

TWIN HARVEST

A BUSINESS PLAN FOR COMBINING URBAN AGRICULTURE WITH A GEOTHERMAL UTILITY

BROCCOLI GARDEN



SUMMARY

Twin Harvest is the trade name for a home-grown, non-profit urban market garden and geothermal district heating utility in one carbon-positive, self-financing, and self-sustaining project. Retained in the public realm, it is a logical policy progression from already well-established community gardens, and fulfills Mayor Robertson's Greenest Cities Initiative "to reduce the city's ecological footprint...and boost urban food production." This initiative addresses the need for both renewable district energy in our cities and urban agriculture of scale.

Small-plot organic farming on its own is a difficult business, barely financially sustainable even with free access to land and water. An urban plot, however, not only saves transport costs by being closer to market, but also has another significant advantage over its rural counterpart: proximity to heated and cooled buildings. Almost any large field can be outfit with a horizontally-laid "slinky-loop" GeoExchange system at a fraction of the cost of deep-drilled geothermal installations necessary on the usual small building plot.

The City of Vancouver owns hectares of empty land suitable for both intensive farming and small-scale geothermal utilities, real estate that City Staff is considering for grant or lease to such an innovative project.

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This business plan proposes the operation of both an urban market garden and geothermal utility on a self-sustaining, full-capital-cost-recovery model. A minimal initial capital investment of roughly \$300,000 per hectare should see repayment with interest in 5-10 years from crop sales, geothermal revenue, and potential carbon credits. The application of federal and local grants may reduce this amortization period further, reducing investment risk and the opportunity cost to the city of tying up real estate.

The **Twin Harvest** team of Diane LaFontaine and Randy Chatterjee are seeking investors interested in funding a pilot project and committed to maintaining public and community control and ownership of both the market garden and the geothermal utility. Should one or more such installations prove successful and revenue-generating in the longer term, we would be open to turning over project management to the City if it develops the expertise and capacity to maintain the project.

Developed locally, this Vancouver initiative combines two globally well-established stratagems for urban sustainability: urban gardening and renewable district energy.

THE INVESTMENT

The City of Vancouver owns hundreds of hectares of vacant or underutilized land, worth several billion dollars, offering little social or economic return, and requiring ongoing maintenance. This plan offers the opportunity to retain land in the public domain, eliminate maintenance and insurance costs, and secure a social, financial, and globally-sustainable return. A **Twin Harvest** project offers a self-financing, community-managed, revenue-generating opportunity without any significant long-term encumbrance.

The site preparation costs of an urban greenfield for high-intensity organic cultivation, including an intelligent permeable “soaker-hose” irrigation system, would come at a minimal cost of \$20,000 to \$25,000 per hectare, assuming a one-inch water feed could be accessed at a point adjacent to the field. The installation of horizontal-tube geothermal heat transfer piping at a two-metre depth and capable of providing 30 tonnes per hectare of transfer media to a nearby building, would run approximately \$250,000.

Set into motion and operated through a non-profit society with minimal paid staff, significant volunteer labour, and expenses restricted almost exclusively to professional planning and installation services--both city and commercial--the initial capital costs of approximately \$300,000 could transform one hectare of underutilized public space. Leaving aside sustainability grants for this project from many probable sources, full capital cost recovery of this entire initial investment is expected from net operating income, and an annual surplus to the City as a lease payment is probable.

OPERATIONS: THE MARKET GARDEN

Organic, permaculture cultivation of a hectare of land requires approximately 1,500 hours of non-mechanized labor, including soil tilling, seeding, mulching, weeding, harvesting and food

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preparation for market, plus 200,000 liters of water for irrigation. This water is equivalent to the annual rainfall onto just 200 square metres (2200 sf) of adjacent roof, if captured in rain barrels. Whether irrigation water is captured from rain or provided at no cost from city mains, expenses are limited to the expected contracting out of 1,200 professional gardening hours over the six month growing season, supplemented by 300 community volunteer hours at the key stages of bed preparation and crop harvesting. Adding equipment expenses, the total variable bare operating costs would be approximately \$40,000 per hectare per year.

On the revenue side, organic food production covering the wide range of edible plants necessary in a permaculture rotation has been shown to have a retail market value ranging from \$25,000 to \$50,000 per hectare in the BC Lower Mainland. This wide range is due both to unpredictable crop loss and volatile retail prices, and it demonstrates the very tight margins under which organic farms in BC currently operate. Given the economics of small-scale organic farming, depending on annual operating income for full cost recovery is unreliable at best.

OPERATIONS: DISTRICT ENERGY UTILITY

In contrast with rural farming however, the presence of heated and cooled buildings immediately adjacent provides a significant additional revenue opportunity: geothermal district energy. This is the second *harvest* of the **Twin Harvest** project. The large flat open spaces required for farming are ideal locations for installing ground-loop geothermal heat transfer systems. Pictured to the left is just such an installation under an open field in North Vancouver.



Compared with deep-bore geothermal installations--typically the only option under urban lots--two-metre-deep horizontal trenching is significantly more efficient at providing added value to adjacent space heating and cooling needs; it would thus be a ready source of additional stable income for the combined project. Furthermore, there are substantial benefits to farm productivity from heat transfer out of buildings into the subsurface soil during summer. Geothermal district energy thus becomes a truly symbiotic, enabling technology for organic farming in an urban context, marrying zero-carbon indoor climate control with a zero-mile diet.

Assuming a system coefficient of performance (COP) equal to 2.8 or greater for the heating season and an Energy Efficiency Ratio (EER) of 13 or better in the summer, a hectare field with 30 tonnes of geothermal heat transfer media could reasonably be expected to offset 45 million BTUs of energy use in nearby buildings. At a current blended average cost per thousand BTUs of home heating and cooling fuel in Vancouver (natural gas and electric power) of \$1.75, the benefit of this energy savings would have a market value of some \$80,000 per year. The cost of maintaining this supply,

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including equipment depreciation and maintenance, would be under \$10,000 per year, thus netting as much as \$70,000 in annual operating income to the project.

FINANCIAL MODEL

After an initial capital outlay of \$300,000, gross income of \$30,000 from farm production and \$80,000 from geothermal offsets sold locally, total variable operating costs of \$50,000, and management/overhead expenses kept below \$25,000 annually, a one-hectare **Twin Harvest** project would run a \$35,000 annual operating surplus. In addition, the sale of carbon credits generated by this carbon-positive venture could net an additional \$20,000 annually, making the project fully break even in six years, and providing an internal rate of return of 18% over 20 years.

Given this financial model--conservative by most estimates--a **Twin Harvest** project could expect to raise all initial capital funding in the green venture market, or even from a local bank. The project would certainly also be eligible for federal, provincial, and private sector grants, all of which would further reduce operational risks and improve the project's sustainable return.

An important additional economic consideration for the City is the benefit of the retention of capital, consumer spending, and employment in the local community, all while providing carbon-positive healthy food and district energy at competitive prices. In a tight public budgets environment, this analysis shows that a sustainable, market return could leverage private funding to create any number of **Twin Harvest** projects in the City of Vancouver, and potentially launch a global trend in both urban agriculture and renewable district energy.

THE MANAGEMENT TEAM

For the initial pilot proposal, Diane Lafontaine, the creator of this concept also referred to as a **Broccoli Garden** or **Broccoli Promenade**, is working in partnership with Kitsilano Neighbourhood House, one of Vancouver's oldest and most community-engaged non-profit societies. Once the project is under way, the project would establish a non-profit society for management purposes, with a diverse board including local residents, food security activists, urban gardeners, local farming professionals, venture funders or lenders, and City staff.

THE SITE

A pilot **Twin Harvest** is a crucial first step. While the City Real Estate Services is currently considering all available sites, one highly suitable lot of just exactly one hectare and now under Parks Board governance, is located in Kitsilano Point on the east side of the 1200-block of Chestnut Street. Flanked by the Music Centre of Vanier Park immediately to its east, the Museum of Vancouver to the north, moderate-density homes to its west, and high-density apartments to the south, this site is a flat grass field with a small treed knoll. Without significant views and adjacent to a dozen hectares of parkland on the shoreline, this field sees little pedestrian or other recreational use. Yet this site is central to a great density of urban consumers who could access such a market garden by foot or bike. The small knoll of trees at the north end of this lawn provides an ideal location for the community to gather on market days, or at any other time to behold and study modern organic farming and renewable energy production right in their own back yard.