proposal review and selection process appropriate?
8. Were the criteria used to select NGBF projects appropriate?
9. How does the due diligence of the NGBF project approval process compare to the process used by the private sector for similar projects? For other public-sector funding programs for similar projects?
10. How long did the project application and approval process typically take? Was this timing appropriate? If not, what were the reasons for any delays?
11. All things considered, what is your view of the project application and selection process?

Phase Gate Approach in Pre-Construction Phases

12. Focusing on the phase gate approach used in the pre-construction phases, how does the timing to process reports and to pass decision gates compare to when there is only private-sector funding?
13. Was the amount of elapsed time from project approval to signed contract and to go through the five decision gates within industry norms? What were the reasons for any delays?

Financial and Human Resources Devoted to the NGBF

14. What level of manager and staff resources have been devoted to the administration of the NGBF by SDTC?
15. Was the level of staff resources sufficient for the administration of the NGBF?
16. Have the managers/staff assigned to the NGBF possessed the needed skills and experience for their roles?
17. Has there been significant turnover in management and staff? If so, in your opinion why did managers/staff leave the organization?
18. Does SDTC offer competitive employment arrangements for managers and staff?
19. In your opinion, have the outside advisors provided the required expertise to deal with the complexities and risks associated with major capital projects?

Results

20. Please describe the history and evolution of the two projects that were not completed (Vanerco and Mascoma Drayton Valley Refinery).
21. To what extent have the two projects that have proceeded (Enerkem and AE Cote-Nord) achieved their objectives to date? Looking ahead, are they likely to achieve their ultimate objectives?

22. What role has SDTC played in helping to form partnerships for these two projects?

23. What has been the extent of media coverage for the NGBF and its projects?

Summary

24. In your view, what are the main lessons learned from the NGBF?

25. Finally, do you have any other comments that have not been covered above?

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Thank you for your participation in the study.

Appendix D: Case Study Summaries

Enerkem Alberta Biofuels Project

AE Côte-Nord RTP™ Project

