# BENCHMARK ANALYSIS AND BUSINESS OPERATION MODEL OF A CLEAN ENERGY COMMERCIALIZATION ACCELERATOR

**by**

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# Executive Summary

The size of the Canadian clean energy market is small and domestic clean technology companies rely on efforts to validate and integrate their technology in a global market to ensure their long-term success and viability. The province of British Columbia (BC) is well positioned to serve the global market for clean energy solutions. High R&D capacity and existing clean-tech companies delivering emerging clean energy technologies, together with investors and supportive governments, could potentially make BC a global leader in supplying direct products, services and infrastructure to the local Canadian as well as the global clean energy markets. Most of these companies are, however, at the R&D or pre-commercial stage.

The Clean Technology Community Gateway (CTCG) is a not-for-profit organization which was established to coordinate clean energy project consortia in BC for end users such as on- and off-grid communities and municipalities. The core business strategy of CTCG is to focus initially on remote communities as its target market. The initiative is designed to close the commercialization gap between emerging clean energy technologies and community needs by managing and implementing large-scale demonstration projects.

In order to develop and implement the best business practices for CTCG, this report explores different business operational models which were adopted by different non-profit clean energy commercialization organizations. A two-stage approach is employed where, in the first stage, over fifteen organizations (including twelve non-profit organizations and three university research parks) in Canada, the U.S., and Europe are selected for benchmark analysis. Four distinct business operational models are identified based upon an in-depth analysis: incubation focused, technology-enabled, market-enabled, and strategic partnership. Thereafter, a typology of organizations is proposed, based on four discriminating models: governance, finance, operation, and revenue. In the second stage, the typological analysis is employed to unravel best business practices for CTCG in view of governance structure, management practice, community impacts, overall business model and performance, strategic plan, and operation.

**Keywords:** Clean Energy, Commercialization, Benchmarking, Incubators, Remote Communities, Business Model, Operation, Performance Indicator, University Innovation Park

# Dedication

To my wife who has encouraged and supported me throughout my life and to my little angel “Hannah”. Thank you for your love, support, and patience during my two-year absence.

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**DISCLAIMER.** This thesis was prepared based on NRC internal and publicly available information for the purposes of completing the requirements of the SFU Management of Technology MBA program. The thoughts, analysis and conclusions drawn are those of the author, and do not represent the opinion of CTCG or NRC.

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# Glossary

| | |
|---|---|
| CAGR | Compound Annual Growth Rate |
| CE | Clean Energy |
| CECA | Clean Energy Commercialization Accelerator) |
| CET | Clean Energy Technology |
| CHN | Council of Haida Nation |
| CT | Clean Technology |
| CTCG | Clean Technology Community Gateway |
| DOE | Department of Energy |
| GHG | Green House Gas |
| ICT | Information-Communication Technology |
| IRR | Internal Rate of Return |
| MNE | Multi-National Enterprise |
| NGO | Non-Government Organization |
| PPP | Public-Private Partnership |
| PRP | Project Review and Planning |
| SDTC | Sustainable Development Technology of Canada |
| R&D | Research and Development |
| ROI | Returns on Investment |
| RPS | Renewable Portfolio Standard |
| SME | Small to Medium Enterprise |
| SOW | Statement of Work |
| TRM | Technology Road Map |
| URIP | University Research and Innovation Park |
| UTTO | University Technology Transfer Office |
| WACC | Weighted Average Cost of Capital |

# 1: Introduction

This chapter focuses on the global and Canadian Clean Energy Technology (CET) commercialization trends in the context of the community needs for Clean Energy (CE) sources and with an emphasis on remote communities. The strategic market position of British Columbia (BC) clean energy capacity, including CE companies, research institutes, investors, and the role of CE commercialization accelerators, is evaluated. The advantages and disadvantages of BC as a CE hub are discussed in terms of community needs, abundance of energy resources, skilled work force, capabilities of emerging CE industries, immediate access to capital, marketing channels, and tax incentives (NRC-IFCI, 2010).

## 1.1 Purpose of the strategic analysis

The presence of technology commercialization centres is increasing due to their vital importance in facilitating and accelerating the transfer of academic and applied research to create and support technology-based firms, and to foster local and national economic growth. The lack of clarity around the governance, performance, operation, and business model of such organizations is, however, a highly significant problem.

The purpose of this applied project is to generate strategic alternatives for the "Clean Technology Community Gateway (CTCG)": a non-profit organization which was established to close the commercialization gap between emerging CET suppliers and community needs in BC. This document attempts to analyze and develop the best business and operational practice for the CTCG based on an extensive benchmark study on the operation of other similar organizations. The overarching research objective is to develop an initial typological and benchmark analysis of commercialization organizations that can give rise to different organization types in view of management practice, business operation model, and performance. A systematic benchmarking analysis identifies aspects of an innovative business operation model with the best fit to the objectives, resources and constraints of the CTCG. The outcome is a detailed, qualitative study about the key variables that determine performance and overall business operation model characteristics of CTCG and other commercialization accelerators focusing on high-tech emerging industries.

The operation and business model developed throughout this report is general enough that it can apply to any entity focusing on commercialization of CETs. The technology recipients are entities along the CE value chain from clean technology raw materials and device suppliers to integrators, CET demonstrators, communities, and end users. The CTCG focuses on remote communities as its initial target market; therefore, in **Section 1.4**, an overview is provided which illustrates global and Canadian trends for commercialization of CE in remote communities.

## 1.2 Deployment of clean energy technology

Clean technology (CT) is usually referred to as a spectrum of technologies and industries ranging across distributed power generators, photovoltaic solar panels, wind turbines, fuel cells, and energy storage systems to environmental consulting, pollution, and water treatment (SDTC, 2010). Sustainable Development Technology of Canada (SDTC) defines a "clean technology company" as:

"*A company that is predominantly engaged in the development and marketing and/or use of its proprietary technology to deliver products or services that reduce or eliminate negative environmental impacts, and address social needs; while delivering competitive performance, and/or using fewer resources than conventional technologies or services.*"

Clean technology (CT) has proven to be a major business opportunity with a growth rate exceeding earlier emerging technologies such as computers and the Internet (Pernick, 2011). Albeit with significant commercialization and time-to-market uncertainties, CT is believed to have the potential to be one of the first industries to recover from the recent economic recession (Parker, 2009).

Approximately 13% of the $787 billion stimulus package in the U.S. was allocated for investments and activities in CET; the major CT industry sub-set (Parker, 2009). New energy regulation promotes increases in efficiency and reductions of the adverse effects of energy generation and consumption such as Green House Gas (GHG) emissions and air quality. Moreover, energy users and producers face volatile conventional energy prices (NRC-IFCI, 2011). As a result, multi-national enterprises (MNEs) and small to medium sized companies are obliged to reduce their energy costs and carbon footprint. Fluctuations in energy prices and its availability have significant impacts on government's policy and on socio-economic prosperity at all scales, from the global scene to local communities (NRC-IFCI, 2011).

CE sector provides new energy solutions that improve ways of supplying energy with lower environmental impacts as well as technologies that make more efficient use of energy (NRC-IFCI, 2011). Currently, the global market for clean energy is estimated to reach $325 billion worldwide by 2020 (Parker, 2009). The CE sector mainly includes clean and alternative energy generation, energy management and efficiency, energy storage and stationary energy conversion by fuel cells, batteries, supercapacitors, hydrogen production and storage, transmission infrastructure and smart grids, sustainable transportation including fuel cell and battery electric vehicles, green buildings including green construction, infrastructure development, community design and real estate, energy efficient lighting and heating, ventilating, and air conditioning (CleanEdge, 2010).

Canada is home to companies with competitive advantages in energy management and sustainable transportation in global value chains of the CT sector (SDTC, 2010). Energy management is referred to as "the strategy of using energy to maximize profits, minimize cost, and enhance competitiveness" (Capehart et al., 2002). Canadian demand for CT solutions is estimated at $35 billion annually, with 6,000 firms employing 250,000 people (CleanEdge, 2010). Despite such a strong demand, Canada is falling behind most developed countries in commercializing technology innovations (SDTC, 2010). The size of the Canadian CET market is small and long-term success and viability of domestic companies relies decisively on efforts to validate and integrate their technology in a global market.

The province of BC is well positioned to serve within the Canadian and global market for CET solutions (BC, 2009). High R&D capacity and existing CT cluster support for emerging CE technologies, together with investors and supportive governments, can make BC a global leader in supplying direct CE products, services and infrastructure to local, Canadian and global clean energy market (Schaefer & Guhr, 2009). Most of the companies are, however, at the R&D or pre-commercial stage.

In order to support the CET sector in BC, the CTCG was formed to (i) establish and coordinate clean energy project consortia in BC for end users such as remote communities, and (ii) close the commercialization gap through managing and implementation of large-scale demonstration projects. The aim of this initiative is to develop local and global opportunities for BC clean energy companies to validate, integrate, and deploy their emerging technologies, by targeting Canadian and global markets.

## 1.3 Industry overview

### 1.3.1 Global clean energy technology market

In today's economic recovery, CT, particularly its major subset CE, has become a driving force. The CT sector is an important source of global economic growth and job creation; the global demand for clean technology solutions is currently estimated at over $US 1 trillion annually (CleanEdge, 2010). For example, South Korea's stimulus package is estimated to commit $84 billion to clean-tech investments by 2013 (CleanEdge, 2010) and China will spend $440 billion to $660 billion toward its clean-energy industry over the next ten years (CleanEdge, 2010; NRC-IFCI, 2010). CET is now the largest category for venture capital investment in the world and accounted for 27% of venture capital in the second quarter of 2010 (CleanEdge, 2010). U.S. based venture capital investments in CE increased 46 % from $3.5 billion in 2009 to $5.1 billion in 2010 (Parker, 2009). Additionally, the U.S. CET venture capital investments constituted 23.2 % of the total U.S. venture activity in 2010 (NRC-IFCI, 2010).

The overall CE market continues to grow and expands in 2011. According to the "Clean Energy Trends 2011" report issued by CleanEdge Inc. (CleanEdge, 2011), total global revenue for photo voltaic (PV) solar, wind energy, and biofuels has increased 35.2% compared to 2010, growing from $139.1 billion to $188.1 billion. While we have witnessed a steady growth in biofuels and solar PV installations, the wind power sector has suffered from a slight decline in market size, both in overall dollars and in installations (CleanEdge 2010; CleanEdge, 2011). Other CE sectors such as hybrid electric vehicles, green buildings, and smart grid have also seen considerable growth rates as indicated in **Table 1.1**.

**Table 1-1** Clean Technology trends from 2000 to 2010, adapted from CleanEdge Clean Energy Trends 2010 report (CleanEdge, 2010)

| | **2000** | **2010** |
|---|---|---|
| Combined global market for Solar PV and Wind | $ 6.5 billion | $131.6 billion |
| Average cost per peak watt to install a solar PV system | $9 | $4.82 |
| Number of hybrid electric vehicles on the road in U.S. | Less than 10,000 | More than 1.4 million |
| Number of hybrid electric vehicle models available globally | 2 | 30 |
| LEED-certified commercial green building in the world | 3 | 8,138 |
| Number of U.S. states with Renewable Portfolio Standard (RPS) | 4 | 29 |
| Percentage of total U.S. venture capital investment in CT | Less than 1% | More than 23% |

The global compound annual growth rate (CAGR; the smoothed annualized gain of an investment over a given time period) for solar photo voltaics (PV) has expanded 39.8%, according to CleanEdge research (CleanEdge, 2011). The global market for wind power has similarly expanded for a CAGR of 29.7% (CleanEdge, 2011). The CE market is reaching a stage that requires wider adoption and utility- scale deployment; thus, the overall growth is expected to slow down in some CE sectors (CleanEdge, 2010). According to Clean Energy Trends 2011, the growth projections for the major CE sectors (solar PV, wind, and biofuels) are as follows (CleanEdge, 2010):

- Global production of biofuels, based on wholesale pricing of ethanol and biodiesel reached $56.4 billion in 2010 and are projected to grow 100% by 2020.
- The capital cost of new wind power installation is projected to expand from $60.5 billion in 2010 to $122.9 billion in 2020. China has been the global leader in new installations from 2009-2011 with a 27% growth. The U.S. capacity, as the world's second-largest market, has declined 50% in 2011.
- The size of the solar PV industry, which includes modules development, system components, and installation, is projected to grow 60% by 2020 from a $71.2 billion industry in 2010.

All three sectors (solar PV, wind, and biofuels) have increased in view of total deployment of their technologies with increased revenue, especially biofuels and wind power (**Figure 1-1).** These three benchmark technologies, which collectively were valued at $124.8 billion in 2008 and $144.5 billion in 2009, are projected to grow to $343.4 billion within the next decade. The growth between 2008 and 2009 was at 15.8% (CleanEdge, 2010).

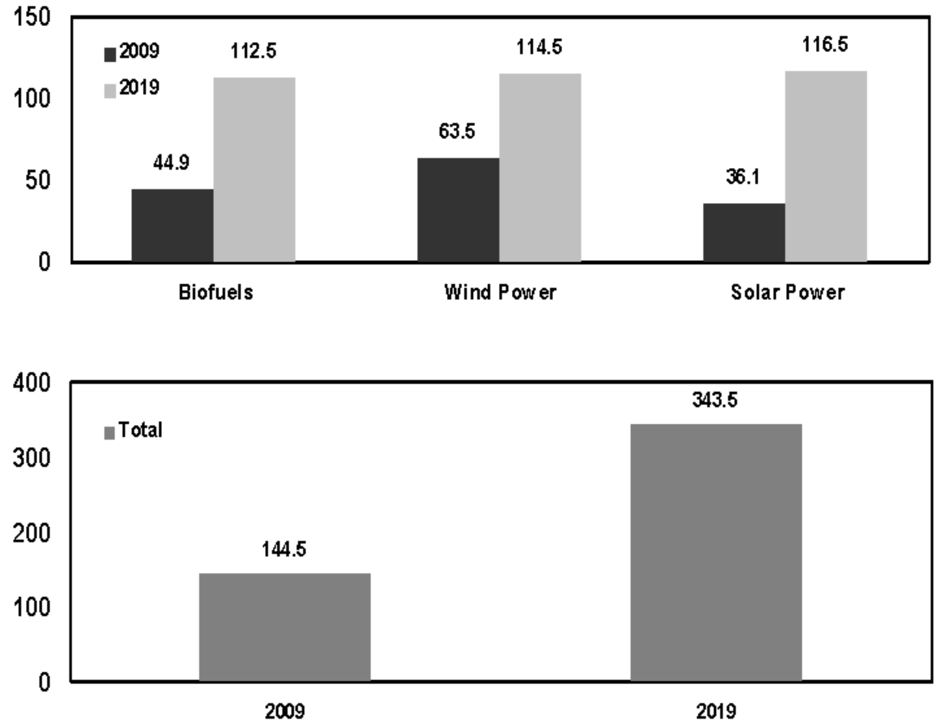


**Figure 1-1** Global clean energy projected market growth from 2009 to 2019 ($US billion), adapted from CleanEdge Clean Energy Trends 2010 report (CleanEdge, 2010)

### 1.3.2 Canadian clean energy technology market

Sustainable Development Technology Canada (SDTC) has reported on Canada's clean technology landscape based on extensive quantitative and qualitative research (SDTC, 2010). According to SDTC's report, emerging CE companies in Canada are highly viable to generate considerable economic, social, and environmental benefits (SDTC, 2010). There is an active and growing base of emerging companies in CE industry. Some companies – such as Day4 Energy (solar PV producer), Westport Innovations (compressed natural gas engine manufacturer), and $CO_2$ Solution (carbon capture and sequestration company), have already attracted considerable global attention and investment opportunities (SDTC, 2010). Ultimately, the success of Canada's CE industry depends on how well its emerging companies commercialize products and services that compete in global markets (SDTC, 2010). Although well recognized for the quality of their technologies, Canadian technology-based companies are not very successful in their efforts to commercialize their products (SDTC, 2010). Concurrently, Canadian companies are building more technical product features through research and development investments than high throughput commercialization practices and processes (SDTC, 2010; NRC-IFCI, 2010).

SDTC's report indicates that the Canadian CE industry could have grown at a CAGR of 47% during the recent recession. The highest growth rates for 2010 to 2012 are expected in the following sectors: Power Generation, Energy Efficiency, Energy Infrastructure, and Industrial Process Efficiency (SDTC, 2010) and the industry will shift from a domestic market to an export market. Highest growth companies achieved growth of 170% during the recession (SDTC, 2010). As an efficient source of job creation, the majority of CE companies in Canada require between $1M and $30M in capital (SDTC, 2010). Despite such strong characteristics, Canadian CE industry is still weak compared to its counterparts in the U.S. and Europe. To a large extent, it is due to the small number of energy infrastructure companies and slow-growing companies. Even those companies with high-growth rates often are sold before they can become "globally-recognized" companies (SDTC, 2010).

### 1.3.3 The impact of CET innovation in BC

According to a recent report from KPMG, the CET sector is an important part of the British Columbia economy as an "engine of economic growth" (KPMG, 2011; Simpson, 2011). The report projects that the CET sector in BC will grow to $2.5 billion in revenue, more than a 57% increase in revenue compared with 2008. It also forecasts that the CET sector can grow to 8,400 employees in 2011 (16.5 % increase compared to 2010) with an average salary of $77,000, making CE industry comparable with B.C.'s mining industry in view of employment and salary profile (KPMG, 2011).

## 1.4 Clean energy technology for remote communities

### 1.4.1 Global position

There are up to 4,000 remote communities around the world, which are not connected to a large, stable electrical grid (Glandt, 2010) and due to the remote nature of these communities, the cost of supplying fuel for electricity is very high. The electricity consumption in these communities is predicted to increase at a rate of about 2% each year (QLD, 2009). Further investment in renewable energy, energy conservation, and energy efficiency and education in remote communities will provide significant profits to consumers and communities by reducing energy costs for both parties.

Usually, the power system for isolated communities is designed and delivered by consultants from non-government organization (NGOs), international programs, or central government agencies (Schaefer & Guhr, 2009). The local community, eventually, may be expected to pay for maintenance and fuel after government subsidy (Schaefer & Guhr, 2009). Renewable energy technologies are seen as a strategy to address the rising power costs for remote communities (SPREP, 2004), because traditional island economies cannot support the costs and maintenance requirements of even simple village diesel power systems (Krumdieck & Hamm, 2009). Renewable power systems typically have relatively high capital cost, however, their operating costs are very low in comparison to diesel generators; therefore, they possess a lower life-cycle cost and associated "levelized" cost of energy (Glandt, 2010). Short-term payback periods for renewable power systems relative to diesel systems are achievable, when combined with renewable alternatives such as fuel cells, **Figure 1-2**.

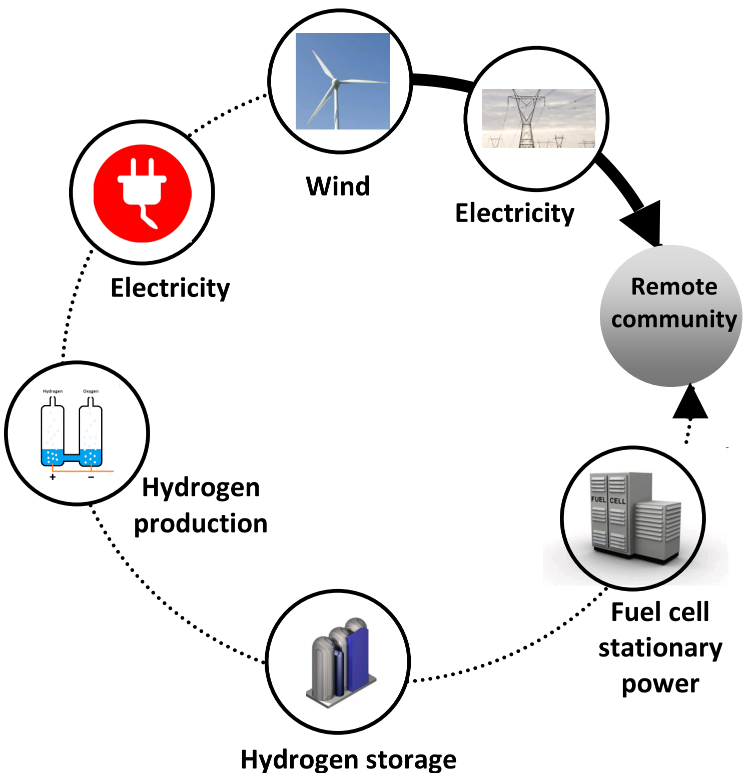


**Figure 1-2** Schematic representation of renewable power systems for a remote community, adapted from Ballard White Paper, Fuel Cell Power as a Primary Energy Source for Remote Communities (Glandt, 2010)

In Australia, the allocated state budget over the next five years is changing the way energy is supplied and used within remote communities in Western Queensland, Cape York, and the Torres Strait Islands (QLD, 2009). Initially, $5 million was allocated to trial energy efficiency and energy conservation initiatives in selected communities and to explore renewable energy options. BioCube is a portable biodiesel production unit about half the size of a shipping container being commercialized by the "Biofuel Partnership" (AusIndustry, 2009). As an Australian technology, it is a relevant example of a community's own green fuel station, which is capable of providing up to 400 people with a sustainable source of affordable clean energy. After two years of trials and challenges, the first BioCube was manufactured in 2009 in Victoria (Australia) by the Australian arm of German engineering group, EDAG, ready for export to countries in Oceania, Asia, India, Africa and the Americas (AusIndustry, 2009).

Clean energy for remote communities has recently attracted strong international attentions among CET vendors, governments, and international organizations. Two projects bringing renewable energy to villages in Peru and Lao People's Democratic Republic have been awarded the United Nations Environment Program (UNEP) Sasakawa Prize of 2008 (UNEP, 2008). Both projects were bringing power solar and hydro power to remote rural communities that did not have access to grid electricity, on the eastern slopes of the Andes and in the farthest-flung regions of Lao People's Democratic Republic.

There is a unique competitive advantage for CE early-stage enterprises in focusing their initial demonstration and integration projects on remote communities. It is a unique environment to accelerate the commercialization, adoption, and penetration of clean technologies. These remote communities provide the platform to build expertise and experience that will be utilized to help other on- and off-grid communities.

### 1.4.2 Canadian perspective

Canada has approximately 300 remote communities that can be served as an immediate target market for integrating and demonstrating CETs, developed by Canadian SMEs. Typically, these small, isolated regions have unstable grid connectivity and generate most of their electricity from diesel generators (Glandt, 2010). Most of Canada's large-scale wind power was developed as a direct result of a federal production incentive implemented in 2002 (Weis & Ilinca, 2010). It was shown that the production incentive, designed by the Canadian Wind Association costs approximately $4.7 M and could result in 14.5 MW of wind energy projects in remote communities in Canada by 2020, saving $ 11.5 M in diesel costs annually (Weis & Ilinca, 2010).

While diesel generators may have a relatively favourable capital cost, they have exceptionally high operating costs due to their low efficiency, combined with the high cost of transporting diesel fuel to remote sites (Glandt, 2010; Kim & Leng, 1999). In addition to increasing diesel fuel prices in the coming years, diesel generators have extremely poor efficiency as they turn down in power. As a result, remote communities typically employ multiple diesel generators to meet their average and peak power demands (Glandt, 2010).

Bella Coola is a community with 1,900 inhabitants located about 400 kilometres north of Vancouver and is not connected to BC Hydro's provincial electricity grid (Dimensions, 2010). It can generate electricity by using "greenhouse emitting diesel generators" and a "run-of-river power" facility, but is not capable of storing it (Kim & Leng, 1999; Glandt, 2010; Dimensions, 2010). The Hydrogen Assisted Renewable Power (HARP) project was funded through a partnership between BC Hydro, General Electric (GE), and Powertech. Also, it was supported by the Province of B.C. and Sustainable Development Technology Canada (SDTC). This project has integrated a stationary fuel cell power system which could reduce Bella Coola's annual diesel consumption by providing storage capacity to the run-of-river-facility. As pointed out by Bill Bennett, Minister of Energy, Mines and Petroleum Resources at the time "This project was a great example of how innovation and technology could be used to strengthen B.C.'s clean energy future" (Dimensions, 2010).

## 1.5 Commercialization of clean energy technologies

"Technology commercialization" is defined as the process of creating economic value from a technical invention (SDTC, 2010; Touhill et al., 2008); however, barriers for CE commercialization are particularly significant for mass-scale commercialization. The cost per unit of CET is the main hurdle and remains high compared to conventional technologies. Moreover, CET developers are still well behind to meet user requirements in view of durability, reliability and performance (Touhill et al., 2008).

Pike research has recently identified the top ten trends to watch CE commercialization in 2011 (PikeResearch, 2011). The main global deployment trends are:

- Investor-owned utilities and development of new renewable power generation
- Power generators that are currently deployed in global market are increasing in size and shrinking in cost (economies of scale)
- Moving power plants from traditional sites to marine sites

- Shifting from alternative current (AC) to direct current (DC) transmission
- Diversification in solar sector in view of size and type of solar panels (thin film or thermal electric)
- Diversification in the wind power sector
- New business opportunity based on waste-to-energy power plant
- The growth of geothermal power generation due to Renewable Portfolio Standard (RPS) in the western U.S.

In the majority of cases, Canadian companies do not achieve the full commercial potential of their technologies (Barber & Crelinsten, 2009). Many companies with attractive technologies will be more attractive to merger and acquisitions (M&A) by foreign firms. These companies usually have little interest in maintaining their main operations in Canada (SDTC, 2010). Therefore, Canadian CET companies need to commercialize their technology at an equal or faster rate than global competitors and generate revenue more effectively. The 2010 CleanTech growth and go-to-market report (SDTC, 2010) emphasized the same critical points: "In the current business environment, the report finds significant and systemic issues and difficulties for Canadian clean technology companies related to: Access to private equity capital, Direct procurement by government and large companies in CT sourced from Canadian companies, and the relative attractiveness of the domestic market for Canadian CT companies."

Understanding the evolution of the risk profile of technology-based companies provides an important tool for identifying the challenges companies face in the product commercialization process (SDTC, 2010). Risk and its management are particularly important elements in the technology commercialization process (Pisano, 2010). The risk profile of a technology company changes dramatically throughout the technology commercialization process. In order to increase returns from their expenditure and lower the risk of investment, the Canadian CET must achieve producer surplus, measured by "the margin of profit over costs" (Garnsey et al., 2006; Pisano, 2010). As indicated by Maine and Garnsey, similar to that in the nanomaterials industry, the cost of CET increases more rapidly than its return (Maine & Garnsey, 2004). The latter indicates that technological risks may prevent CE companies from achieving producer surplus (Pisano, 2010). As indicated by Garnsey et al. (2006), another source of risk in the market place is that related to customer adoption capability and occurs when the market risk for introducing a new product by a new company is increasing. Established companies are able to lower their costs faster than the new company can scale up its "discontinuous innovation" (Garnsey et al., 2006). Operational risk is "the risk that the company will fail to resource and/or execute the necessary strategies to acquire and retain customers" (SDTC, 2010; Slack et al., 2010). Depending on their "technology road map (TRM)" and commercialization process, companies may employ different skills, examine various disciplines, and look to different manners to manage their financial activities. **Figure 1-3** shows that the process of commercialization is divided into R&D and product development. The role of operation evolves from R&D activities to market penetration process. The role of technology diminishes along the process of product development and commercialization.

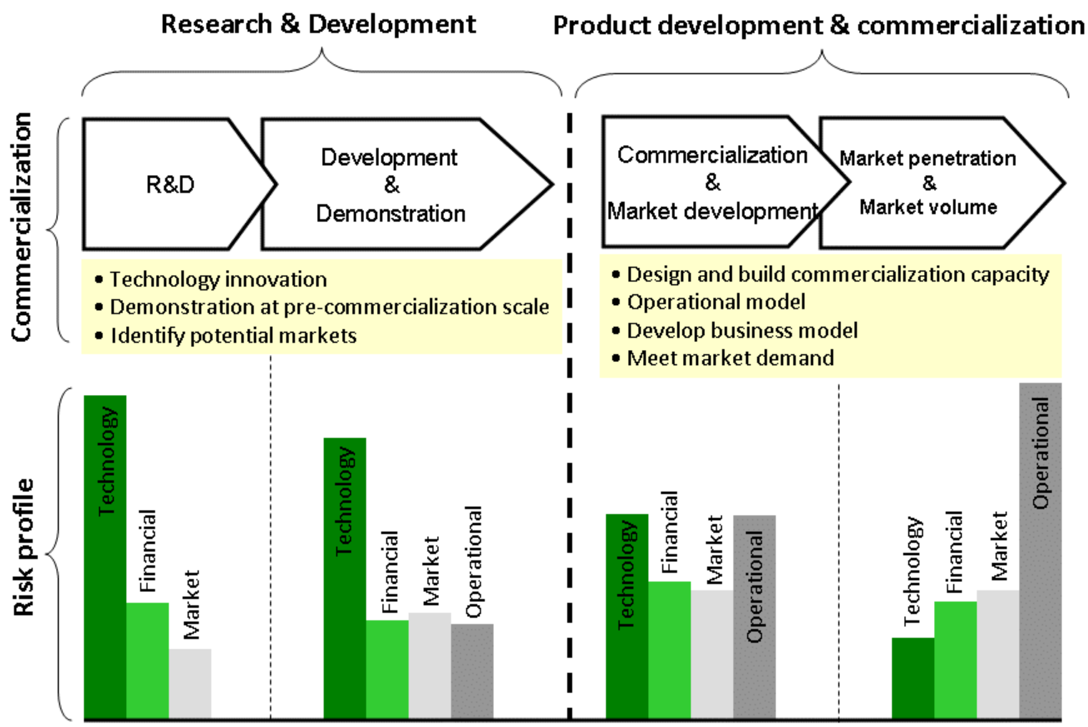


**Figure 1-3** Technology and product commercialization process framework, adapted with permission from SDTC Go-to-Market Report 2010 (SDTC, 2010)

Demonstration is a success factor for CET commercialization, indicating the visibility of the technology and the ability to scale up or be applied in a new manner (CleanEdge, 2010, SDTC, 2010, PikeResearch, 2011). Demonstration projects allow validation and promotion of local CE technologies (NRC-IFCI, 2010). However, setting up a demonstration project is challenging for small companies with small or no experience in other demonstration projects. Forming consortia to enhance the project-funding process is of vital importance to the success of large-scale demonstration projects (Schaefer & Guhr, 2009; NRC-IFCI, 2010). These demonstration projects can attract governmental funds and establish local market opportunities for CET companies. Alternatively, demonstration projects may accelerate the consumers' early adoption process (NRC-IFCI, 2010). As the CleanTech growth and go to market report 2010 states: "the Early Adopter Challenge Market attractiveness is a key challenge for Canadian CT companies. Many organizations are reluctant to invest as customers of Canadian clean technology. As a result, Canadian CT companies are increasingly dependent upon foreign markets as their key growth driver. But domestic markets must also be seen as a key enabler for exports" (SDTC, 2010). The report identifies five key areas where government can play a remarkable role to connect CE companies to the domestic CE market: "Price signal to trigger investment / Visibility / Strategic procurement / National infrastructure / CET Standards" (SDTC, 2010). A non-profit CE commercialization accelerator can help implement these requirements at the provincial and national levels (NRC-IFCI, 2010).

### 1.5.1 Commercialization strategies

Investing in R&D seems to be a vital solution for long-term stability of the CE industry. "While recognizing the critical importance that world-class research and development plays in a technology company's overall success, it is only when a product is commercialized that a company's commercial success is possible, and when customers see value in and are willing to buy the product or service offered" (SDTC, 2010). According to the National Business Incubator Association, the U.S. has over 1100 business incubators as compared to roughly half that number in China (Reddin, 2011). In CET, however, the U.S. is losing the competitive position to China in important areas such as solar photovoltaics and batteries, where the technology traces its roots to the U.S. and Europe (Reddin, 2011). A stable policy environment that supports CE supply and CE usage, gives China and Europe a competitive edge. A close collaboration between government, academia, and industry increases the chance of attracting the required commercial, financial and technical resources for CE commercialization (CleanEdge, 2010).

In today's highly disrupted capital market, early-stage venture investment has dropped considerably and this is especially the case for CET "a sector which has struggled to demonstrate strong, broad-based financial returns" (Sarta, 2005). The North American venture capital investment in clean technology was $3.5 billion in 2006, representing 45% growth compared to that in 2005. Investors such as Sustainable Development Technology Canada (SDTC) have been investing $1.05 billion in Canadian clean technology companies (SDTC, 2010; NRC-IFCI, 2010).

Canada ranks 13th out of 17 developed countries in commercializing technology innovations. Moreover, the size of the Canadian market is small and domestic clean technology companies must sell their innovations to global markets for long-term success. Scaling and deploying clean technologies often involves significant capital investment while venture funds are trying to invest as little as possible to retain a positive cash flow. Thus, CET firms must enable growth through "radical innovation" while empowering their capabilities and complementary assets (Maine, 2008). The venture-backed CET firms usually focus on their product development process when exploring emerging markets, which requires an active managerial practice to reduce risk and opportunity cost (Markman et al., 2005). This focus on "capital efficiency" means early-stage companies are out of the picture for heavy capital investment. Hence, there has been a clear gap between the early-stage CE companies found in incubators and what venture capital investors are interested in (Selman, 2010). Other fast-growing economies such as China's have overcome the gap by choosing CE commercialization as their national priority and support large venture to invest, demonstrate, and adopt CETs (Selman, 2010; Reddin, 2011).

### 1.5.2 University research park concept

Up to 50% of all U.S. economic growth over the past more than fifty years is argued to be the result of investments in research and development (Sonka&Chicoine, 2004). The success of business incubators and technology parks in university settings is often determined by how well technology is transferred from the labs to their startup firms. University technology transfer offices (UTTOs) function as ‘‘technology intermediaries’’ in fulfilling this role (Autio, 1997; Sonka&Chicoine, 2004). The entrepreneurship process and an appropriate model for the role of the UTTO in business incubation are scarce. A linear process is generally assumed for the university commercialization process, where initially a technology-based idea is generated from research, protected by patents, and finally is transferred to a newly established firm to commercialise the idea (Autio, 1997; Druilhe&Garnsey, 2003).

Druilhe and Garnsey analysed emerging ventures among Cambridge University spin-outs (Druilhe & Garnsey, 2003). They identified and revised five main types of business models (consultancy, development, software, product-based, and infrastructure creation) that have been adapted by academic entrepreneurs. According to Druilhe and Garnsey, the university entrepreneurial process is comprised of (i) opportunity recognition, (ii) mobilization of new combinations of resources, and (iii) organization of the resource base. The commercialization process should identify a framework to address two questions: (a) which UTTOs' structures and licensing strategies are most conducive to new venture formation; and (b) how are the various UTTOs' structures and licensing strategies correlated with each other (Markman et al., 2005). To close the gap between CE developed in a research lab and commercialization processes in a spin-out CE company, an appropriate link between companies and research centres should be built. BC already has this great research potential in CET, which can potentially enhance the innovation capacity of CE companies (NRC-IFCI, 2010; BC, 2009).

### 1.5.3 Public Private Partnership

Demonstration project through a Public-Private Partnership (PPP) model is an appropriate route for early commercialization of emerging CE technologies and a number of definitions have been proposed for the PPP projects (Valsangkar, 2010). The governments should be willing to diminish their overall control over the project and should be ready to share the expected revenue with the private partner(s). The private partner, on the other hand, should invest considerably in anticipation of the expected revenue (Valsangkar, 2010). If a project's future revenue stream is predicted reasonably, it will likely attract private partnership (Hall, 2008; Valsangkar, 2010).

The entities involved in a PPP project share working capital, revenue, risk, responsibility, assets, and authority. Revenue sharing models are based upon the risk-return relationship and principles of finance. Risks can be measured in terms of financial loss, business loss, socio-economic impacts, and administrative complexity (Hall, 2008; Valsangkar, 2010) and returns have to be proportional to the risk faced by the PPP partners (NCPPP, 1999; Hall, 2008).

### 1.5.4 Commercialization accelerator concept

The primary role of a CE Commercialization Accelerator (CECA) is to support and facilitate large-scale demonstration projects to help early stage CE companies with development and deployment of their technology. As shown in **Figure 1-4**, the main objective is to shorten the time-to-market process by optimizing the design-to-demonstration process as well as most time consuming administrative, procurement, and regulatory processes that most of CET companies are facing (NRC-IFCI, 2010). In a similar vein, many CECAs provide or facilitate incubation opportunities to early stage companies. One of the main roles of an incubator is to prepare their clients to connect to outside investors and to help facilitate the "lean demonstration" or "early market penetration process" (NRC-IFCI, 2010).

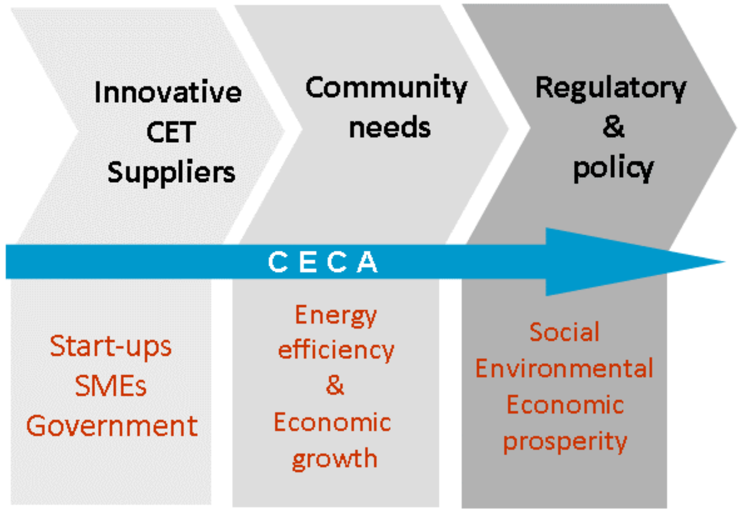


**Figure 1-4** Schematic representation of CECA's interaction with impacted stakeholders

A CECA can adapt and execute a critical business development process, e.g. negotiation with energy utilities, access to industry partners, manage project, and play the role of a trusted third party validator to service end users and access the distribution channels (NRC-IFCI, 2010; NRC-IRAP, 2011). "CECAs are not-for-profit entities that focus on bringing local and international companies, industry partners and research centres together in the pursuit of establishing consortia and of finding enabling parties for CE projects" (NRC-IFCI, 2010). Moreover, the commercialization accelerator focuses on building up relations with lead and co-investors in order to help start up companies for demonstration and early commercialization of their CE products.

## 1.6 Objectives and scope of this study

This document focuses on detailed benchmark analysis by reviewing and analyzing several high-tech commercialization and accelerator organizations. The performance and evolution of other similar organizations are systematically analyzed to identify and implement the best business operation practice to fit the objectives, resources, and constraints of CTCG. A typological and benchmarking analysis is utilized to review external organizations in view of governance, management practice, overall business model, financial resources, strategic plan, and operation. The benchmarking studies also identify performance indicators in view of: financial returns, quality and speed of project development and execution, and overall impacts on communities and CE industry.

CTCG differentiates itself from other such organizations by focusing on remote communities as its initial target market. The benchmarking reveals best practices for organizational structure, business model, and operation that could have a major impact on the success of the CTCG initiative. Data has been gathered from the senior management of other commercialization firms, government institutes, and NGOs, while the evolution and performance of similar organizations to CTCG was either surveyed or collected from existing information. A systematic analysis identifies aspects of a business operation model with the best match to the characteristics of CTCG.

# 2: Internal Analysis of CTCG

In order to provide strategic alternatives to CTCG, it is necessary to understand the current structure of the organization, the shortcomings of the current operation processes, and the capacity of the organization both to change the business model and implement a new business strategy. Therefore, this chapter provides an overview of the organizational structure, business strategy, and other internal characteristics of CTCG, by placing an emphasis on governance, business operation model, and financial resources. At the end of this chapter, the structure and operation of the Haida project, as the initial focus of CTCG, is provided, and the interplay between performance indicators and the current operation of CTCG is discussed in detail.

## 2.1 Background

CTCG is a neutral, not-for-profit, federally incorporated organization comprised of public and private sector partners who are collaborating to develop and deploy clean energy solutions within remote communities (CTCG, 2011). CTCG's strategy is to evaluate, establish, coordinate, manage, and implement large-scale clean energy projects for end users, primarily those in remote communities. The aim of this initiative is to develop local and global opportunities for Canadian clean energy companies to validate, integrate, and empower their emerging technologies, by targeting national and global markets and increasing the level of technology readiness.

CTCG coordinates and links the resources to support end users and integrators such as remote communities and municipalities to develop clean energy solutions with strong impacts on the economic growth and job creation in those communities. The ultimate achievement of such initiatives will be to create opportunities for companies in clean technology sectors to access global markets (CTCG, 2011).

### 2.1.1 Business strategy

The core business strategy of CTCG is to focus initially on remote communities as the target market. Remote communities provide excellent platforms for emerging CE technologies that are mainly supplied by SMEs and early stage ventures. These firms are not able to demonstrate and test their technology in local communities, municipalities, and end user domains due to rigid regulations and lack of available infrastructure. The CTCG's long-term business strategy is to provide services to BC remote communities and leverage that success to help connect SMEs and CET providers in BC and Canada to the global market to sell their viable and demonstrated CE technologies.

### 2.1.2 Characteristics and value proposition

By bringing together the technology suppliers and linking with other clean energy clusters, CTCG is a one-stop-shop to provide the expertise and support activities required for developing clean energy projects. Its initial Board of Directors formed with five core members; including two federal and provincial representatives, a president, and two representatives from private stakeholders in addition to advisory board members (CTCG, 2011).

CTCG neutrally provides a sustainable clean energy commercialization platform. The services include technical and financial solutions and managerial resources that are required to develop CE systems, as shown in **Figure 2-1**. CTCG performs its first few projects in remote communities and aligns its organizational structure and operation to develop, support, and administer such projects. The latter is central to maximizing the success of CTCG to accelerate the commercialization, adoption and penetration of CET to local and global market segments to address energy needs of on- and off-grid communities.

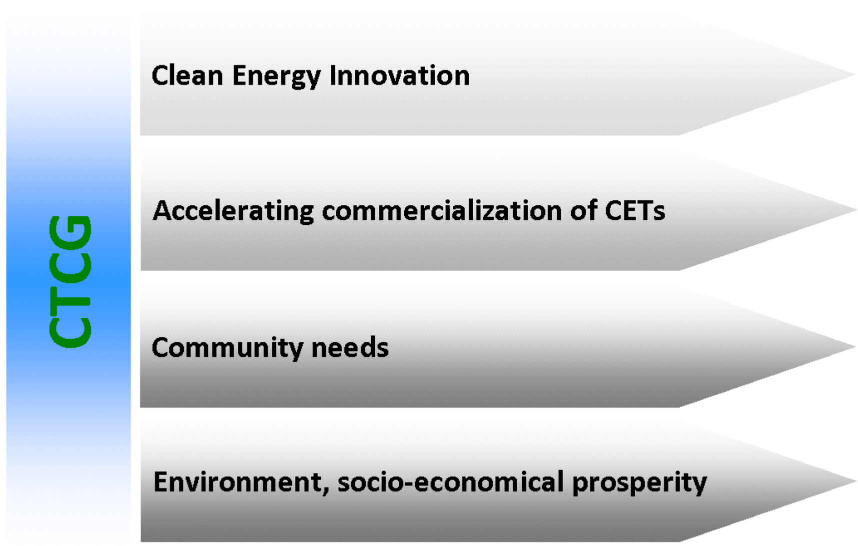


**Figure 2-1** CTCG's business strategy and value proposition

#### 2.1.3 Strategic market positioning

CTCG can scale up and deploy clean technologies by attracting low capital investments for short-term projects and high capital investments for long-term community projects. The core strategy of CTCG is "capital efficiency" by involving early-stage companies and attracting public funds or working with established large CE ventures with interests to fund, support, and implement CE projects.

## 2.2 Governance, business, and operation model

#### 2.2.1 Governance structure

CTCG is a public-private partnership and is governed by a Board of Directors consisting of Member Directors and an Advisory Board, all external to the management of CTCG. The Board of Directors elects Advisory Board members. Member Directors are designated and appointed by Member Organizations of CTCG (National Research Council, Province of British Columbia, Private Stakeholders).

To ensure an efficient managerial structure, four levels of authority are implemented; the Board of Directors, the Executive Committee, the Audit Committee, and CTCG Management. This approach allows operational issues to be handled efficiently and independently and policy matters to be brought to the appropriate level without any conflict of interest and unnecessary delays (Bloom, 2010). The President of CTCG reports to the Board of Directors.

##### 2.2.1.1 Board of Directors

The Board of Directors monitors and supports the strategic plans developed and executed by CTCG Management. The Board meets regularly to review all aspects of the operational performance of the organization. The CTCG Board of Directors has the responsibility of choosing a strategic business plan, long-term vision, and ensuring sound relationships between CTCG, partner organizations / technology suppliers and its clients and a high-standard level of business practice and performance (Bloom, 2010; CTCG, 2011).

##### 2.2.1.2 Executive Committee

The Executive Committee is composed of the Chair of the Board of Directors and a minimum of two other Directors who are appointed to the committee annually by the Board. The Executive Committee oversees project operations and promotes discussion between Directors and the President of CTCG. It provides feedback to the President on important issues related to execution and performance of CE projects as required in board meetings.

#### 2.2.1.3 Audit Committee

The Audit Committee is composed of a minimum of three Directors elected annually to the committee by Member Organizations of CTCG, which also elect a Chair of the Committee. The Audit Committee monitors and recommends changes in the governance of CTCG. The Audit Committee assists the Board of Directors in fulfilling its responsibility to oversee the integrity of the accounting, auditing, and financial reporting practices of CTCG, and other duties as assigned by the Member Organizations. The Committee oversees the financial reporting to members, monitors processes to manage financial risk, and monitors legal, ethical, and regulatory requirements (Bloom, 2010).

As shown in **Figure 2-2**, a close interaction exists between the board of directors and the audit committee with respect to the project development and execution process. The executive committee, president, and CTCG management closely monitor the risks, performance, and efficiency of the projects. The primary role of the member organization is to ensure that the type of CE projects and their execution are in accordance with the mandate and needs of the communities. The member organization also ensures that those projects are beneficial to CE companies to accelerate commercialization and improve the positioning of their technologies for local and global markets.

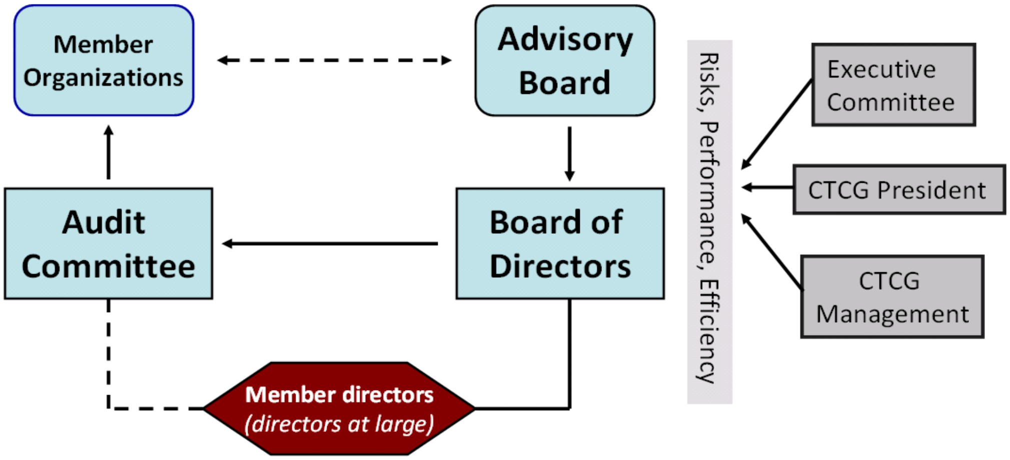


**Figure 2-2** CTCG's governance structure. The scheme is adapted from (Parent, 2010)

### 2.2.2 Strategic business model

#### 2.2.2.1 Business model statement

CTCG contracts with private and public partners (communities, municipalities) on coordination, education, market and technical evaluation, execution, and managing clean energy projects for remote communities. CTCG's strategy for financial sustainability is to obtain at least 70% support from service sales (marketing, technical, and educational), supplemented by net income from foundation grants, membership fees, and fixed pay offs from clean energy projects.

Public-private partnership has been recognized as an innovative approach to the procurement of public projects (NCPPP, 1999; David Hall, 2008; Valsangkar, 2010). The current CTCG business model consists of a partnership among the institutional users (i.e. remote communities), a non-profit corporation (CTCG), and the developer (technology suppliers). The CTCG business model should be flexible and built upon a realistic assessment that covers technical issues, legal, regulatory, policy frameworks, institutional and capacity status, commercial, financial, and community social and economic impacts.

CTCG gets involved in clean energy projects in the form of a public-private partnership and may share capital, revenue, risk, responsibility, assets, and authority (Valsangkar, 2010). In **Chapter 5,** several strategic alternatives are provided as business and revenue generation models for CTCG. Those revenue sharing models are based upon the potential risk and return relationship principles of finance (Valsangkar, 2010). If exercised, the proposed models can provide bases for CTCG to share capital investment and revenue. In summary, the discounted cash flow, working capital, fixed and variable costs for running the projects and revenue sharing (Valsangkar, 2010) through fixed and variable payoffs constitute CTCG's core business models (NRC-IRAP, 2011).

### 2.2.3 SWOT analysis

Identifying Strengths, Weakness, Opportunities and Threats, also known as a "SWOT Analysis", is a powerful technique that can provide insights into the competitiveness and attractiveness of CTCG in CE markets. As summarized in **Figure 2-3**, the strengths of CTCG are in its technical and marketing expertise and access to a broad range of R&D, technical, and business supports, through which it can provide subsidized consulting services to communities and CE companies. The weaknesses are related to short-term difficulties in attracting policy makers and CET companies due to limited resources. The initial financial resources of CTCG are mainly from government, community, or municipality grants, which require strong collaboration and matching funds from CE industries. The threats for penetrating into (remote) community energy-consumption markets are mainly related to resistance from communities and consumers to change their behaviour, and high transaction costs associated with replacing the existing power generators with CETs. In terms of opportunities, CTCG can collaborate with communities and CE early stage ventures to implement CE projects for remote communities, creating strong environmental and social impacts.

| | |
|---|---|
| **STRENGTHS**<br>• Subsidized consultants to communities and CET early-stage companies<br>• Available technical, marketing, and business related expertise in CETs<br>• Access to relevant resources | **WEAKNESSES**<br>• Limited buy-in from policy-makers and CET companies<br>• Resources |
| **THREATS**<br>• Consumer behaviour and resistance<br>• Transaction costs<br>• Limited buy-in from policy-makers and technology companies | **OPPORTUNITIES**<br>• Partnerships<br>• Change in communities' lifestyles and policy<br>• Increase sustainability<br>• Economic, social and environmental benefits |

**Figure 2-3** SWOT analysis for CTCG in the CET market

## 2.3 Haida project

### 2.3.1 Haida first nation and impacts of clean energy

The Haida people have been in Haida Gwaii since time immemorial (CHN, 2011). The traditional territory includes part of southern Alaska, the archipelago of Haida Gwaii, and its surrounding waters. Half of the total 5000 inhabitants on the islands live in Haida (CHN, 2011). Haida nation resides throughout the islands but is concentrated in two main regions, Old Massett at the north end of Graham Island and Skidegate at the south end. Vancouver is located 770 km south of Haida Gwaii and Prince Rupert with a population of 13,392 is located 100 km east across Hecate Srait (CHN, 2011). Haida Gwai Island is connected to the grid, but has a high reliance on diesel generators.

CTCG's first project is a collaboration with the Council of the Haida Nation ("CHN"). The main impacts of this project for CHN are priorities from environmental (proper land use), cultural, social, and economic points. In return, CHN contributes to the development of a healthy island economy, which is the mandate of the Haida Nation's Corporation, Haico (NRC-IRAP, 2011).

CTCG assists the CHN and the residents of Haida Gwaii in achieving their stated vision of having their local energy requirements met fully through renewable resources. The collaboration has been focused on identifying and evaluating renewable energy options for Haida Gwaii (CTCG-CHN, 2011). CTCG is eager to create a balanced approach to the initiative, which in addition to reviewing energy demand and techno-economical requirement, will successfully fulfill the need for community involvement throughout the project. Ultimately, the Haida Gwaii initiative will create a template to assist neighboring central and North Coast communities in transitioning away from diesel-dependence towards a sustainable future based on 100% renewable, clean energy technologies (CTCG-CHN, 2011; NRC-IRAP, 2011).

### 2.3.2 AS-IS operation process

In the initial stage, CTCG plays a role as a "technical evaluator" to monitor and evaluate the viability and framework of the Haida project (CTCG, 2011). The existing CTCG business operation model for the Haida project consists of two phases: the first phase of the project consists of execution of a 3-month work plan, focusing on evaluating renewable electricity options. The second phase evaluates broader renewable energy options (CTCG-CHN, 2011). The CTCG work plan has been designed to support the CHN in their current discussions with a utility company to assist the CHN and utility vendor in developing a strategy that could financially benefit both groups (CTCG-CHN, 2011). During phase II, CTCG performs outreach and engages community through training, education and sharing of information. Phase III will eventually focus on execution and implementation of the plan and will seek high capital investment from private vendors and public entities. Along these phases, the role of CTCG evolves from project evaluation and planning to project management, tapping into associated member organizations (federal and provincial government, and private CET vendors) for improving project effectiveness (cost, speed, quality), as indicated in **Figures 2-4, 2-5.**

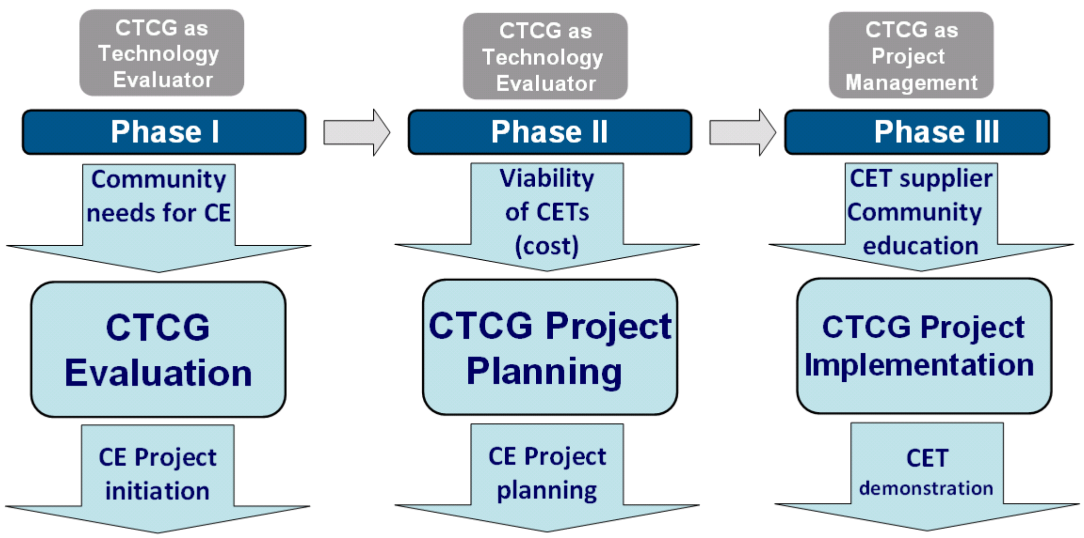


**Figure 2-4** Input-transformation-output processes for CE project planning and execution at CTCG

At the time of initiating the Haida project, CTCG consisted of staff specialized in marketing, project coordination, and project management. All are familiar with the implementation and execution of clean energy projects. The existing staff are responsible for coordinating and managing business development activities primarily in the areas of promoting the capabilities of the organization and managing revenue-generating activities. CTCG provides business support to the CHN project manager (jointly recommended by CHN and CTCG, and appointed by CHN) and engineers from private vendors to define client needs, project concepts, and statements of work.

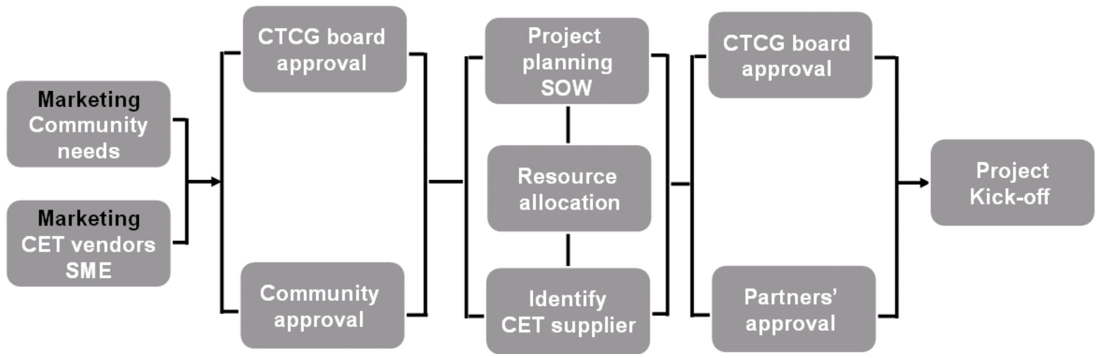


**Figure 2-5** Actual stages for CTCG's project planning and execution

### 2.3.3 Shortcomings and gaps of AS-IS operation process

There are potential shortcomings and deficiencies of AS-IS business operation that were described in the previous section. Currently, there is not a clear process to monitor communications between CHN and CTCG to ensure speed, financial requirements, and the quality of the contracting services or to identify the required board's approval process in the beginning of the project development process. The majority of projects that CTCG intends to execute with remote communities are heavily reliant on external funding. The time to finalize requirements and signed documents is long, tedious and frustrating, which can sometimes discourage the CET vendor and remote community. As the conflict of interest issues are not identified and managed before the development of Statement of Work (SOW) and contract, there is a chance that the contracts can fall into bottlenecks in the later stages, even after SOW approvals. Moreover, the turnaround time from the project entering the contracting phase until the contract is completed is long. The required involvement of the board and audit committee is not identified yet, so the contracting process can fall into other bottlenecks at later stages. More importantly, there is no particular process to measure the performance of the project agreement approval process, project planning, and project execution particularly in view of impacts on community, quality, cost, required finance, and speed.

### 2.3.4 Performance metrics and indicators

In order to relate performance to operation, performance objectives should be identified. Finalizing the time of the agreement process influences speed, dependability, and quality, while it does not affect cost. Longer contracting times lead to lower speed, low quality service, and delays on starting the project (high dependability). The level of communication between community, private vendor, and CTCG affects quality, speed, and flexibility with less effect on cost and dependability. Miscalculation and late identification of required finance and approval processes (executive committee/board agreement and concerns regarding possible conflict of interest, for instance) could create several feedback loops and greatly affect speed and quality. Therefore, the degree that CTCG services reflect clients' needs and desires (in terms of conflict of interest issues between the private vendors' representative in the board and project execution committee, payment schedule, and project execution process) impacts quality and dependability. The performance objectives for the AS-IS process are ranked as high community impact, private vendor impact, high quality, high speed, high dependability, high flexibility, and low cost. These attributes are primary drivers for CTCG to serve communities and emerging CET industries to create jobs, enhance living standards, lower energy costs, and increase energy efficiency. This is clearly indicated in **Table 2-1** and is visualized in the polar diagram in **Figure 2-6**.

**Table 2-1** Ranking the performance objectives for AS-IS operation process

| | **Quality** | **Speed** | **Dependability** | **Flexibility** | **Impacts on companies** | **Impacts on community** | **Cost** |
|---|---|---|---|---|---|---|---|
| Finalizing time | High | High | High | Low | High | Medium | High |
| CTCG communication plan | High | High | Low | High | High | High | / |
| Identification of required approval processes | High | High | Low | Low | High | / | Low |
| Client needs and desires | High | / | High | / | High | High | / |

In view of operation, the AS-IS process contains complex communications between CTCG and CHN and consists of several feedback loops. In view of structure, the operation process shows too many steps with less interrelation and integration. In view of resourcing, the AS-IS process may lead to inefficient use of funds by miscalculating the required approval process, leading to duplication of efforts.

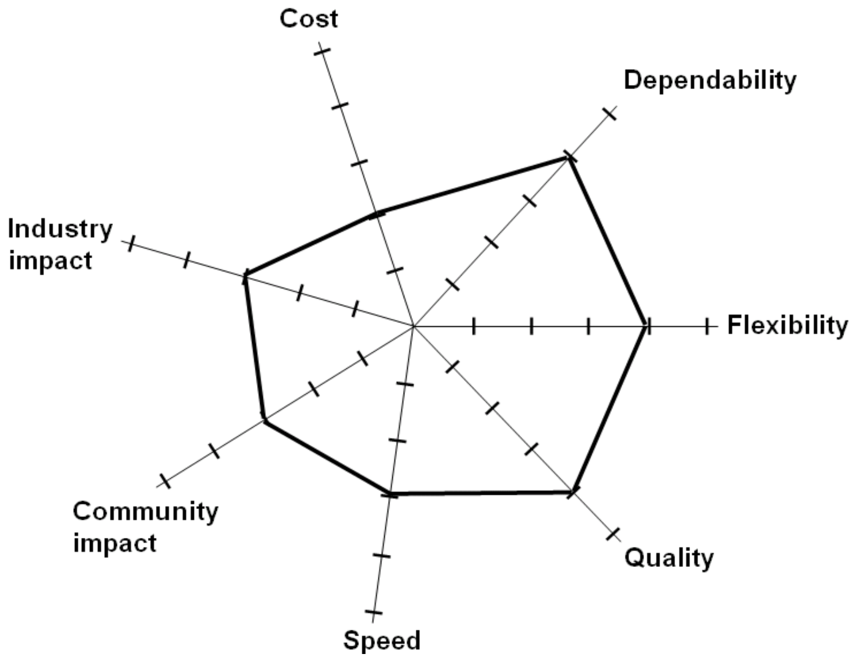


**Figure 2-6** Polar diagram for CTCG's AS-IS project development and execution process

# 3: External Analysis

In order to provide an innovative alternative for business operation at CTCG, an external analysis is necessary to assess different non-profit organizations involved in the commercialization of CETs. The benchmarking study aims to understand the effectiveness and performance of those organizations which can ultimately provide the best possible operation model for CTCG. Therefore, this chapter focuses on extensive benchmarking of thirteen commercialization organizations in Canada, U.S., and Europe. The benchmarking study was conducted through on-line sources, company interviews, and site visits.

The benchmarked organizations were compared based on their governance structure, overall financial resources and strategy, core business model, and operation. This benchmarking highlights major challenges and perspectives of these non-profit organizations engaged in commercialization of high-tech products, particularly within the CE sector. Based on their distinct business operational models and an in-depth analysis, the chapter provides insights on the role of governance and financial resources on an innovative business model, on which these organizations are operating.

At the end of this chapter, the performance of the benchmarked organizations is assessed based on internal and external measures in view of the number of partnerships with government agencies, business, and industry constituents and the overall impacts on social and economic benefits to the communities and emerging CE ventures.

## 3.1 Benchmarking

Benchmarking is "the process of learning from others". It is a management tool for learning and comparing processes, performance, and learning among enterprises (Slack et al., 2010). Benchmarking provides a range of techniques with opportunities for learning by comparing two examples of the same process. Benchmarking compares the different methods that companies employ to manage the product or service development processes and defines the cause or causes of those differences.

In the benchmarking process, firms select examples of actual "best practices" then compare their performance. Benchmarks can be constructed along several dimensions of performance such as quality, productivity, flexibility, and customer service. The comparisons can be made with similar firms (in terms of size, sector, and product/markets) or with different ones with the underlying principle being to "identify the strengths and weaknesses of the firm and the directions for future development of competitive advantage" (Camp, 1989). Benchmarking offers a structured methodology for learning and is increasingly being used by small enterprises to motivate learning and change (Polt et al., 2001; Tidd et al., 2005).

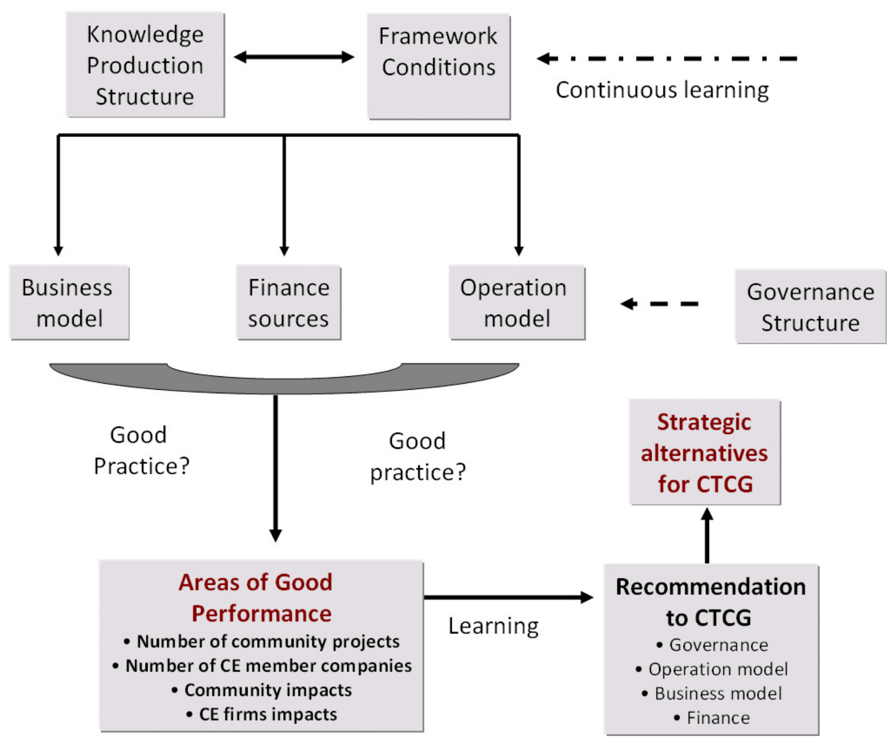


**Figure 3-1** Methodology of benchmarking framework and its relation to strategic alternatives of CTCG, adapted from (Polt et al., 2001)

The basic features of the benchmarking approach and the implications for CTCG are shown in **Figure 3-1**. In the context of this study, the benchmarking aims to show how different non-profit organizations for commercialization of CETs are comparable in view of governance, finance, business model and operation. The benchmarking study also provides means to understand the effectiveness of those organizations on a range of performance measures (Tidd et al., 2005). Additionally, a mix of different types of benchmarking will include external benchmarking (comparison of operation between different organizations), competitive and non-competitive benchmarking (benchmarking against organizations from non-competitive or competitive market), and practice benchmarking (comparison between another operation practice) (Slack et al., 2010). For performance benchmarking, the main focus is on input and output measures by emphasizing impacts on community and CE firms, quality, speed, and cost of the CE projects.

## 3.2 Benchmarked Characteristics

The organizations surveyed in this document are benchmarked based on business strategy, governance, financing, business model, operation, and overall performance.

### 3.2.1 Business strategy

Strategic management is of vital importance to any business organization. Business strategy is essentially an ongoing process to evaluate company success and attempts to "ideally continue or improve that success" (Anthony, 1994; Grant, 2005). The definition of business strategy includes corporate planning which focuses on the overall purpose of the business. In some cases, it may be the company's mission statement, which determines where the business wants to be in the long-term. Business strategy identifies the target markets and determines how the organization actually functions within those markets. This could include what the business needs to do in order to be able to function in new markets.

In the context of this benchmarking exercise, one should notice that non-profit organizations seek different niche markets than for-profit businesses. The business strategy of non-profit organizations for CET commercialization is benchmarked in view of their dedication to social benefits, location, organizational structure, and core business focus. This image and the resulting public financial support are taken into account in these benchmarking studies. Although some of these organizations have an income-generating business as part of their structure, others are dependent on public funds for the majority of their cash flow (Blackbaud, 2004). Broadening the access to government and public funding as much as possible helps to ensure the long-term stability and financial security of these organizations.

### 3.2.2 Governance structure

Governance is usually referred to "the overall processes and structures used to direct and manage an organization's operations and activities" (PAGVS, 1999). The leading authority, i.e. the board of directors, uses it to provide guidance and monitor the values and goals of the organization through policy and procedures. The ultimate goal of governance is to protect the public interest. The “public interest” includes client population, workers, volunteers, members, funding agencies, and the public (CUPE, 2004). In the non-profit sector, governance is comprised of volunteers and is the domain of the board of directors. Proper governance requires the board to “stand outside the organization and hold it accountable to the public interest” (AFNM, 2010). In proper governance practice, the CEO or executive directors or anyone reporting to these individuals should have no voting privileges: “the board governs and [the] management manages” (CUPE, 2004).

The governance structure is of vital importance to the successful performance and operation of the CET commercialization accelerators. For the purpose of this benchmarking survey, existing governance models within the benchmarked organizations are particularly characterized. These models vary from governing “Innovation Research Centres”, “Commercialization Centres”, and “Research Networks” to “Private-Public Partnership”, and “Network of Centres of Excellence”. The typology of these models is provided based on a recent work by Bradshaw et al., where the role of a “hybrid governance” model is examined (Bradshaw, 2007). Further, an attempt is made to map current governance perspectives among benchmarked organizations by accounting for different models; the Policy Governance model, the Entrepreneurial model, the Constituency model, and the Emergent Cellular model (Bradshaw et al., 2010). In **Chapter 4,** the characteristics and pros/cons of each model are described. A governance structure for CTCG based on the strengths of each model, which capitalizes on characteristics of the CTCG, is proposed.

### 3.2.3 Financial model

Financial management of non-profit organizations is similar to financial management in the commercial sector in many respects; however, certain key differences shift the focus of a non-profit financial manager (NEAIG, 2008). A for-profit enterprise focuses on profitability and maximizing shareholder value. A not-for-profit organization’s primary goal is not to increase shareholder value; rather it is to provide some socially desirable need on an ongoing basis (Blackbaud, 2004; NEAIG, 2008). Also, a not-for-profit generally lacks the financial flexibility of a commercial enterprise because it depends on resource providers that “are not engaging in an exchange transaction” and mostly based on indefinite grants or funding opportunities (Blackbaud, 2004). The resources provide goods or services to a client other than the actual resource provider (Blackbaud, 2004); thus, the not-for-profit must demonstrate its stewardship for the public resources (NEAIG, 2008). The shift to an emphasis in external financial reports has made the use of “fund accounting systems” very critical for non-profit organization (Blackbaud, 2004). Financial management in public-private partnerships has been justified because they release public funds or save on taxes (Engel et al., 2011).

The benchmarking analysis focuses particularly on **high-level and qualitative** data on financial strategy, funding opportunities, revenue models, financial sustainability, and to a limited extent (due to a lack of available quantitative data) on cash outflow/inflow situations. Additionally, budgeting and financial sources are two areas of financial management that are extremely important exercises for the benchmarked organizations. The organizations pay close attention to whether they have enough funding sources or revenue from services to continue providing services to its clients. It has been challenging to determine and predict the cash flow status of the organizations, because an organization relies on revenue from “resource providers that do not expect to receive the service provided” (Blackbaud, 2004). This is mostly related to the limited ability of not-for-profit organizations to access fund from the capital market and their inability to raise money from equity and debt options. The level of leverage can be an important factor, particularly if the non-profit is fundamentally able to leverage based on a high leverage ratio. Budgeting and projection are thus a critical activity, which is emphasised throughout the analysis for CTCG’s financial model.

### 3.2.4 Business model

“Business model is the managerial equivalent of the scientific method [that] you start with a hypothesis, which you then test in action and revise when necessary” (Magretta, 2002). Business Model conveys an execution strategy and is a living document, “a playbook on how the organization will make money” (Fisher, 2005). The key elements of the business model must determine the methods by which the organization accomplishes its mission and generates revenue (Masaoka, 2010). While it lists the programs and revenue streams, it is not specific about the drivers for either the programs or finances. “The business model statement should help focus the leadership's attention on what keeps this organization sustainable” (Masaoka, 2010).

Here, the business models of the benchmarked organizations are analysed including incubation model, technology service model, consulting and market linkage model, education, networking, and cluster service model.

### 3.2.5 Operation model

Operation of non-profits, particularly for performing PPP projects come in a variety of forms in view of project execution, ownership, liability, risks, and project management (NCPPP, 1999). For instance, a public partner (federal, state, or local government agency or authority such as remote community) contracts with a private partner to provide and/or maintain a specific service. Under the private operation and maintenance option, the public partner retains ownership and overall management of the public facility or system called “Operations and Maintenance” model (NCPPP, 1999). On the other hand, the private party can finance the construction or expansion of a public facility in exchange for the right to build residential housing, commercial stores, and/or industrial facilities at the site called “Developer Finance Operation” model (NCPPP, 1999). The private developer contributes capital and may operate the facility under the supervision of the government. The developer gains the right to use the facility and may receive future income from end user fees. The developers are likely pay a fee or are required to purchase capacity in an existing facility, which in turn, is used to expand or upgrade the facility. Developer financing arrangements are often called “capacity credits”, “impact fees”, or “extractions”. Developer financing may be voluntary or involuntary depending on the specific circumstances.

The analysis for operation models among the benchmarked organizations is based on a “customer focused” operation. This type of operation may vary depending on various revenue models including market and technology consulting, technical (testing, integration) services, technical, market, and education or network linkages. The resource and capabilities thus include engineers, scientists, business people, and market analysts. In incubation and real estate focused organizations, the operation requires resource and capabilities including physical space, building maintenance, and technicians. If the organization is mainly focused on licensing (the case of R&D based organizations), the resources and capabilities also include legal service and personnel, business planners, and business developers.

## 3.3 Benchmarked organizations

The benchmarking study was conducted through on-line surveys, company interviews, and site visits. Qualitative and quantitative data was collected from non-profit organizations engaged in commercialization of high-tech products, particularly within the CE sector. The data included governance structure, revenue and business models, operation, financial sources, project portfolios, management structures, and qualitative financial data. Companies were identified through a process by consultation with federal government (NRC-IRAP), provincial government lists, as well as private sources. Through consultations, 15 organizations (three of which were university innovation parks including university-based accelerator centre in Waterloo) were identified extending from Canada to the US and Europe. In addition to on-line surveys of more than ten organizations, in-depth interviews were conducted with three organizations [MaRS (Toronto), Clean Technology and sustainable Industries Organization (CTSI), Bloom (formerly called Ontario Centre for Environmental Technology Advancement, OCETA)] and two site visits (MaRS, Accelerator Centre/Waterloo) were held for the better development and understanding of the operation and revenue models. All companies included in the research met the definition of a non-profit "High-Tech Commercialization Centre", which is defined as an organization that seeks the process of turning a technological idea into a viable financial success, either through the creation of a business, providing service and facilities, or through the licensing of the idea to a receptor (GCT, 2011).

### 3.3.1 US-based CE commercialization organizations

#### 3.3.1.1 Clean Technology and Sustainable Industries Organization

The Clean Technology and Sustainable Industries Organization (CTSI, http://www.ct-si.org/) is a 501c6 (exemption of business leagues) non-profit organization with headquarters offices in Austin, Texas and satellite offices in Cambridge Massachusetts, San Francisco California, Detroit Michigan, Geneva Switzerland, and Washington DC. CTSI defines the mission of the organization as "advancing the commercialization and global adoption of clean technologies and sustainable industry practices - through community building, advocacy, and knowledge exchange" (CTSI, 2011).

CTSI is a global advocate for research, development, commercialization and implementation of clean technologies and sustainable business practices across all industrial and business sectors. "CTSI promotes not only new and disruptive technologies, but champion technologies and business practices that improve the efficiencies and sustainability of traditional industries such as Energy, Transportation, Chemical, Agriculture, and Food" (CTSI, 2011).

Business strategy. CTSI is a matchmaker between communities or CT integrators, CT vendors, and public or private R&D centres (CTSI, 2011). The CTSI's business strategy is to provide a "cross industry community" to promote CT development, profitable commercialization, and global integration of sustainable industry practices, enabling the transformation of businesses, governments and society towards a more sustainable global economy.

**Governance.** An "advisory board", comprised of experts from the private sector, CT vendors, national research labs, private research centres, universities, capital investment entities, and consultants govern CTSI.

**Business model.** IP management for early stage company matching with investment and corporate partners, and membership/education (annual membership fee ranges from $2000-$5000) are the main CTSI's business models. The main CTSI's revenue source is based on industry and policy leadership programs, community development, and networking. CTSI provides active matching between tech transfer offices, early stage companies, corporate business development interests, governmental award programs, and the investment community (CTSI, 2011). The organization also develops programs and advocacy towards publicly funded research, privately funded grant challenges, educational and media programs, and technology publication and dissemination. CTSI partners with venture networks, external review boards and award programs to continuously allow member opportunities of immediate problem-solution, technology-business, and venture-investment matching. These programs serve to accelerate the delivery of new technologies or practices into the marketplace and society. Members of CTSI are eligible to receive "Level One Certification" for supporting the development, commercialization and/or adoption of clean and sustainable technologies. Also, CTSI is developing clean technology and sustainable industry based tutorials and short courses. CTSI offers business growth round tables in webinar format on the topics of policy, funding and marketing for members of the organization.

**Finance.** The main sources of CTSI's finance are government grants, revenues from training and education and networking activities (conferences and workshops), revenue from market linkage service, membership fees, and CT project payoffs from public-private-partnerships.

**Operation.** CTSI core executive and operating team consists of the President and the Founding Chairman, Executive Director and CEO, Chief Scientific Officer, VP operations, "TechConnect" operations manager, membership and marketing manager, and CT operations director. It operates based on ongoing membership activities, networking and training/education through organizing conferences, workshop and meetings, and market/technical linkage services through managing multi-parties projects.

#### 3.3.1.2 New England Clean Energy Council

The mission of New England Clean Energy Council (NECC, http://www.cleanenergycouncil.org/) is to “accelerate New England’s clean energy economy to global leadership by building an active community of stakeholders and a cluster of CET companies” (NECC, 2011). The Council represents close to 400 members and affiliate member organizations, including CE companies, venture investors, major financial institutions, universities, industry associations, utilities, and large commercial end-users. Working with its stakeholders, NECC develops and executes a wide range of programs in six key focus areas: Innovation, Growth, Education & Workforce Development, Adoption, Policy & Advocacy, and Research.

**Governance.** NECC is governed by a board of directors and an executive committee. The board is composed of representatives from industries, local and provincial government, universities, investors and fundraisers. Industry executives, start-up representatives, and environmental activists form the executive committee.

**Business model.** The New England Clean Energy Foundation’s business models are (i) administrating CE initiatives and (ii) educational and enrichment programs and events. It also provides foundation for funds projects in the areas of Innovation, Education & Workforce Development, and Research.

**Finance.** Government grants, revenues from training/education, networking activities (conferences and workshops), and incubation rentals are the main financial sources for NECC.

**Operation.** The operational staff includes the president, the director of operations, one communication manager, two program managers, and a program assistant. The main current operation consists of administering the advocacy portion of the CE Consortia initiative. The project is a proposed framework for accelerating CE research and commercialization.

#### 3.3.1.3 Energy Efficiency and Renewable Energy

Energy Efficiency and Renewable Energy (EERE http://techportal.eere.energy.gov/) belongs to the Department of Energy (DOE). By partnering with industry, state and local governments, universities, and manufacturers, EERE plays a critical role in improving energy efficiency practices and increasing their adoption by American consumers, industry, and governments (EERC, 2011).

**Business strategy.** The Office of Energy Efficiency and Renewable Energy (EERE) invests in CE technologies that strengthen the economy, protect the environment, and reduce dependence on foreign oil (EERC, 2011). EERE leverages partnerships with the private sector, state and local governments, DOE national laboratories, and universities to speed the adoption of new technologies in renewable energy, advanced vehicles and fuels, and energy efficiency (EERC, 2011).

**Governance.** EERE is governed by executives and board members, who are assigned directly by DOE.

**Business model.** EERE's business model is to support the cost and "corporate-level" activities including, business administration, commercialization, and deployment of CE technologies.

**Finance.** Government grants, revenues from training/education and networking activities (conferences and workshops), revenue from market linkage service, business, and market analysis services are the main financial sources.

**Operation.** The office of EERE operates and works with several of the U.S. Department of Energy's national laboratories in order to support and further its mission.

#### 3.3.1.4 National Institute for the Commercialization of Clean Energy

The National Institute for the Commercialization of Clean Energy (NICCE http://www.virginiaenergynetwork.com) is the parent organization for the National Modelling and Simulation Centre of Excellence, the National Capital Clean Energy Incubator, and the Virginia Clean Energy Business Incubator. NICCE represents collaboration between Virginia Polytechnic Institute and State University, the University of Virginia, James Madison University, and numerous private companies in the scientific and technological fields.

**Business strategy.** NICCE is a clean and renewable energy commercialization company, providing specialized business incubation and support services to developing clean energy companies and the incubators (NICCE, 2011).

**Governance.** NICCE is governed by a board of directors, advisory board, and executive committee.

**Business model.** Incubation is the main business model of NICCE.

**Finance.** The main financial sources are government grants, revenues from training, education, and networking activities (conferences and workshops).

**Operation.** The NICCE's business models are (i) technology validation, (ii) matching technology to customers, and (iii) capitalize on companies by providing space (incubation) and services at all levels. NICCE plays a role in helping companies find suitable site locations for business development, expansion and or manufacturing and helps them negotiate the terms.

### 3.3.2 Canadian CE commercialization organizations

#### 3.3.2.1 MaRS

MaRS (http://www.marsdd.com/) addresses Canada's challenge in "needs to better turn invention into innovation". The CT Practice at MaRS is the responsible division, working on R&D and commercialization of CETs. The practice group works closely with clients to support their growth (MaRS, 2011).

**Business strategy.** MaRS' strategy is to secure an economic future for Canada and Canadians through the "power of scientists' discoveries" (MaRS, 2011). As shown in **Figure 3-2**, MaRS has established an effective process to review, research, support, and help transform disclosures from member institutions into marketable products and processes (MaRS, 2011).

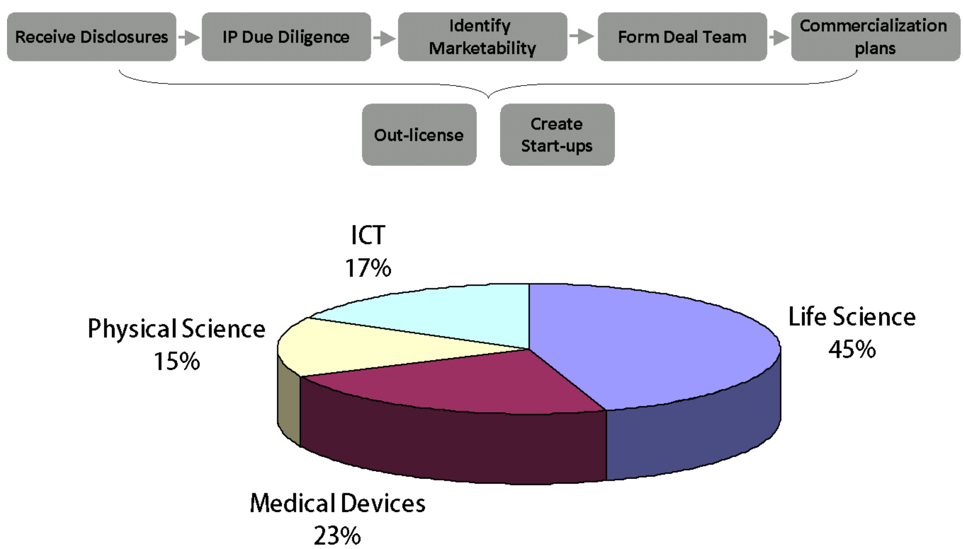


**Figure 3-2** MaRS's business strategy and focused area (ICT: Information-Communication Technology), adapted from (MaRS, 2011)

**Governance.** The board of directors is composed of high-level executives representing large industrial ventures, financial institutions and banks, former university presidents, investment companies, and presidents or CEOs of public and private R&D research centres. The organizational structure is comprised of VP of Practice to whom CT lead reports, VP talent, VP real estate (incubation), and VP partner programs, all reporting to the CEO.

**Business model.** MaRS delivers value and services to entrepreneurs through five key partners, the most important of which is MaRS Innovation. MaRS innovation is a member-based partnership designed to transform the academic research enterprise into a successful commercialization cluster. The business models range from mentoring and market intelligence to workshops and educational events. MaRS also manages and funds the process of patent filing and issuance, develops business cases for the intellectual property transfers and undertakes project planning on their commercialization (MaRS, 2011).

**Finance.** MaRS' source of financing comes from visionary individuals and organizations, government grants, revenues from training/education and networking activities (conferences and workshops), incubation rentals, revenue from market linkage service, membership fees, and R&D project payoffs.

**Operation.** MaRS has expertise in all areas of new discovery development and commercialization. The staff brings experience in market intelligence and analysis, investor sourcing, technical know-how, deal making, and licensing. An agency agreement is established between MaRS Innovation and the member organization for the commercialization of a specific discovery (MaRS, 2011). Sometimes, when it makes scientific and business sense, MaRS bundles compatible discoveries together from across all relevant members (MaRS, 2011).

#### 3.3.2.2 Ecotech Quebec

Écotech Québec (http://www.ecotechquebec.com/) "unites and mobilizes" the CET industry and participates in the "greening" of the Quebec economy through sustainable development (Écotech Québec, 2011). It supports entrepreneurs in accelerating the design, development, adoption, commercialization, and export of CETs.

**Business strategy.** Écotech Québec's mission is to position Québec as a centre of excellence for CET in North America and to become an "engine of wealth creation and prosperity". It helps make Québec more "competitive, greener and healthier" (Écotech Québec, 2011).

**Governance.** Volunteer executives from industry and consulting firms, and representatives from universities as advisory members govern Écotech Québec. The main board members are the President (Cycle Capital Management), the Vice-President (Enerkem), and the Treasurer (Biothermica Carbone Inc.).

**Business models.** Écotech Québec adopts a partnership model to gather key players from Québec, Canada and the world while contributing to the development of CET from all of Québec's regions. Écotech Québec develops tools and activities that respond to these players' needs (Écotech Québec, 2011). As the first organisation of its type in Canada, Écotech Québec aims to "build cohesion and synergy to help the CET industry develop to its full potential".

**Finance.** Government grants, revenues from training/education and networking activities (conferences and workshops), incubation rentals, revenue from market linkage service, and project payoffs are the major sources of income.

**Operation.** Écotech Québec mostly operates on networking activities. It seeks partners among industry players in order to generate more opportunities and partnerships and to encourage industries to take action in order to accelerate development and facilitate the commercialisation of CET in Québec.

#### 3.3.2.3 The Bloom Centre for Sustainability

The Bloom Centre for Sustainability, formerly called Ontario Centre for Environmental Technology Advancement, *OCETA* (http://www.bloomcentre.com/), is a private corporation, operating as a not-for-profit, with a focus on advancing the market adoption of clean technology and sustainable solutions (Bloom, 2011).

**Business strategy**. Bloom works in close collaboration with leading organizations in the public and private sectors to "drive positive change through the application of sustainable processes, practices and technologies that maximize resource efficiencies, enhance competitiveness, reduce environmental and social impact, and mitigate risk" (Bloom, 2011).

**Governance.** Bloom is governed by a Board of Directors, all of whom are external to the management of Bloom. The Board of Directors monitors the contractual relationships between Bloom and its clients. There is a close interaction between the Board of Directors, the Executive Committee, and Bloom Management while the president and CEO of Bloom report to the Board of Directors.

**Business model.** Bloom provides services in five models including "risk management and decision-support, market research and thought leadership, capacity building and training, strategy development and implementation, and program design and delivery" (Bloom, 2011).

**Operation.** Bloom operates relies on projects with flexible contractual assignments ranging from targeted short-term engagements, to multi-year, multi-client projects and programs involving highly developed technical, business and project management capabilities.

**Finance.** Bloom receives grants from government and obtains revenue from training/education and networking activities (conferences and workshops), revenue from market linkage service, project payoffs, market, and business analysis services.

### 3.3.3 European clean energy commercialization organizations

#### 3.3.3.1 ECO world Styria

ECO world Styria in Austria (ECO http://www.eco.at) claims to be "the world best CT cluster". ECO is the globally leading business cluster in energy and environmental engineering and is the supporting organisation of the economic-political initiative in the areas of energy and environmental engineering of the province of Styria. With 156 members as of 2010/07/16, ECO is forecasting to be the top in the fields of biomass, solar energy, mass flow, and water/wastewater by 2020 (ECO, 2011). At the beginning of 2010, ECO was elected the "World's Best Greentech Cluster" by the US investor's network Cleantech Group (Parker, 2009**,** ECO, 2011).

**Business strategy.** ECO supports the companies in Styria by providing basic services and projects with strategic levels, know-how, and providing new market opportunities. The mission is to increase the number of employees in Styrian environmental engineering companies to 20,000 and to double the number of Styrian technology leaders to 20 by 2015 (ECO, 2011)**.**

**Governance.** ECO is owned and governed jointly by representatives from SFG Steirische Wirtschaftsförderungs GmbH, the province of Styria (Specialist Department 19D), the City of Graz as well as Binder+Co. AG, e² group umweltengineering GmbH, FIBAG Forschungszentrum für integrals Bauwesen AG, and KWB – Kraft und Wärme aus Biomasse GmbH.

**Business model.** The main business models are project design, project development and project management, IP management, and consulting. The business activities and services are mainly aimed at increasing the competitiveness of ECO CLUSTER companies.

**Finance.** In addition to subsidies and shareholder's contributions, financing of ECO takes place via contributions of the members (membership fee) as well as revenue from projects and services.

**Operation.** The operation of ECO depends on the type of service models that are provided to member companies and includes participation in the design of new research topics, cooperation with the ECO companies, consulting on national and international markets, patent analysis for defined areas of technology, innovation potential evaluation, technology and development partner identification, project development/management, and exclusive funding map (ECO, 2011).

#### 3.3.3.2 OSKE CleanTech Cluster Initiative

The OSKE Centre of Expertise Program in Finland (http://www.oske.net/en) combines diverse innovation activities in which high-level research is combined with technological, design and business competence (OSKE, 2011). The program is a tool for regional innovation, which contains ready-made operating models and networks for the national and international markets. The program offers networks and services for companies, universities, and research institutions (OSKE, 2011).

**Business strategy.** The Centre of Expertise Program is a fixed-term special program coordinated by the "Ministry of Employment and the Economy, in compliance with the Act on Regional Development" (OSKE, 2011). It targets local, regional and national resources at the utilisation of top-level expertise. The program supports regional strengths, the specialization of regions, and cooperation between "Centres of Expertise".

**Governance.** OSKE is coordinated and governed by a multi-disciplinary committee appointed by the government. In the committee, there are representatives from relevant ministries and other interested groups. The committee is assisted by the Secretariat with experts, representing the Ministry of the Employment and the Economy, the Ministry of Education and the Finnish Funding Agency for Technology and Innovation (Tekes).

**Business model.** The business model is based on networking and market linkage activities to enhance the attractiveness of regional innovation environments, in order to attract international companies, investments, and top experts to Finland.

**Finance.** Financing takes place via government grants and subsidies.

**Operation.** The operation is mostly based on networking activities amongst industry players in order to generate opportunities and partnerships to connect industries to global market.

#### 3.3.3.3 Copenhagen Cleantech Cluster

Copenhagen Cleantech Cluster in Denmark (http://www.cphcleantech.com/) is a one-stop entry to Danish CET and was launched by Danish CET companies, research institutions, and public organisations (CCCD, 2011).

**Business strategy.** The vision is to develop one of the world's leading and most renowned CT clusters, support existing and attract future CET companies to the region, and to create superior value for the cluster companies and research environments. It differentiates itself by putting CETs and communities together across value chains (CCCD, 2011).

**Governance.** The cluster is governed by executives from a group of partners representing the entire value chain of the Danish CT industry which include: Research institutions (DHI, Risø DTU, University of Copenhagen, Copenhagen Resource Institute, and GEUS ); Industry (Siemens, Novozymes, Haldor Topsøe, Better Place, Vestas, Ernst & Young, Oland, Seas-NVE, Deloitte, and Dong Energy)**;** Governmental institutions and NGOs (Copenhagen Capacity, Confederation of Danish Industry, Scion DTU, Symbion Science Park, EnergyMap.dk, Business Frederikssund, Municipality of Roskilde, Municipality of Kalund-borg, Business Link Greater Copenhagen, and Business Link Zealand).

**Business model**. The business model of Copenhagen Cleantech Cluster is primarily based on partnership and networking activities, and PPP projects. The projects specifically meet the needs of an ever-changing CET industry cluster (CCCD, 2011).

**Operation.** The Copenhagen Cleantech Cluster operates a "One Stop Shop" where one can gain an overview and access to the entire Danish CT cluster. The One Stop Shop is the knowledge centre that ties all the projects and partners together. Cleantech start-ups receive customized help with business models and financing through start-up programs.

### 3.3.4 Non-clean energy commercialization organizations

#### 3.3.4.1 The Centre for Drug Research and Development

The Centre for Drug Research and Development in Vancouver, BC (CDRD http://www.cdrd.ca/) provides a one-stop, structured access to scientists and BC's $400-million research and innovation engine (CDRD, 2011).

**Business strategy**. CDRD's strategy is to focus on collaboration and development using existing R&D networks, facilities, and infrastructure.

**Governance.** The Project Development Group (PDG) at CDRD is responsible for managing the portfolio of CDRD projects to ensure that projects meet their goals and objectives. The PDG consists of the Scientific Director, the CDRD Heads, the Director of Business Development, and the Director of Project Management. The Joint Development Committee (JDC) determines selected projects for development within CDRD and oversees the progress of all CDRD projects. The JDC's membership includes the CDRD executives (CEO and Scientific Director), division chairs, strategic advisors, and independent experts as needed (CDRD, 2011).

**Business model.** R&D linkage, project management, and market linkage are the main business models of CDRD. Its commercial arm, CDRD Ventures Inc. (CVI), acts as an interface between the Centre for Drug Research and Development and industry. CDRD also considers technologies in-licensing to bring opportunities for strategic partnerships with pharmaceutical and biotech companies. Programs are eventually out-licensed to pharmaceutical or biotech partners or spun off as life sciences companies.

**Finance.** In addition to in-licensing, out-licensing, project management, and technology/market linkage activities, CDRD offers support to investigators seeking grant funding for their CDRD-approved projects. In addition, CDRD can act as a partner on collaborative drug-discovery team grants.

**Operation.** Investigators submit a potential project to CDRD, thereafter CDRD adapts the operation processes from preliminary assessment of the proposal development, to project review and project approval. The approved project undergoes JDC review and renewal process before turning to a technology dossier, as shown in **Figure 3-3**.

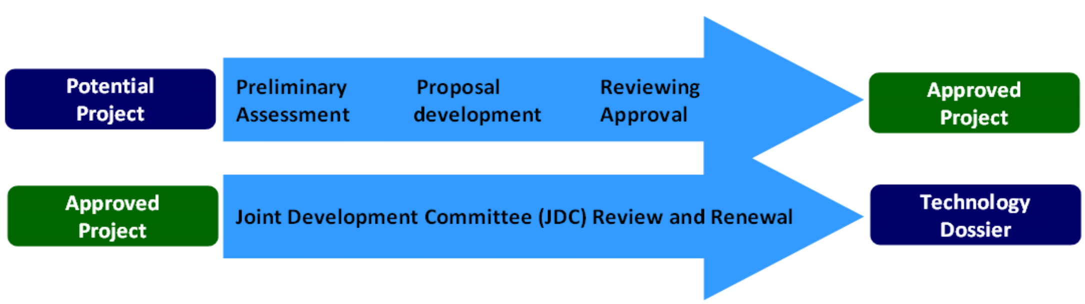


**Figure 3-3** CDRD operation model, adapted from (CDRD, 2011)

#### 3.3.4.2 Wavefront

Wavefront in Vancouver, BC (http://www.wavefrontac.com/) is a not-for-profit national centre of excellence for wireless commercialization. “Mobile network operators value Wavefront as a neutral, independent entry point to identify and assess high potential mobile applications for their particular market and business requirements”. Wavefront is also interested in working with international application providers that are looking to develop business relationships in the North American market (Wavefront, 2011).

**Business strategy**. Wavefront accelerates the growth and success of wireless companies in Canada. The mission is to help wireless enterprises to accelerate time-to-market, capital efficiency, and foster company growth and global expansion (Wavefront, 2011), as shown in **Figure 3-4**.

**Governance**. Wavefront's governance is composed of Chair, Vice Chair, Secretary, Treasurer Officer and Directors, comprising of entrepreneurs, operators, device manufacturers, venture capital firms, and small businesses to large enterprise companies.

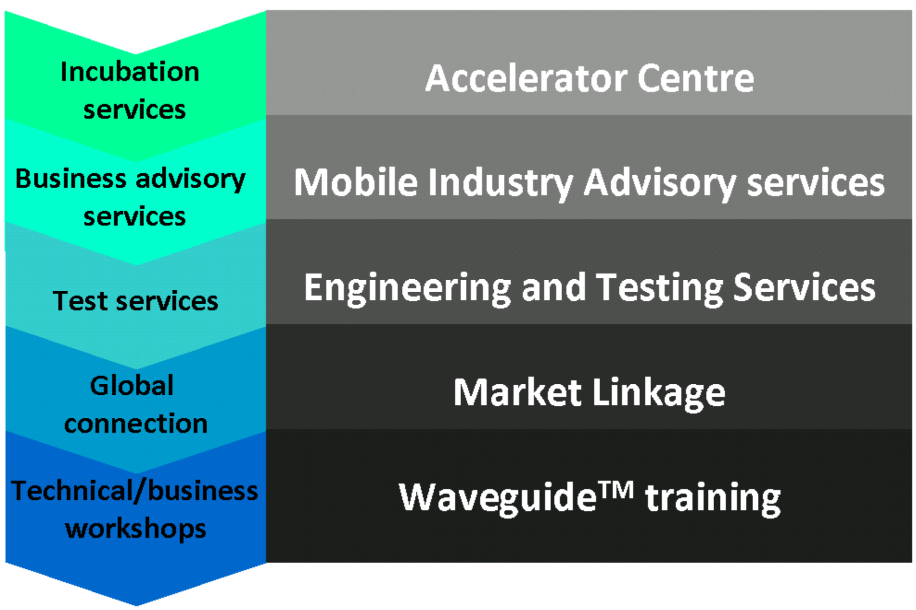


**Figure 3-4** Wavefront business model and strategy, adapted from (Wavefront, 2011)

**Business model.** Wavefront improves the speed-to-market of mobile applications and devices by providing emerging companies with a single point of access to shared commercialization services. Through the training platform WaveGuide™, Wavefront provides training, membership, technical workshops, mobile industry advisory services, incubation office space, engineering and testing resources, and market linkages that facilitate commercial engagement.

**Finance.** Wavefront's initial financing was based on seed funding from the BC Provincial and Federal Governments, and private companies. The current financial sources are based on government grants, revenues from training/education and networking activities (conferences and workshops), revenue from technology or market linkage service, membership fees, and incubation rentals.

**Operation.** The operating staff is composed of President; Vice President, Business; Vice President, Development & Strategy; Director, Engineering Operations; Director, Marketing; Wireless; Accelerator Architect; Executive Administrator; Marketing Manager; Sales Operations Manager; and Wireless Lab Engineers. The operation model consists of several activities includes networking, incubation, technical, market, and training services.

#### 3.3.4.3 University Research and Innovation Parks

University Research and Innovation Parks (URIPs) are business and recreational parks that are normally operated by Universities to foster innovation, commercialization and economic growth through university, industry, and government partnerships (URPA, 2011). The benchmark results rely on public information for several university research parks, available from UPRA (URPA, 2011).

**Business strategy.** Innovation Parks establishes an effective process to review, research, support, and help transform disclosures from university research labs into marketable products and processes. The goal is to build on an invention's value, focusing on inventions in the university labs and help from university Intellectual Property (IP) office.

**Governance.** Usually a board of Advisors and an Executive Director are appointed directly by the University to govern URIPs. The Executive Director oversees the development and management of the park which is usually owned and operated by the University or is often a subsidiary of the university.

**Business model.** The business model is based on an agency agreement, established between the Innovation Park board of director and the University offices including departments' lab facilities (which are usually governed under university VPs), UTTO, and university advisory boards (office of president on their behalf) for the commercialization of a specific discovery, ensuring that policies are compatible with members' policies around IP.

**Finance.** The financing is usually through university endowment funds, government grants, and revenues from training/education and networking activities (conferences and workshops), incubation rentals, project payoffs, royalty fee, and licensing fee.

**Operation.** The operation of a URIP is usually managed fully or partially together with university operation facilities. UTTO manages and funds the process of patent filing and issuance, develops a business case for the intellectual property, undertakes project planning on its commercialization, and finds funds to bridge the technology gaps that will strengthen the discovery's business case.

## 3.4 Performance indicators

In this benchmarking study, organizational performance is assessed based on internal and external measures in view of cost, speed, dependability, and flexibility. The main input performance measure is the number of resource partnerships established by the organization with government agencies, business, and industry constituents. Other internal performance measures include developing facilities and infrastructure, growth of resource and capabilities, number of member companies, job growth, and salary levels.

The output performance measures include endowment value, the quality and pay off of communities' new energy infrastructure. Local, state, and national economic impact are also measured, for instance, in terms of total number of jobs created. Finally, recognition received from national-regional organizations and the media determines the social impacts of the organization. Other performance measures such as cost, speed, dependability, and flexibility of the organization to perform projects or CET related activities are considered in the analysis of performance of benchmarked organizations.

## 3.5 Summary of benchmarking study

**Table 3-1** summarizes benchmarking results for various internal characteristics and performance factors for selected benchmarked organizations. Each organization is identified based on its overall business strategy, operation and business focus, financing strategy and resources, and their impact on community, early-stage CE companies, and number of member companies and organizations.

**Table 3-1** Summary of characteristics and performance measures for some of the benchmarked organizations

| | **CTSI** | **Bloom** | **MaRS** | **Wavefront** | **ECO** | **URIP** |
|---|---|---|---|---|---|---|
| **Strategy** | "Matchmaker" Service oriented (community and CE firms) | Technical/ business service provider to communities, government, and CE firms | Incubation | Service oriented | CE Cluster | R&D oriented |
| **Governance** | Advisory board | Board of directors | Board of directors | Board of directors | Advisory board | Advisory board |
| **B-model** | - Market & technology linkage<br>- Network & training | -Technology consulting<br>- Market & business services | - R&D<br>- Business & technology consulting services | - Incubation<br>-Market & technology services | - Membership<br>- Network focused | - Licensing<br>- Incubation |
| **Operation** | - Customer focused (Membership) | -Project based | - Project based<br>- Customer focused<br>- Incubation services | -Incubation<br>-Project based | - Network services<br>- Consulting<br>- Project-based | - R&D services<br>- Incubation |
| **Finance** | - Government grant<br>- Membership fee, training activities | -Project pay-offs<br>-Government grants | -Incubation fee<br>-Services | -Incubation fee<br>-Training<br>-Services | - Tech/market Services | - Incubation fee<br>- Licensing fee<br>- Univ. fund |
| **Number of member companies/ communities** | High | Medium | High | Low | High | Low |
| **Impact on (community, company)** | High | High | Medium | Low | High | Low |

# 4: Analysis of Benchmarking Results

Based on the benchmarking study, this chapter provides a detailed analysis of the benchmarked organizations in terms of governance structure, management practices, finance, business and operation models, business strategy, performance, and the resulting social, environmental, and economic impacts. For the sake of simplicity, the focus is on those organizations with a mission close to that of CTCG or on those with characteristics which are adaptable to CTCG. These organizations are: CTSI, MaRS, Bloom, URIPs, ECO, and Wavefront. Moreover, a typological framework and relevant contingencies are developed to unravel variations in business and operation models, which characterize different types in terms of organizations' core business focus and management practice or governance structure. The proposed model is a preliminary attempt that can be potentially used to provide a framework theory for further typology studies of non-profit commercialization centres in general. A contingency approach was chosen based on the most critical characteristics (environment, management, and business strategy) for selecting the governance structure and composition of each individual organization type. Finally, the business models and typology frameworks are used in **Chapter 5** to improve the performance and effectiveness of CTCG.

## 4.1 Governance

The accepted governance structure among non-profit organizations generally follows the policy governance model developed by the American consultant John Carver (Carver, 2006). The Carver model, however, has shown drawbacks for board governance (Bradshaw et al, 2007). One criticism is that the Carver model gives too much power to the executive director. Moreover, "it puts unnecessary distance between the board and the organization it governed, left board members feeling alienated, consumed a lot of board time and eventually created a backlash". Several boards have indicated that the Carver model is "too complex to understand and implement, requires too much time and training and erodes board control and accountability". CUPE national research branch provided several comparisons between the Carver model and corresponding concerns from several non-for-profit member organizations, as illustrated in **Table 4-1** (CUPE, 2009).

**Table 4-1** Comparison between Carver and concerns from CUPE board members, adapted from CUPE National Research Branch (CUPE, 2009)

| Carver model | Criticisms |
|---|---|
| The board governs the non-profit, it does not manage it. | Who defines "govern" and "manage"? |
| Instead of operational concerns, the client population should be the board's central focus. | Staffing, budget, and contracting issues are off limits. |
| The board speaks with one voice. | Innovative, independent, and creative thinking is discouraged and accountability is reduced. |
| The board only focuses on outcomes and not the activities that created those outcomes. | This gives the management more freedom to make decisions that can negatively impact the work (using contractors, reducing working hours, etc.) |
| Committees are eliminated because they may interfere with management's responsibilities. | The staff and public have less access to board members. |

Several perspectives such as governance function, interpretive, and political perspectives are generally distinguished in order to introduce and implement a new governance model for non-profit organizations.

### 4.1.1 Governance framework

Bradshaw et al. suggested a typology to frame the existing governance models of non-profits into five different categories: the Policy Governance model, the Entrepreneurial model, the Representative Board model, and the Emergent Cellular model (Bradshaw et al., 2010). **Figure 4-1** summarizes the governance models suggested by Bradshaw et al. and maps some of the benchmarked organizations. The horizontal axis of this framework characterises how far the governance structure of the organization is "established" with little intention to change (stable) or open to change and able to innovate new ways of working (innovative). The changes are often motivated by increasing efficiency or bringing about fundamental social changes (Bradshaw et al., 2010). The vertical axis characterizes the extent of the governance function to work in a network of member organizations with a distributed and interdependent balance of power (pluralistic) versus those governance structures with centralized, top-down power structures (unitarity) (Bradshaw et al., 2010). The governance structure of multi-stakeholder organizations connected in a distributed network with a commitment to be innovative and flexible (e.g., MaRS) is well described by the pluralistic-innovation quadrant. As described in detail in **Chapter 5**, this model is a potential alternative to the current **CTCG** governance structure.

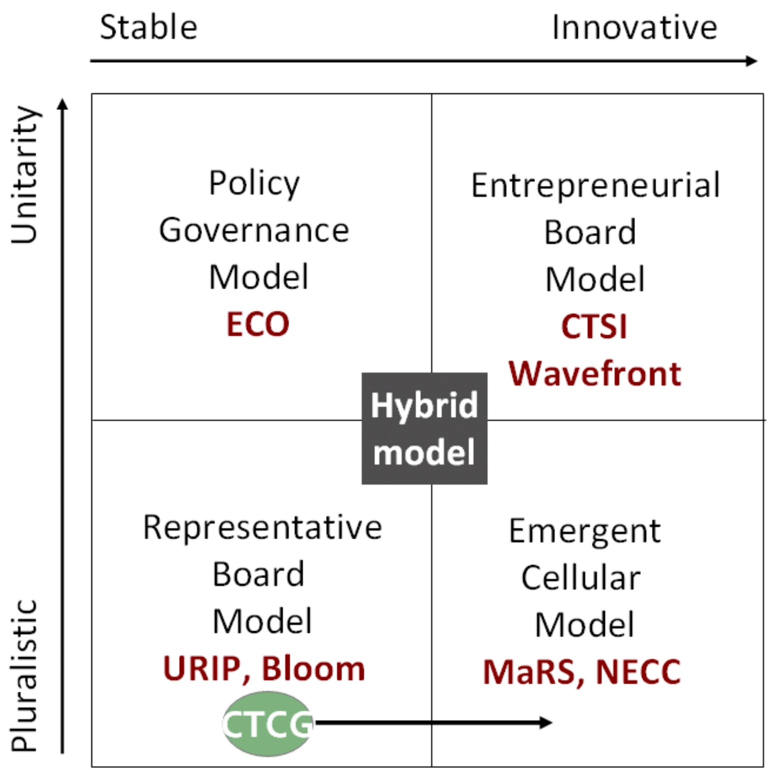


**Figure 4-1** Governance models and role of a hybrid model, adapted from the governance framework proposed by Bradshaw et al. (2005). Some of the benchmarked organizations as well as CTCG are mapped onto this grid (See Chapter 3)

### 4.1.2 Policy governance model

This model is usually focused on enforcing a "situation of stability" and "established" working methods in an individual organization. One important characteristic of this model is that it distinguishes between the leadership roles of the board and the chief executive officer (CEO) (Bradshaw et al., 2010). The board plays a role on behalf of its communities to monitor the mission, values, capabilities, and strategic priorities of the organization. The CEO, on the other hand, is evaluated by the board and provides leadership in managing and operating activities to ensure its alignment to the mission of the organization. Cluster-type non-profit organizations such as **ECO** and **Copenhagen CE Cluster** are governed by this model (**Chapter 3**).

### 4.1.3 Representative board model

This model refers to a board composed of representatives from associated organizations that form the non-profit entity. In this model, boards are typically large (15-40 members), which presents the risk that they may be inefficient. There is a "direct and clear link" between the organization's board and its associated members (Bradshaw et al., 2010). Through their representative in the board, the participants can take actions in control over policy and decision making processes. The board-CEO relationship and board expectations from the CEO are a function of board representative composition. The CEO is in charge of managing the operations of the organization under direction of the board. This model fits university research and innovation parks (**URIP**), **Bloom**, and the current governance structure of **CTCG**.

### 4.1.4 Entrepreneurial board model

This model is often referred to as the "business or corporate model of governance" and applies to a single organization. It focuses on improving the efficiency and effectiveness of the organization by implementing innovative "change management" processes (Bradshaw et al., 2010). Fulfilling the stakeholders' interest plays a large role in this governance model, where the emphasis is on a "short-term immediate return rather than a long-term vision" (Bradshaw et al., 2010). The major drawback is that the Chair of the board often acts as the CEO of the organization. This model describes the **Wavefront's** and **CTSI's** governance structure.

### 4.1.5 Emerging cellular model

This structure is best described as the model of governance for organizations that are formed by several organizations or are "multi- stakeholder organizations". The organizations in this model are connected through an extended network. They are formed from cells of "self-managing teams, autonomous business units, or operational partners". These building blocks operate alone with strong interconnection with other cells. It is believed that such organizations generate and share their know-how in a very innovative and efficient way (Miles, 1997). Of the benchmarked organizations, **NECC**, **NICCE**, **EERC**, and **MaRS** are typical organizations with such a governance structure.

### 4.1.6 Hybrid model

This model was first introduced by Bradshaw et al. and gathers the most critical aspect of all the previous four models using a contingency approach (Bradshaw et al., 2010). It borrows the clarity of the roles and responsibility from the Policy model, "vision-driven" and "focus-oriented" approaches from representative model, "efficiency-focused" and "business-like" character from the entrepreneurial model, and an emphasis on pluralistic and knowledge-relationships from the emergent cellular model. The applicability of this hybrid model is not well examined in real work organizations. Four characteristics (evolutionary, form and membership, process, pace and topics, and dealing with conflicts and power differences) were identified as important challenges in implementing this model. Depending upon the type of adopted business model (technology or market enabled versus network or incubation focused), such a model can be well implemented to **CTCG**'s governance structure.

## 4.2 Operation

### 4.2.1 Operation framework

Operation of a non-profit commercialization centre is a direct function of financial sources and revenue models of the organization. The latter also determines the resources and capabilities that are needed to fulfill revenue targets. Some activities such as technology services (evaluation, testing, integration, and maintenance), network linkage, business, and training services are primarily focused on customers and require close interaction with clients or members. Other activities such as incubation involve operations that do not necessarily rely on a day-to-day customer relationship. These activities (e.g., incubation), are usually controlled and operated based on an overall strategy and thus require different resources and capabilities than a merely customer-based service (physical space, building maintenance, and lab technicians if applicable). In the case of R&D based organizations, the organization is mainly focused on business development and licensing, and therefore the resources and capabilities include legal service and personnel, business planners, and business developers. Based on overall business and operation models discussed in **Chapter 3**, the operation of benchmarked organizations was characterized and categorized into three different dimensions: Customer focused, incubation focused, and licensing focused. **Table 4-2** summarizes various operation models that were employed by selected benchmarked organizations. Depending upon their business model and strategy, some of the organizations (MaRS and Wavefront, for example) adapt more than one or all of these operations, simultaneously.

**Table 4-2** Operation models that are currently practiced by some of the benchmarked organizations as well as the current operation model employed by CTCG

| | CSTI | Bloom | MaRS | Wavefront | URIP | CTCG |
|---|---|---|---|---|---|---|
| **Customer focused** | ✓ | ✓ | ✓ | ✓ | ✗ | ✓ |
| **Incubation focused** | ✗ | ✗ | ✓ | ✓ | ✓ | ✗ |
| **Licensing focused** | ✗ | ✓ | ✓ | ✗ | ✓ | ✗ |

✓ applicable; ✗ not applicable

### 4.2.2 Customer focused

In a customer-focused operation, the commercialization organization provides services that benefit the clients and members directly through market and technology consulting, technical (testing, integration) linkage services, and network or market linkage services. In this model, the service provider (a non-profit organization or a public-private partnership) contracts with an "end-user" customer (a private member company, federal, state, or local government agency, municipality, or authority such as a remote community) to provide and/or maintain a specific service. The service, regardless of its nature, is intended to market, test, demonstrate, or integrate a new CE technology. Depending on the business model and required socio-economical impacts, the ownership, operation, maintenance, short- and long-term revenue, and overall management of the public facility or system are shared or distributed between the service provider(s) and the customer. The required resources and capabilities in this operation include engineers, scientists, as well as business and market analysts (**CTSI, MaRS, Bloom, and CTCG**).

### 4.2.3 Incubation and real-estate focused

This operation focuses on renting real-estate facilities within the organization by offering physical spaces, labs or testing facilities to early-stage ventures. The incubator maintains the quality of the incubation services and assures the long-term operation of the facilities. This operation requires physical space, building maintenance, and technicians (**MaRS, Wavefront, URIPs**).

### 4.2.4 Licensing focused

The resource and capabilities for this operation model include legal services, qualified personnel, and business planners. The operation is mainly focused on creating and managing intellectual properties independent or in collaboration with small emerging companies and offering them to potential buyers (**URIPs, MaRS**).

## 4.3 Financial resources

The financial resources among the benchmarked organizations vary and include grants from government and public sectors, venture capital (VC) funds, fee-for incubation rentals, revenue from project-related services such as technology and market services, market linkage and project management services, membership and education/training or networking services such as planning conferences, workshops, and webinars. **CTSI**, **Bloom**, and **CTCG** receive a significant amount of government/public grants or public-private funds, which are usually organized as a "community fund". The typical level of the public-private investment is beyond that of either public funds or those of the private CE vendor by itself. The financial process and resources for the incubation model, adopted by **URIPs**, **MaRS**, and **Wavefront**, are partly or fully managed by VCs (Clarysse et al., 2005). The level of funding in this case is substantially greater than the grants from government and public sectors. For the former group of organizations, both the timeline and the nature of community projects determine the level of the required funding from the private and public sector and the potential revenue generated from the projects. Organizations included in the third group, such as **ECO,** need to set-up large financial resources to create a centre of excellence or CE clusters. **Table 4-3** provides the financial sources for some of the benchmarked organizations.

**Table 4-3** Financial sources for some of the benchmarked organizations as well as CTCG's current financial sources

| | CSTI | Bloom | MaRS | Wavefront | URIP | CTCG | ECO |
|---|---|---|---|---|---|---|---|
| **Public Private fund** | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✗ |
| **VC fund** | ✗ | ✗ | ✓ | ✓ | ✓ | ✗ | ✗ |
| **Large public grant** | ✓ | ✓ | ✓ | ✗ | ✗ | ✓ | ✓ |

✓ applicable; ✗ not applicable

## 4.4 Business model

### 4.4.1 Business model framework

To commercialize products or services in CE, companies face very different opportunities, challenges, and risks (SDTC, 2010). Start-up capital, or "the amounts of capital that must be invested to develop the technology or to build a plant or capability, before the company can sustainably generate positive cash flow", is one of the most important requirements of the businesses (SDTC, 2010). The second factor is the "number of clients" to which the company provides its services.

Based upon the qualitative data collected in the benchmarking studies, four types of business activities are identified: (i) incubation, (ii) technical services, (iii) market linkage services, and (iv) partnership activities. **Figure 4-2** illustrates these four business models and includes mapping of some of the benchmarked organizations (CTSI, CTCG, and Bloom). This framework has been modified and adapted from SDTC (2010). The **Incubation** business model **(BM 1)** is capital intensive, requiring significant capital investment to build, maintain, and improve incubation and R&D services (including land, office spaces, labs, and testing facilities). This business model primarily targets emerging CE ventures. The **Technology enabled model (BM 2)** requires medium to high levels of capital investment and includes any technology-driven activity from evaluation and assessment to demonstration, integration, and operation. Relative to the first model, **BM2** has many more clients among communities, early-stage, or established CE ventures. The **Market-linkage model (BM3)** has low capital intensity with higher numbers of customers among SMEs than the two other BMs. The service in this model is typically delivered in combination with partnership and "matchmaking" services. **BM2** and **BM3** are referred to as "service oriented" business models. The **Strategic partnership model (BM 4)** is highly dependent on private-public partnerships. The organization with this BM is also developing and selling proprietary technology and performs education or training services. This model is targeting a larger group of clients as "member companies".

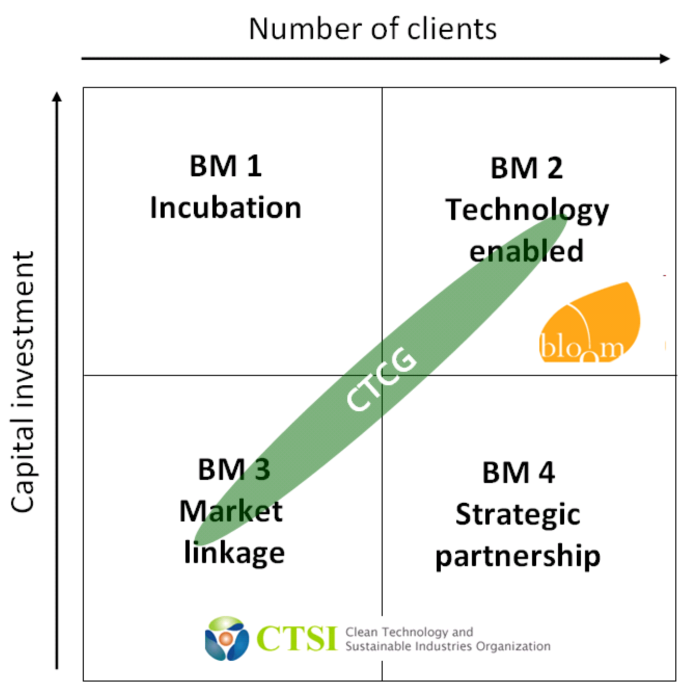


**Figure 4-2** Business models grid, modified and adapted with permission from SDTC (2010). The business models of CTCG, CTSI, and bloom are mapped on the grid. Both "technology enabled" and "market linkage" models are applicable to CTCG. Some of the organizations such as MaRS (not shown here), apply a "hybrid" business model by implementing all these business models in their operation.

### 4.4.2 Incubation

The organizations that adopt this business model help their clients connect to the investors and "facilitate" or accelerate such interactions (Selman, 2010). Often, the clients suffer from an inability to showcase their technology to the investors or attract customers directly. Different approaches are employed by such organizations to close the gap between incubator clients and VCs. One approach is that the organization, based on a recommendation from the board of advisors, may provide a seed-stage fund to add value to the incubator clients to make them more attractive to other investors and to admit the most technically and commercially promising businesses (Selman, 2010). Thereafter, the incubator may provide the clients with technical, market, and business services. The other approach is more resource-intensive by focusing on fewer clients to increase the chance of longer-term business success and enhancing the opportunity for attracting more seed capital (NRC-IFCI, 2010). **MaRS, Wavefront,** and **URIPs** have adopted this business model.

### 4.4.3 Strategic partnership

This model is usually referred to as "strategic partner engagement" (Selman, 2010) and includes organizations that are leveraging their relationships with strategic partners such as government organizations and suppliers [original equipment manufacturers (OEMs), or multi-national enterprises (MNEs)]. "Risk and gain sharing" among the organization and partners are the main characteristics of this model. (Selman, 2010). Under this business practice, the commercialization organization, in partnership with government agencies or large CE ventures, supports emerging CE companies to develop or demonstrate their CET to the communities. Concomitantly, the early-stage CE company builds reputational capital that can help them to become successful more rapidly in global markets. For instance, Bloom has accelerated the commercialization of CETs of many early-stage companies by developing and executing projects with provincial government or public/private utility commissions (Bloom, 2011). Notably, this model is categorized in conjunction with the "market and technology service" model and therefore is not considered in the typology analysis as a stand-alone model. Among the benchmarked organizations, the business model used by **CTSI, Ecotech Quebec,** and **Bloom** is closest to the "partnership model" and to some degree can be adopted by CTCG.

### 4.4.4 Technology enabled and market linkage models

In the "technology enabled" model, the organization provides services which span from technology and consulting to finding suitable CE technology and partner organizations for facilitating CE demonstration and integration activities. **(CTCG, CTSI, MaRS, Bloom, Wavefront, OSKE, ECO)**. The market linkage model is usually complemented by networking activities including education, training, webinars, and conferences, which are free of charge or based on a membership fee. These activities help to engage early stage companies integrating and implementing their emerging technology in various communities, with or without partnerships with established (CE) vendors. **(CTCG, CTSI, MaRS, Wavefront)**.

## 4.5 Typology of CE commercialization organizations

In order to define a general typology for CE commercialization organizations, it was noted that none of the previously discussed relevant dimensions (governance, financial source, business model, and operation) could adequately represent the salient types of CE commercialization organizations. Therefore, a general typology framework for defining a commercialization organization is necessary that includes aspects of all four dimensions. In **Chapter 5**, a transition is discussed from individual dimensions to concrete concepts, to determine if such classifications can be useful to both CTCG and community end users. Two relevant factors represent "key facets" of a CE commercialization centre: (i) the role of public representatives in the governance structure, which consequently determines the extent of public-private partnerships in the organizational operation and business model, and (ii) the nature of the activities [service-oriented or facilitator (incubator, cluster and networking enabled)], which dictates the required level of capital investment. **Table 4-4** summarizes the typology of commercialization firms and outlines the organizational variables that drive the formation and operation of each type of the benchmarked commercialization organizations. It also provides detailed descriptions of each organization type. The benchmarked organizations can be classified into four types of organization: R&D focused, technology enabled, market enabled, and network enabled. This typology is constructed based on aspects of the previous dimensions, namely: governance structure, business model, operation model, and financial strategy and resources. The extent of public involvement in the Board of Directors versus private technology suppliers determines the governance characteristics. These are referred to as "public-private partnership" characteristics. Other characteristics such as business and operation models and financial strategies depend directly or indirectly on governance structure and overall business strategy of the organizational type, e.g., the level of public (grant) versus private investment in the commercialization organization.

On a broader perspective, the organizational typology proposed can potentially provide a framework for exploring how variations in organization governance structure and business operation practices can relate to outcomes and overall performance (McCarthy et al., 2005). It may reveal independent and control variables for enhancing performance and socio-economical impacts of the organizations and could be employed as a basis for developing empirical testing theories (McCarthy and Gillies, 2001; McCarthy et al, 2011).

**Table 4-4** Typology of benchmarked commercialization organizations

| Type | Characteristics |
|---|---|
| **R&D focused** | **Governance:** Board includes representatives from government and public/private institutions<br>**B-model:** Incubation, licensing, and business consulting services<br>**Operation:** Incubation and/or licensing<br>**Finance:** Public funding, VCs |
| **Technology enabled** | **Governance:** Public/private<br>**B-model:** Service oriented<br>**Operation:** Customer focused using engineering and testing facilities<br>**Finance:** Service fee |
| **Market enabled** | **Governance:** Private, public/private<br>**B-model:** Membership, service oriented<br>**Operation:** Customer focused using business and market consultants<br>**Finance:** Membership fee, service fee |
| **Cluster and network enabled** | **Governance:** Government, public/private<br>**B-model:** Membership, networking/ training<br>**Operation:** Customer focused using training, networking, consultant, and advocacy service providers<br>**Finance:** Membership fee, service fee, public funding |

## 4.6 Contingencies

The approach taken on contingency is built upon previous work conducted by McCarthy et al. and Hardy et al. on the evolution and classification of organizational configurations, new product innovation, managerial practice and inter-organizational connections, and collaborations (McCarthy et al, 2000; McCarthy and Gillies, 2003; McCarthy, 2005; Hardy et al., 2005). As shown in **Table 4-5**, the environmental contingencies for benchmarked organizations include temporal factors (age and development phase) (Koh et al., 2005), spatial factors (size and geographic location) (Agrawal, 2001), and the size and intensity of the community-involved projects (Santoro and Chakrabarti, 2002). Strategic contingencies determine whether the organization focuses on real estate and incubation activities, the type and level of CET that member companies are developing for communities, the promotion of market linkage activities, and the encouragement of firms to enter global markets. The management contingencies mainly involve the governance structure, the process that the board follows to determine the organizational strategies, promotion of market or technology linkages, encouragement of private-public partnerships, and increased collaboration with private or public R&D organizations, private CET vendors, and communities.

**Table 4-5** Contingency of commercialization organizations in view of environment, strategy, and management practice

| Contingency | Structure |
|---|---|
| **Environmental** | **Temporal factors:** age and development stage (established or new organization)<br>**Spatial factors:** size (number of staff, R&D equipment, market and business strategies) and location (Europe, Canada, U.S.) |
| **Strategic** | **Focus:** (incubation, membership, market/technology services, project management, or establish CE cluster networks)<br>**Type of services:** (market/community driven or technology driven)<br>**Level of CE technology transfer:** (Demonstration, implementation, or long-term operation)<br>**Encouragement:** (public-private involvement and the tendency to transfer to global markets) |
| **Management** | **Different realization of core business:** (incubation, public-private partnership, the role of private technology suppliers)<br>**Promoting the technology and market linkage services**<br>**Collaboration:** (private or public R&D and Research Technology Organizations [RTOs], CET vendors, communities) |

## 4.7 Summary of benchmarking analysis

**Figure 4-3** illustrates the clean energy commercialization "not-for-profit" typology. It provides the summary of the benchmarking analysis and organizational typology approach described in Section 4.5. Also, CTCG and some of the other benchmarked organizations are mapped onto this grid. The non-profit organizations are characterised in terms of two independent factors; the tendency to establish public-private partnerships (which is determined by board member composition and financial resource strategy) and overall capital investment required by the organization to provide market linkage, technical services, or network, training, and advocacy support to SMEs or communities. The public-private partnership spans from a weak partnership (purely private or purely public) to a strong partnership (where the risks, profit, and operation of the CE projects are shared among the government and private entities). Organizations such as MaRS and CTCG apply a moderate, flexible strategy for public-private partnership. The latter provides MaRS and CTCG with business strategies to provide services to communities and public entities on one hand (which requires implementing strong a PPP business operation strategy) and to private, small CET firms on the other hand (which often require a flexible business operation and the sharing of strategies in view of risks and profit).

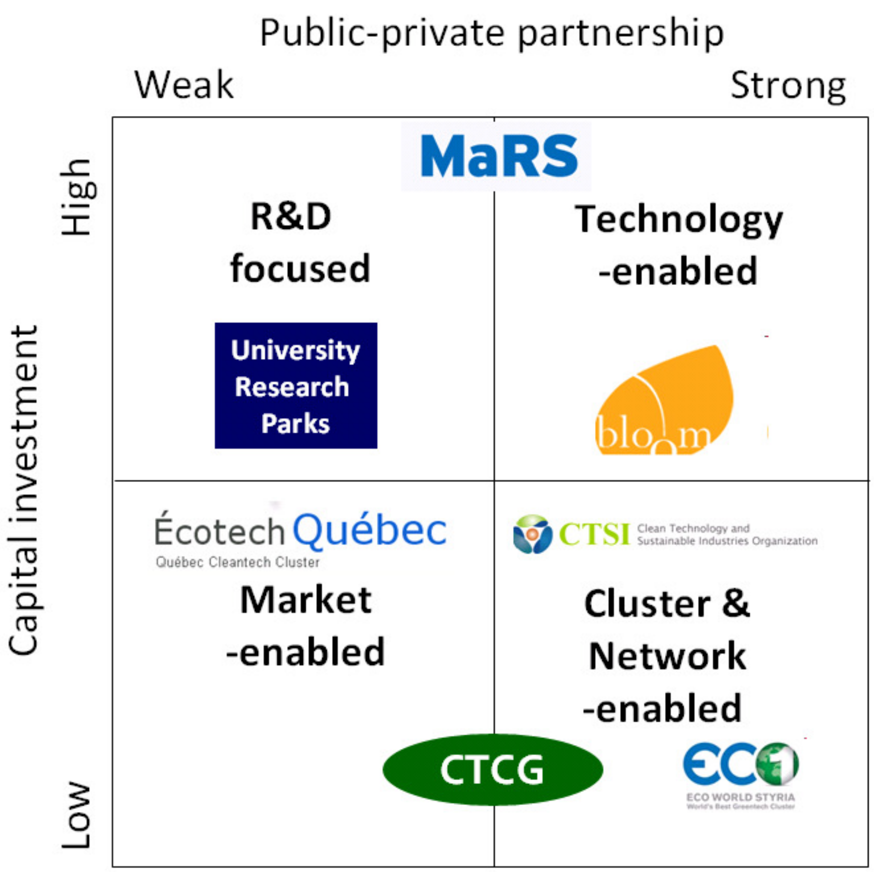


**Figure 4-3** Clean energy commercialization "not-for-profit" grid. Organizations such as MaRS and CTCG apply a moderate, flexible strategy for public-private partnership to provide market linkage and technology enabled services to both communities and early-stage CE companies.

# 5: Evaluation of Strategic Alternatives

In order to unravel the best business practices for CTCG, this chapter applies the organizational typology which was proposed in **Figure 4-3**, in view of governance, business model, and operation framework. The aim is to evaluate and assess the most viable strategic alternatives in the areas of governance, business model, and a customer-centric operation. Additionally, the financial resources and performance metrics for CTCG are discussed. Lastly, the "Haida" case study is presented and analyzed in **Section 5.9** in terms of the impact of a new business operational model employed.

The suggested alternatives must fulfill performance measures and implement the best operation and business models to maximize the environmental, social, and economic impacts of CTCG. The rationale is to enhance effectiveness of CTCG to provide high quality, high speed, and low cost services to remote communities and, in return, to ensure a high throughput technology transfer to emerging CET ventures in BC.

## 5.1 Governance

Overall, CTCG needs to move toward a different governance structure than the one under which it currently operates. Among those governance models that were discussed in the benchmarking analysis (**Section 4.1**), CTCG must consider all of the governance structures, described in Chapter 4, and adapt one that best suits its needs. Most likely, the best choice will be either "representative board model" in the short-term or the "emerging cellular model" in the long-term.

Given the scope and extent of the Haida project, the first CTCG community project, a "representative board" model is the best governance model that fits CTCG's objective, capital investment, and operation. This is because the CE supplier and community representatives on the board control over policy and decision-making process. The board members at CTCG represent associate organizations including provincial and federal governments and the executives of private CE companies. Although the board is not large (four member directors in addition to the president), there are more than fifteen advisory board members that facilitate communications between community end users, CTCG, and CET vendors. The board members and associated committees make decisions over the types and sizes of CE projects, the role of CTCG in those projects, as well as overseeing the operations of CTCG.

Once established on the “representative board” model, CTCG can evolve its governance structure to an “emerging cellular” model depending on how much control and authority CTCG wishes to maintain. If having control is the predominant desire, a “representative board” model should be considered.  In contrast, the “emerging cellular” model could serve as a more suitable governance structure in the long-term, where large CE projects need a strong network of member communities and require extended outsourcing to private CE vendors. **Table 5-1** provides some of the positives and negatives associated with each of the four governance models.

**Table 5-1** Summary of the evaluation of governance models for CTCG

| Governance models | Negatives | Positives | Evaluation |
|---|---|---|---|
| **Policy governance model** | Politically oriented decisions | Strengthens the role of community or member organizations to monitor the priorities and operation of CTCG | ✗ |
| **Representative board model** | The high industry oriented composition of the board may privatize public-private projects | Needs lower capital investment and is aligned with initial operation of CTCG | ✓ **(a)** |
| **Entrepreneurial board model** | (Remote) communities discomfort with private sectors to deliver CE projects or services | Highly fulfilling the stakeholders’ interest | ✗ |
| **Emerging cellular model** | Hard to debate on a lowest cost project among member organizations | CTCG can build-upon existing CE clusters and community needs | ✓ **(b)** |
| **Hybrid model** | Needs extended resource and capabilities and larger capital investment | Opens several parallel business opportunities and enhances the quality of CE projects | ✗ |

✓ selected; ✗ not selected; (a) short term; (b) long term

## 5.2 Business model

The most viable business model for CTCG is based on “service oriented” activities, which include both “technology enabled” and “market linkage” services. The CTCG core business consists of contracts with private and public partners (communities and municipalities). The technology enabled model covers a variety of services from technology evaluation and CET assessment to project planning, coordination, resource management, implementation, execution, and managing clean energy projects for remote communities. The market linkage service primarily targets early stage CE ventures. This requires demonstration and government certification of their technology and relies on short- to long-term testing, demonstration, and integration by end users. The “technology enabled” model is generally more capital intensive than “market linkage” services, but can attract clients among service recipients from communities, early-stage, or established CE ventures. These two business models require relatively low capital investment and their success strongly depends on the size of projects and the role of CTCG in those projects.

### 5.2.1 Alternative business model

One strategic move for CTCG among “technology enabled” services is to engage in large-scale CE projects by leveraging the partnership with strategic partners such as government and technology suppliers (strategic partner engagement model). CTCG’s financial position limits the organization’s direct involvement in capital-intensive CE projects, which usually have high impacts on communities and could lead to substantial payoffs to CTCG. By employing a strategic partner model, CTCG can generate CE projects mainly based on public-private partnerships. The “technology enabled” services can follow different “revenue sharing” strategies among the end users, CTCG and the CET suppliers. CTCG can play a role as a project evaluator, in which the feasibility and capability of a specific CET in fulfilling remote communities’ needs is evaluated. Other technology services depend upon CTCG’s available resources and capabilities to directly participate in project execution as project manager or monitor the project as per the community’s or CET supplier’s request. The latter can cover technical and marketing services for developing adequate legal and CE regulation and in the long-term can include education and training services to the community (cluster and network enabled model).

According to Valsangkar, the financing and ownership of the CE facility can belong to either the public or private partner (Valsangkar, 2010). The public agency might provide the financing and accept the costs and risks. Alternatively, the private party might provide or share the financing capital, generally in exchange for a long-term contract to operate the facility and generate long-term revenue. In the following, various services that CTCG can provide to CE vendors or communities within this framework are described in detail.

#### 5.2.1.1 Technology evaluation services

If the private CET company has the ability to fund and run the project independently, the role of CTCG and the public partner is limited to a predefined period to monitor and evaluate the viability and framework of the project. In this case, the CTCG business model is to establish a "Service Level Agreement" with the public sector or private vendor. CTCG can provide an independent and effective evaluation of the framework to the public sector and technical/market evaluation to the private partner, **Figure 5-1**. The model is particularly suitable when several private vendors can participate, decreasing the amount of capital investment needed from each vendor. The vendor accepts the overall financial risk of the project, whereas the municipality shares the risk of loss of administrative control (which can be transferred to CTCG). The latter could lead to end-user and residents' dissatisfaction; thus, CTCG has to ensure that its contribution will lead to improvements in municipality services (Valsangkar, 2010). Either fixed or variable payoffs by the vendor to the government are expected. The second phase of "Haida project" can fall into this service model.

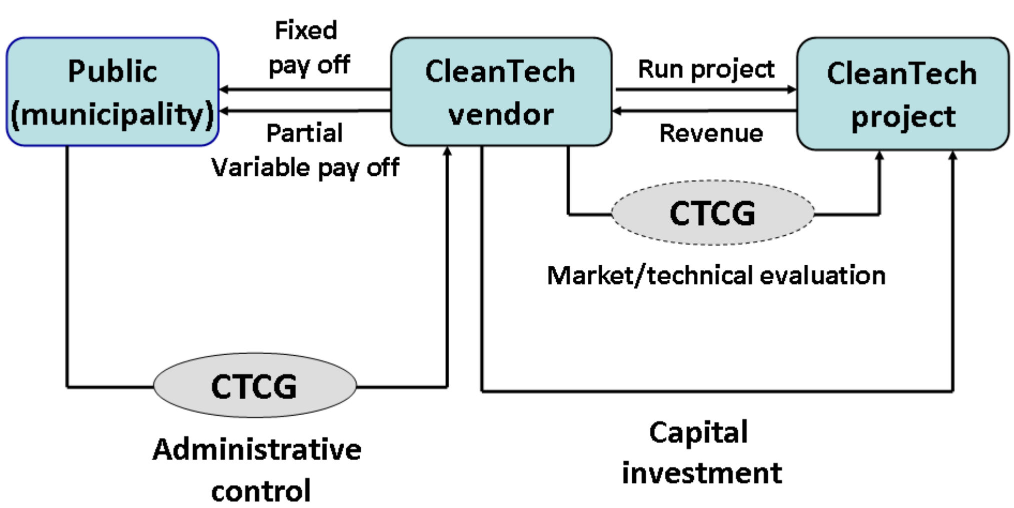


**Figure 5-1** A business activity in which CTCG plays a role as project evaluator, adapted and modified from (Valsangkar, 2010)

#### 5.2.1.2 Project management services

In this model, the public sector provides the capital investment and the project is completely run by the private partner. This model is particularly useful for utilizing the efficiency of the private vendors in running clean energy services to remote communities. In this case, the capital investment is too high for private enterprises to invest directly into the project. CTCG will play a central role in managing the project with close interaction with private vendors and full responsibility for the efficiency and performance of the project, **Figure 5-2**. In this model, the private enterprise can receive a fixed or variable pay. Compared to the previous model, the role of CTCG is expanded from concept and evaluation to implementation and operation. The community takes the financial risk. Both the public partner and CTCG incur the administrative risk of project failure and subsequent loss of credibility amongst the end users. Thus, the public partner may require CTCG to operate under a strong Service Level agreement. Through CTCG, government exercises close control over the vendor in this model. Government also becomes the major beneficiary of the revenue generated through this model. Depending on whether the services by the private sector influence the revenue generation process or not, a fixed or a variable payoff model to CTCG should be suggested to the public sector. The third phase of the "Haida project" can fall into this service model.

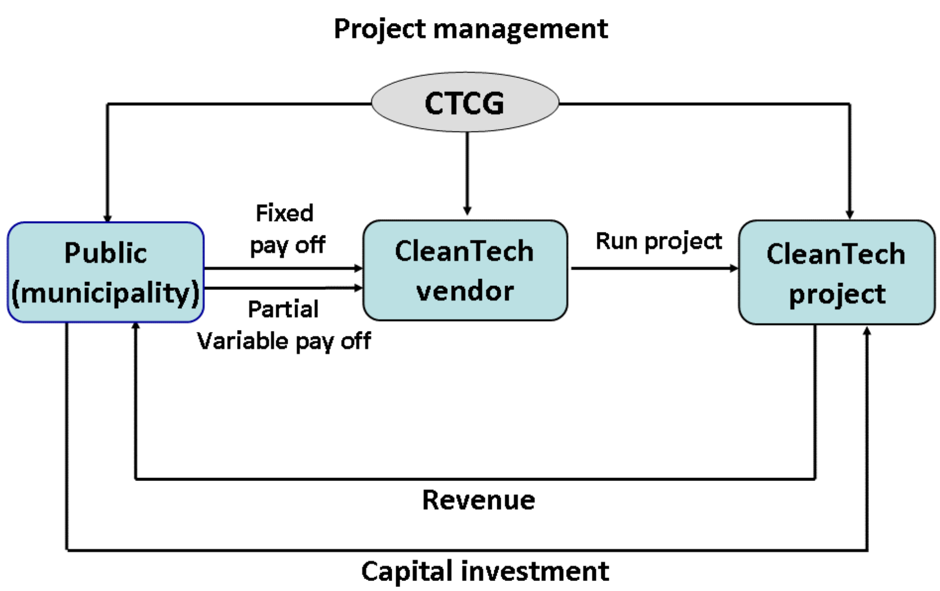


**Figure 5-2** A business activity in which CTCG fulfils the role of project manager, adapted and modified from (Valsangkar, 2010)

#### 5.2.1.3 Project partnership services

This alternative service model is only viable in the long-term. It requires high capital investment and a rigorous partnership with private CE vendors and CTCG's partner organizations. This model implies the involvement of CTCG as a project partner and divides the risk and return between the CTCG, public, and private partners equally, **Figure 5-3**. Both private and public partners invest capital into the project. Returns are shared as per the original capital investment ratio as well as the risk perception of the partners. CTCG employs technical expertise, project management, and marketing resources & capabilities to run the projects. It focuses on ensuring efficiency, reliability, and overall business profitability. These projects require large capital investment and include large regional clean energy demonstration, implementation, and integration projects. The public sector(s) can participate in the investment and accrue annual revenue for their investments. This model can be well adopted by CTCG for future project opportunities within other regions in Canada or beyond the Canadian market.

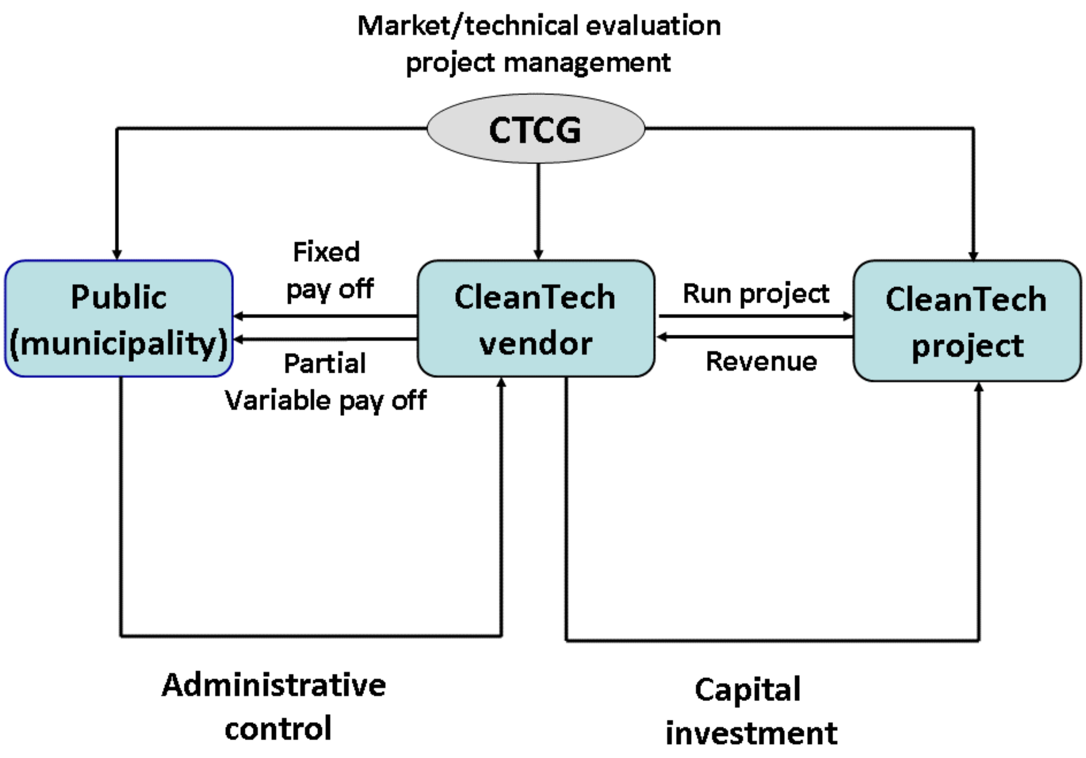


**Figure 5-3.** A business activity in which CTCG fulfils the role of project partner, adapted and modified from (Valsangkar, 2010)

**Table 5-2** provides the characteristics of various business models and summarizes the strategic alternatives for CTCG. The evaluation is based on a combined approach which employs revenue sharing models developed by Valsangkar (Valsangkar, 2010) and others (NCPPP, 1999; Hall, 2008) as described above, and transferring insights from the benchmarking analysis and business model typology (**Figure 4-2**).

**Table 5-2** Summary of the evaluation of business models for CTCG

| Business models | Service provided by CTCG | Service recipient | Capital investment | Return to CTCG | Impacts on Community | Impacts on early stage CE ventures | Evaluation |
|---|---|---|---|---|---|---|---|
| **R&D focused** | R&D services | Early-stage & SMEs | High | Low | Low | High | ✘ |
| | Incubation & Licensing | Early-stage CE ventures | High | Low | Low | High | ✘ |
| **Technology enabled** | Technology Evaluation | Community End users | Low | High | High | High | ✓ **(a)** |
| | Project Management | Community CE supplier | Low | High | Medium | High | ✓ **(b)** |
| | Project Partnership | CE supplier | High | Low to High | Medium | Low to High | ✘ |
| **Market enabled** | Market linkage | Early-stage & SMEs | Low | High | Medium | High | ✓ **(c)** |
| **Network enabled** | Education, Advocacy, Training | Community CE ventures | High | Medium to High | Medium | Medium | ✘ |

✓ selected; ✘ not selected; (a) short term; (b) intermediate term; (c) long term

## 5.3 Operation model

Based on the operation framework in **Chapter 4**, this section provides various strategies that CTCG can integrate and apply within its "customer-centric" operation model. The operation mode is determined depending upon the size of PPP CE project and type of the services. These operation modes need to be aligned with CTCG overall business model. Additionally, the required resources and capabilities in project management, business analysis, communications, and marketing are discussed.

### 5.3.1 Customer focused

Customer focused is the only viable operation model for CTCG. The organization works with communities to identify and develop clean energy strategies and models based on locally available resources. CTCG particularly provides tools and assessments to help them make decisions. CTCG also provides market services to clean energy technology companies to develop and deliver a solution to these community needs, and advises and supports them in identifying local communities' needs and in accessing global markets (**Figure 5-4**). The required resources and capabilities include engineers, scientists, and business and market analysts. All CTCG services and projects are focused on developing a sound understanding of the needs of customers and the market. Based on this understanding, CTCG develops collaborative partnerships with technology vendors, service providers and other relevant stakeholders, to design and deliver initiatives that meet the communities' expectations as well as the market performance expectations, and relevant government regulations and standards.

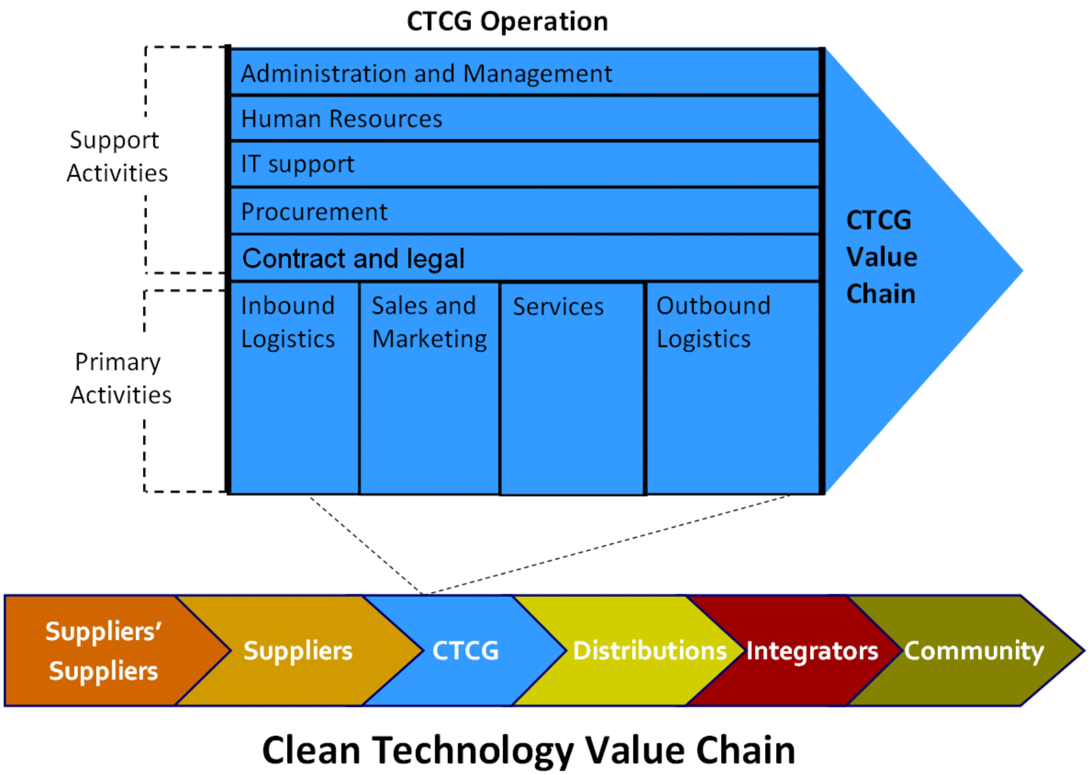


**Figure 5-4** The relation between CT value chain and CTCG operation. The scheme is adapted from (Parent, 2010)

### 5.3.2 Operation strategies

For a relatively large, partnership-based CE project, depending on scale and type of services, one of the following two alternative operation strategies can be adapted to the PPP business model to carry out projects (NCPPP, 1999; Hall, 2008).

#### 5.3.2.1 Build-operate-transfer model

The private partner (technology supplier) in collaboration with CTCG (through technical and market services) build a facility to the specifications agreed to by CTCG and the community, operates the facility for a specified time period under a contract or agreement with the community, and then transfers the facility to the community at the end of the specified time period. In this case, the private partner will provide some of the financing for the project, so the length of the contract with CTCG must be sufficient to enable the private partner to realize a reasonable return on its investment through user charges (NCPPP, 1999). At the end of the contract period, the public partner can assume operating responsibility for the facility, or contract its management to CTCG.

#### 5.3.2.2 Turn-key model

In this operation format, the community directly contracts with CTCG to design and build a complete facility in accordance with specified performance standards and criteria agreed upon by the community and CTCG. CTCG seeks a private developer who commits to build the facility for a fixed price and absorbs the construction risk of meeting that price commitment. The private partners use fast-track construction techniques (such as design-build) and are not bound by public sector procurement regulations (NCPPP, 1999; Hall, 2008). One upside reward of this operation is that CTCG is exposed to the entire operational risks. CTCG services in this operation model consist of performing due diligence and regulatory consultation, as well as education services.

### 5.3.3 Required human resource and capabilities

#### 5.3.3.1 Project team skills

CTCG requires expertise in project management, business and clean technology analysis, fund raising, communications, and marketing skills to implement the activities in the strategic project plan that are aligned with CTCG's business model.  Business and technology analysts are hired on a project-based fashion.

#### 5.3.3.2 Partner organizations

New projects need implementation of expertise and staff with new skills. In order to achieve cost effectiveness with CTCG projects, some of the extra work for which no internal expertise exists needs to be transferred to the partner organisations, assuming they have adequate resources to engage in the projects. CTCG must ensure that the associated costs and timeline are planned and budgeted accordingly in the project plan.

#### 5.3.3.3 Project management and governance

CTCG project management and project governance are exclusively proposed and controlled by the board of directors and associated committees and in consultation with the CTCG president.

#### 5.3.3.4 Support functions

One or two staff members specialized in administration, communication, and marketing need to be hired on a permanent or full-time basis to function in the following areas of operation: finance and administration, fundraising and communications, IT and technical support, human resources, and project management support.

## 5.4 Revenue model

A typical PPP contract should optimally balance risk and the opportunity cost of public funds, which usually have a minimum long-term revenue guarantee for CTCG. The optimal contract consists of a combination of market development for the technology supplier, technical review and due diligence services to end users (i.e. remote community), and educational training services (**Figure 5-5**).

### 5.4.1 Market development services

CTCG recognizes the necessary bridges that connect market requirements with supply technologies. The internal expertise and extensive network of stakeholders and industry contacts at CTCG can be utilized to increase demand-side customer awareness of "commercial readiness" of various clean technologies and environmentally sustainable solutions. CTCG works directly with key sector players (end users, community authorities, suppliers, regulators, and other private stakeholders) to identify the needs of customers in targeted market sectors and to promote an early adoption strategy by carrying out performance benchmarking, capacity-building and demonstration projects in "real-world" commercial conditions. Both private and public sectors are the recipients of these services.

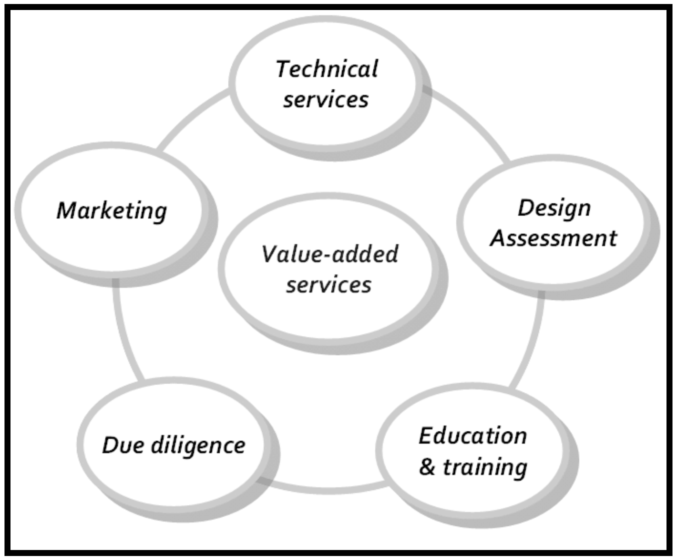


**Figure 5-5** Schematic representation of CTCG's possible revenue models

### 5.4.2 Technical services

CTCG can provide highly specialized technical review and due diligence services related to clean technology products and services to both the public and private sectors. Specifically, CTCG can implement a performance management framework to generate a baseline, measure, and verify the environmental performance of technologies, products and projects, thus ensuring a high internal rate of return (IRR).

### 5.4.3 Education and sustainability services

In a long-term perspective, CTCG can also collaborate with project partners from all levels of government, industry associations, and authorities to build capacity within communities and small-to-medium sized businesses. Educational services can help technology suppliers find commercialization partners, and help communities identify and evaluate new technologies. The education and sustainability services are performed through "membership" options. CTCG should reserve the right to refuse membership to any organization whose mission and actions fail to uphold CTCG core objectives and values. The primary outcomes of education services are "Community Support and Development" and "Technology Commercialization". Business workshops are designed to provide small and medium sized member companies with the business tools they need, to test and integrate their technology and to examine go-to-market strategies. Technical or customized training workshops can primarily target potential market segments within remote communities, authorities, and regulators who intend to build, test or implement clean energy technology platforms.

## 5.5 Financial resources

The financial source for the majority of CTCG's projects is public-private funding (**Section 4.3**). In the early stages of a project, the project manager performs a general assessment of the financial requirements of implementing the plan over the expected lifetime of the project, which could be fairly simple for smaller and shorter term projects and more comprehensive for complicated projects. Budgeting and cash management are two important areas of financial management for CTCG. Special attention should be given to the current and potential sources of income, the estimated costs of services and monitoring activities, and any projected financial resource gaps.

A financial projection for five years operation of CTCG, based on a "plausible" scenario, is provided. **Tables 5-3** and **5-4** provide CTCG's income statement and expenditures over a five-year period. During the implementation stage in years 1 to 3, CTCG expects to fund the operations at ~$350K per year for 2012. This increases steadily to $564K in 2015. The funds will be raised from government and private sources. The breakdown of the revenue sources and operational expenses are outlined in the tables below. CTCG plans to reduce the funding from government grants, which are expected to be up to $100k/yr for the first three years. The remaining funds will be generated through the project in terms of technical services to technology suppliers or communities. The latter is expected to be ~$200-500K to cover the operating expenses for the first five years. The financial projection is based on revenue from at least two projects per year and includes minor additional revenues from educational and marketing services. Thus, this financial scenario is conservative.

**Table 5-3** CTCG's income statement

| ($, thousands) | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|
| **Revenue** | | | | | |
| Grants | 100 | 100 | 50 | 0 | 0 |
| Membership and training services | 25 | 31 | 46 | 70 | 105 |
| Marketing services | 100 | 125 | 187 | 281 | 421 |
| Technical services | 100 | 125 | 187 | 281 | 421 |
| Private equity | 25 | 25 | 25 | 0 | 0 |
| | | | | | |
| **Total revenue** | 350 | 406 | 496 | 632 | 949 |
| **Expenses** | 350 | 406 | 496 | 467 | 564 |
| **Net income** | 0 | 0 | 0 | 165 | 385 |

**Table 5-4** CTCG's table of expenditures. FTE=Full time employee

| ($, thousands) | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|
| **Labour** | | | | | |
| Administration (4.0 FTE) | 200 | 210 | 220 | 231 | 243 |
| Management | 110 | 121 | 133 | 146 | 161 |
| **Operational costs** | | | | | |
| Travel | 10 | 20 | 43 | 12 | 50 |
| Lease for office space | 15 | 15 | 15 | 15 | 15 |
| Marketing (advertising, presentations, workshops) | 10 | 30 | 50 | 50 | 75 |
| Others | 5 | 10 | 35 | 12 | 20 |
| **Total** | **350** | **406** | **496** | **467** | **564** |

## 5.6 CTCG performance metrics

The primary attributes that drive CTCG to serve communities and emerging CET industries are creating jobs, enhancing the standard of living, lowering energy costs, and increasing energy efficiency of on and off- grid communities. Particularly, the community-driven projects seek to decrease or eliminate fossil fuel based energy sources, thereby reducing GHG emissions. The latter contributes to economic, environmental and social prosperity for the region.

**Table 5-5** provides evaluation of the performance objectives for the alternative business operation models at CTCG. Each of the three business operation models (technology-enabled, market-linkage enabled, and network enabled) is rated against the performance measures on a scale of High to Low. CTCG's performance is measured based on internal and external metrics including quality of services, speed of delivering services, impacts on community, impacts on private vendor, cost, and overall impacts on CTCG's growth.

The main internal performance measures are quality and speed of the project-based services. Other internal measures such as financial return to CTCG can be determined by the number of projects performed per year which impact the CTCG's growth directly. As seen in **Table 5-5**, the long-term growth of CTCG is strongly impacted by "technology enabled" services, where a rating of "High" corresponds to at least two community projects with average revenue of more than $150 k per year (**Section 5.5**).

The output performance measures include endowment value, communities' new energy infrastructure, local, state, and national economic impact, and recognition received from national/regional organizations, and the media. The impact on community is measured in view of encouraging intensive use of local renewable resources, and revenue for local communities. The latter can be measured by the operation cost of the renewable power system in comparison to diesel generators. CTCG will also build capacity through skills training and education on sustainability and empowering and involving communities in decision-making processes. A rating of "High" corresponds to services that impact communities only, whereas a rating of "Medium" is associated with those services that impact community and private CE companies equally. Finally, the impact on private CE vendor is measured in terms of expanding market and growing companies' revenue, increasing employment opportunities in British Columbia and Canada, creating export, and trade opportunities for clean electricity in the global market. All the three business operation models impact CE vendors with a rating from "High" to "Medium".

**Table 5-5** Evaluation of the performance objectives for alternative business operation models

| Business operation models | Type of service | Quality of services | Speed of delivering services | Impacts on CTCG growth | Return to CTCG | Impacts on community | Impacts on companies | Cost |
|---|---|---|---|---|---|---|---|---|
| **Technology enabled** | *Technology Evaluation* | High | High | High | Low | High | Low | Low |
| | *Project Management* | High | Medium | High | Medium | Medium | Medium | Low |
| | *Project Partnership* | High | High | High | High | High | High | High |
| **Market-linkage enabled** | *Market Linkage* | High | Low | Low | High | Medium | Medium | Low |
| **Network enabled** | *Training & Education* | High | Low | Medium | Medium | High | High | Medium |

## 5.7 Alternative operation process for Haida project

In this section, a practical application of the strategic alternatives and their interplay with performance measures at CTCG is provided. The aim is to understand how a new business operation model impacts project development (Phase I) and contracting (Phase II) processes of the Haida project which is managed by CTCG. The analysis is focused on a partnership with council of the Haida nation as described in detail in **Chapter 2**. The type of service in this project is categorized as "technology evaluation and project management". The initial role of CTCG is to assess the implementation of a specific CET and evaluate alternatives.

The "quality" and "speed" of the project can be improved by improving communication among CTCG, community, and private CET suppliers. A coordinator, with no extra cost to CTCG (possibly seconded or out-sourced from a private vendor or community), must be added to the project staffing structure. The main responsibility of this person will be to perform effective and timely communication planning that is aligned with the overall strategic objectives of the project. The coordinator develops and reports on appropriate performance measurement indicators for the executive and audit committee and communicates with the project manager on required processes for new projects and creates the time-line and project approval processes. The coordinator also works closely with the executive committee to coordinate and integrate the project review and planning (PRP) process with business development process and strategic objectives. On the other hand, the representative of the audit committee, responsible for audit and conflict of interest issues, should be involved in the new project approval process to forecast potential arising conflict of interest issues and provide appropriate solutions in consultation with the board of directors and partner organizations. The outcome should be communicated with the executive committee.

The new performance objectives are summarized in the polar diagram in **Figure 5-6**. In regards to operation, the TO-BE process contains improved communications between CTCG, the community, and the private vendors, and therefore improves the impacts to the industry and community as well as the quality, speed, and dependability of the process. In regards to structure, the new process possesses high interrelation, lower risk of reworking, and less feedback loops. In regards to resourcing, the TO-BE process leads to one additional project staff and early involvement of the coordinator and financial management that diminishes duplication of efforts. Therefore, the performance objectives are improved in view of estimated total project cost, project time-line, and project impacts.

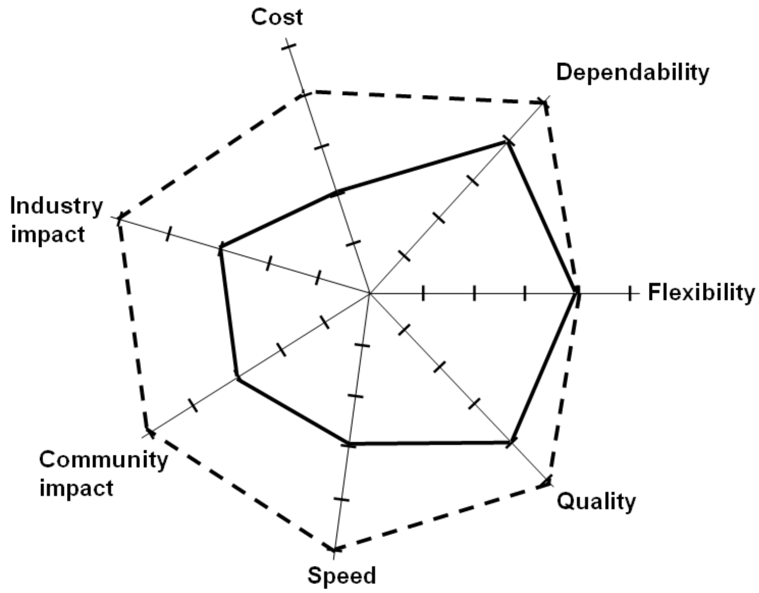


**Figure 5-6** Polar diagrams: TO-BE process (dashed line) vs. AS-IS process (solid line)

# 6: Conclusions and Recommendations

Clean Technology Community Gateway was formed to establish and coordinate clean energy projects in BC for end users by focusing on remote communities. The organization aims to close the commercialization gap of emerging CETs through managing and implementing of large-scale demonstration projects (CTCG, 2011). Based on a detailed benchmarking study and typological analysis, the main objective of this report was to develop a suitable business operation model for CTCG. This chapter summarizes the processes undertaken throughout this report for benchmarking of similar organizations and provides the main conclusions and recommendations.

## 6.1 Benchmarking and business operation framework

This report was comprised of an extensive benchmarking study and detailed typological analysis to review CE commercialization organizations in view of configuration, management practice, overall business model and performance, strategic plan, and operation. Based on a typology approach and contingency characteristics, a business operation plan was suggested for CTCG which identified performance indicators, actual board structure, business and administration activity, cost, and financial strategy.

The two key facets along which this paper discriminated business operation models of the benchmarked CE commercialization centres were (i) the degree of public-private partnership, and (ii) the financial resources and revenue models that determines the level of capital investment. The typology of commercialization firms provided organizational variables that enforce the formation and operation of each type of the benchmarked commercialization organizations. As well, it provided detailed descriptions of each organization type, by positioning CTCG within its industry. Based on the details governance structure, business model, operation model and financial strategy, four possible types of non-profit commercialization organizations were suggested: R&D focused, technology enabled, market enabled, and network enabled. Moreover, the environmental contingencies for benchmarked organizations were provided in terms of temporal factors (age and development phase), spatial factors (size and geographic location) and the size and intensity of the community involved projects.

## 6.2 Recommendations

As a short-term business strategy, CTCG should focus on remote communities as its initial target market. An innovative, long-term business strategy requires efforts to build upon CTCG's success in providing services to BC remote communities and connecting SMEs and CET providers in BC and Canada to the global market. Based on the typology study, the strategic alternatives for CTCG were "representative board" and "emerging cellular" models for the governance, "technology enabled" and "market enabled" services for business model (either as CE project evaluator, manager, or partner), "customer-focused" model for operation, and public-private funding as the main strategy for tapping into available financial resources. CTCG can enter CET projects in form of a public-private partnership as technical evaluator, project manger, or project partner and may share several ingredients such as the capital, revenue, risk, responsibility, assets, and authority. The strategic alternative business services provide CTCG with opportunities to share capital investment and revenue based upon the potential risk and return relationship.

The "not-for-profit" commercialization organization framework, provided in **Figure 4-3,** suggested that CTCG should implement a flexible and PPP business operation strategy to be able to provide services to communities and public entities on one hand, and to private, small CET firms, on the other hand. A longer-term recommended business model for CTCG is to leverage their strategic partners (government and technology suppliers) to engage in large-scale "technology enabled" services and projects. Currently, CTCG cannot be directly involved in capital-intensive CE projects due to its limited financial resources. By employing a strategic partner model, CTCG can generate CE projects mainly based on public-private partnerships. The latter impacts remote communities highly and could generate substantial project payoffs and positive cash flow to CTCG.

The case study was mainly focused on a newly established "Haida" project. The main project characteristics in view of operation, structure, resourcing, and performance were identified. An improvement in communication plans, project approval process, role of board auditing, and eliminating some bottlenecks in operation were recommended. In this case study, the analysis was particularly focused on the pre-contract and project development phase (Phase-I) and partnership / contracting phase (Phase-II).

## 6.3 Validating the models and future work

Although the proposed typology and contingency were mainly built upon benchmarked organizations and CTCG, the business operation and organizational frameworks can potentially provide guidelines for any commercialization accelerator focusing on high-tech emerging industries, including biotech and information-communication technology (ICT). In-depth quantitative analysis of the four key dimensions (governance, business, operation, and finance) was beyond the scope of this study. Future work includes gathering data to validate business operation models and to explore how variations in organization governance structure and business operation practices can relate to outcomes and overall performance of the commercialization organizations. The latter requires extensive data and rigorous financial information such as projects' Returns on Investment (ROI), Internal Rate of Return (IRR), and Weighted Average Cost of Capital (WACC) of the benchmarked organizations. Thereafter, the controlling factors for enhancing performance, economical viability, and socio-economical impacts of the organizations can be further developed and be used as a basis to develop empirical testing theories.

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