RESEARCH HIGHLIGHTS

July 2001 Socio-economic Series Issue 85

ASSESSING THE FULL COSTS OF WATER, LIQUID WASTE, ENERGY AND SOLID WASTE INFRASTRUCTURE IN THE FRASER VALLEY REGIONAL DISTRICT (FVRD)

Introduction

The Fraser Valley Regional District (FVRD) in British Columbia has drafted a Growth Strategy to guide growth, change and development over the next 25 years. This strategy deals with issues such as air pollution, water quality, traffic congestion, affordable housing, employment, energy use, parks and green space. Its purpose is to promote human settlement that is socially, economically and environmentally sustainable.

Conventional cost/benefit analysis for such a strategy would focus on economic issues. Full Cost Accounting (FCA), the more appropriate approach for a sustainable strategy, would add social and environmental considerations. This project uses the FVRD as a case study to develop a methodology for the application of FCA to a growth strategy.

The project also included the initial development of an associated software tool for compiling and analysing detailed infrastructure profiles, and using these profiles to assess the full costs of different growth scenarios.

Part 1 of the report provides background information about the FVRD and the methodology which links Regional goals with growth measurement indicators.

Part 1 objectives were to:

- outline basic infrastructure issues of concern;
- provide a situational analysis of existing infrastructure;
- create a list of "operational goals" from those already adopted by the FVRD;
- propose a series of performance measurement indicators relative to each goal; and
- estimate current performance of FVRD communities and set future targets.

Part 2 describes the development of the software tool for monitoring and evaluating infrastructure costs and performance as part of an Environmental Management System (EMS), and presents results of its application to the FVRD. As just one component of the "technical program" of the FVRD's first Regional Growth Strategy, this project addresses only a limited range of details and issues in the categories of solid waste, water and wastewater, energy, land use, and roads and infrastructure costs.

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Full Cost Accounting, Methods and Performance Indicators

While different methodologies exist for conducting Full Cost Accounting (FCA), the underlying premises are essentially the same. As noted, FCA is a method through which the costs of a given action are assessed in a broader context than the economic one. These perspectives are typically grouped into social, environmental and economic spheres, thus providing a method for including all potential impacts of proposed development actions. This allows the evaluation not only of qualitative impacts but also of the social and environmental impacts borne by third parties. Most importantly, it allows complex decisions to be assessed from an holistic and integrated viewpoint.

Key components of the methodology used for the FVRD were:

- the assembly and calculation of detailed resource use, demographic, building stock, emissions, wastes and land profile information;
- computer modeling to permit the development of archetypes or single entities representative of a larger entity; and
- indicators as a method of measuring performance and impacts in key areas, providing the crucial link between information assembly and modeling, and FCA.

Indicators make complex systems understandable to the public and decision makers. A set of indicators captures many broad issues of concern (such as water), thus presenting a "fuller" cost account for existing infrastructure and proposed growth strategies. An effective set of indicators helps a community determine, in measurable terms, were it is, where it is going and, how far it has yet to go to reach desired targets.

Ideal indicators for the FVRD would measure the region's long-term viability to the degree its economic, environmental and social systems are efficient and supportive. This would help to manage growth and achieve sustainable development. Due to the scope and budget of this project, the number of indicators was limited and the focus restricted to infrastructure, energy and land-use issues. Therefore, they are only a partial measure of sustainability and must be used in conjunction with other evaluative tools and reports comprising the FVRD Technical Plan, including transportation, environment and ecology, housing, employment and economy, quality of life, and agriculture.

Unlike traditional cost benefit analysis, the indicator framework approach permits consideration of quantitative and qualitative impacts. This allows analysis of non price-based factors such as social equity, ecosystem health, aesthetics and lifestyle. Coping with the large number of potential impacts represents a difficulty when applying a Full Cost Accounting framework to regional growth analysis. In the FVRD study, only a core set of indicators was addressed in the economic and environmental spheres.

Part of the FVRD Strategy is a framework for assessing and evaluating various growth options, with a focus on sustainability and different patterns of land development. This includes the development of a methodology linking the FVRD's goals and objectives for infrastructure and land use categories to a set of indicators for measuring and monitoring performance. In this project, the following four issue categories of environmental and economic indicators of FVRD performance were addressed:

1. Solid Waste

- amount of solid waste produced annually per capita
- amount of solid waste disposed to landfills annually per capita
- annual expenditure on municipal solid waste services per capita

2. Water and Wastewater

- annual per capita amount of water consumed for residential purposes
- per capita area of land used for streets, roads and alleys
- annual per capita expenditure on water abstraction, treatment and distribution per capita
- annual expenditure on sewage treatment

3. Energy

- per capita electricity and fossil fuel energy consumed for operation of residential buildings
- CO2 emissions from single occupancy vehicles

4. Infrastructure Costs

- annual expenditure on municipal solid waste services per capita
- annual expenditure on water abstraction, treatment and distribution per capita
- annual expenditure on sewage treatment per capita.

Each issue category was then addressed in terms of current status within the FVRD, issues of greatest concern and associated indicators of performance. The FVRD goals relating to environmental performance and infrastructure were used to establish a set of five key performance indicators that can be measured and assessed over time:

i) solid waste;
ii) water consumption;
iii) wastewater;
iv) energy consumption; and
v) air emissions.

Each of these selected key indicators were measured in terms of current performance, preferred performance and performance associated with three alternative settlement patterns —high (building types/density similar to Vancouver); medium (a 50/50 compromise between what now exists in the FVRD and Vancouver); and low (no change) density.

Urban settlement patterns have a small but significant impact on the amount of solid waste produced and disposed of in landfills. If all other factors are held constant, the high-density settlement pattern will result in 13 per cent less water consumption than low-density one. High-density development with less street frontage requires less than half the land for roads than the current FVRD form.

Settlement patterns have almost no impact on the amount of energy used for each type of building (one building in a dense development will use almost the same as one in a less dense development). However, the more single family dwellings there are in a community, the more energy will be consumed on average, for every individual. As people travel shorter distances and use vehicles less in a high-density settlement pattern, this will result in 22 per cent less in CO2 emissions. Any amount of population density will reduce CO2 emissions in the FVRD.
A low-density settlement pattern indicates that houses are bigger and more spread apart. Experience demonstrates that people living in smaller units and lots produce less solid waste and consume less water, thus minimizing demands on municipal infrastructure. A more compact urban form has fewer road networks and shorter distances.

Environmental Management System (EMS)

The project provides a foundation for a regional Environmental Management System (EMS), a pro-active approach to protect and enhance environmental quality. An EMS attempts to integrate environmental goals within the existing management structure rather than mitigate individual instances of environmental damage. It includes a comprehensive set of policies and procedures to minimize negative impacts of resource use and to achieve goals for environmental performance. An EMS also allows an organization to communicate its environmental performance, both internally and externally, as part of Full Cost Accounting (FCA).

The basic elements of an EMS include:

- goal statements and a commitment to achieve the goals;
- environmental impacts analyses related to company or municipal operations;
- performance measurement criteria, indicators and targets;
- an action plan for meeting targets;
- a monitoring program for ensuring accountability.

Development of a Monitoring Tool in the FVRD Case Study

Part 2 of the project establishes a system that can be used for monitoring the performance of the FVRD and ensuring accountability. This is a software application tool consisting of an ACCESS database and an ARCVIEW GIS file, which allows data to be presented spatially, or as part of standard reporting formats. The tool allows planners to complete indicators of performance at various spatial scales and provides a mechanism for efficiently collecting data and calculating the key indicators of performance for the FVRD; it also provides feedback on how well the FVRD is performing relative to its goals. Also included is a database to provide the essential information for analysing the FVRD infrastructure. The case study further refines the indicators of performance so they can be used for any regional planning purposes. Results for the FVRD are presented in terms of water, wastewater and energy infrastructure.

Enumeration Areas

A key feature of the database structure is a geographical breakdown of the database into basic census components called Enumeration Areas (EAs). The FVRD is composed of 354 EAs which vary widely in area but contain an average population of 1,000 people—about as many as a single census-taker can handle. While it was originally proposed to use traffic zones for the database, they proved too large for refined analysis and their boundaries tend to change over time while EA boundaries are congruent with municipal jurisdictions and census data. Since the EA is the lowest level of aggregation within the database, all indicators are reported at the EA level —or a combination of EAs.

Indicators

A core set of 29 different indicators covering water, liquid waste and energy are addressed by the software. Indicators were calculated from a hybrid approach using bottom-up and top-down methods with statistics on population, housing, agriculture, industry, land area, and road and linear infrastructures. Bottom-up indicators are modified so total resource flows and costs are consistent with any metered or measured resource flows. Indicators are calculated for the year with the most current data and, as the database is regenerated each year, earlier data is archived for an historic perspective. The software tool includes an "EA Profile" report to provide a more complete overview of the basic statistics on the EA. The software tool presents core energy indicators such as average day energy consumption, direct expenditure by rate payers and energy-related greenhouse gas emissions.

In addition, the GIS application can be used for three mapping functions —selecting specific EAs, viewing elements of specific infrastructure such as roads, plants or corridors and mapping the results of indicator analysis. Land use information and indicator results can be viewed on a map for the entire FVRD, or zoom options can be used for detailed analysis. It is proposed to design the tool for Web access with a querying function. A sub-categorization allows for the indicators to be further analysed at varying levels of detail.

Summary

The indicators are important as they indicate progress towards, or away from, environmental sustainability. Using Full Cost Accounting (FCA), the cost of municipal infrastructure can be used to indicate service efficiencies which, in turn, reflect progress in social, environmental and economic areas.

The database and methodology developed by this project are expected to be suitable for other regions in BC and Canada. The tool, having been designed with Web-based applications in mind, could also become widely accessible and applicable. While the report provides information on the development of the database, indicators and the methodology of the FVRD case study, the software tool is best appreciated as a computer demonstration.

The software demo can be viewed by contacting The Sheltair Group Resource Consultants Inc. in Vancouver or, their client, the Fraser Valley Regional District (FVRD), or CMHC who have the tool on CD-ROM. Contact information follows. To use the tool, it is necessary to have ARCVIEW pre loaded and a verified version of MS ACCESS.

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Housing Research at CMHC

Under Part IX of the *National Housing Act*, the Government of Canada provides funds to CMHC to conduct research into the social, economic and technical aspects of housing and related fields, and to undertake the publishing and distribution of the results of this research.

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