

Appendix C

Green Power Sourcing Strategy

(Based on the report completed by The Delphi Group)

Background

The City has set a target to source 25% of its electricity needs from renewable sources over a five (5) year period. Based on the City's current electricity consumption of approximately 2,000,000 megawatt-hours (MWh), the renewable or green electricity component would be about 500,000 MWh.

The City has been investing in green and renewable projects including deep lake water cooling, solar PV and geothermal. These initiatives have contributed about 3,700 MWh to date and will increased to 7,400 MWh by year 2013. The City has also committed to purchase 20,000 MWh of green power for City Hall. These initiatives have contributed to about 27,400 MWh which is about 5% of the total target.

Approach to Renewables

While developing the strategy it became clear that the approach had to extend beyond a simple purchasing option because of the significant green electricity cost premiums and this would not be financially sustainable in the long term.

A three part approach was undertaken by Delphi:

1. Assess the City's renewable electricity sourcing options
2. Review programs designed to provide incentives to the establishment of new renewable generation assets
3. Evaluate the City's options to influence the development of new generation assets

Delphi then evaluated four sourcing options: a) Green electricity purchase, b) Commercial joint ventures, c) City joint ventures (Toronto Hydro Energy Services) and d) Community power.

Green Electricity Purchase: This is the simplest option, however, very costly in the long term. This option includes Power Purchase Agreements (PPA's) from existing green power providers. There are a number of commercial green electricity purchase offerings in the Ontario market. The green electricity is primarily generated from low-impact hydroelectric and wind generation and the standard for this product is managed by the Canadian Environmental Choice Program including the Ecologo certification. The cost for this electricity can range from \$0.02/kWh to \$0.11 depending on the source. The cost of electricity from the most recently developed wind projects ranges from \$0.09/kWh to \$0.11/kWh. As mentioned above the availability of green power through this option is limited.

Commercial Joint Ventures: This option could include collaborative projects where the City would sign long-term PPAs. The developer would develop and operate the commercial-scale projects. One scenario in this option would be that the City provides all the debt financing for a project in return for a lower price for the electricity over a 20 year PPA. The City would not have an equity stake in this option and the City involvement would likely end before the end of life of the project. There may also be some legal issues with the City getting into this type of financing arrangement that would need further study.

City Joint Ventures: This option envisions the City directly or through a development partner such as Toronto Hydro Energy Services Inc. (TH Energy) developing projects with direct City investment, financial incentives and entering into a long term PPA which would reduce the cost of green power to the City. The cost of green power under this scenario would essentially be based on the cost of the project. TH Energy is the energy management subsidiary of the Toronto Hydro Corporation. TH Energy has identified and is assessing 7 renewable generation options. These projects in themselves could meet about 90% of the City's green electricity requirements.

Asbridges Bay T.P., Biogas:	8 MW
Green Lane, Biogas:	8 MW
Highland Creek T.P., Biogas:	1 MW
Dufferin Green Bin, Biogas:	2 MW
Disco Road Green Bin, Biogas:	2 MW
Zoo/Beare Rd, Wind:	10 MW
Offshore wind:	100 MW

The offshore wind project may take longer to build than the 5 year time frame of achieving the 25% green power target. Furthermore, as per Delphi study, the investment cost is not known and would potentially be higher than an onshore wind farm project. An alternative option would be to develop and build a wind farm onshore in partnership with TH Energy.

There are financial advantages with this type of capital joint venture. The expected life-span of wind turbines is estimated to be at least 25 years. The City, therefore, would continue to benefit from the additional generation beyond the 20 year investment. The City also has an equity stake in the asset and could potentially realize the value by selling it at the end of the project. Since the City owns the asset, the City would also own all the environmental greenhouse gas credits and which potentially could be traded, sold or retired.

Community Power: This option would involve the City providing PPAs to community groups or cooperatives generating power. Examples of this include photovoltaic installations on residential buildings (homes) or a commercial sized wind turbine (e.g. wind turbine at Exhibition Place).

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While community based power would likely have a higher upfront cost than other projects, there are social, environmental and other intangible benefits associated with distributed renewable community power.

In order for the City to take advantage of these projects the City could consider establishing its own feed in tariffs or compensate generators based on the electricity delivered to the grid. The overall cost for this option would be higher than the joint venture options.

The current feed-in tariffs (RESOP) are not high enough to stimulate community projects.

Diversified Sourcing Strategy.

In order to achieve the significant amount of 500,000 MWh of green power by 2013, an aggressive multiyear strategy framework should be considered as outlined in Table 1.

Table 1 - Green Power in Megawatt-Hour (MWh)

Year	Retail Green Power	Biosgas	Solar	Wind	Total
1	20,000				20,000
2	20,000				20,000
3	20,000	168,000	3,000		191,000
4		168,000	6,000	320,000	494,000
5		168,000	12,000	320,000	500,000
Year 5 %Total		33.6%	2.4%	64.0%	100.0%

The City would be required to sign 20 year Power Purchase Agreements (PPAs) in order to secure the green power as outlined above. The long term commitment is defined to a certain extent by the Ontario Power Authority's (OPA) Renewable Electricity Standard Offer Program (RESOP). The contracts under this program are guaranteed for a 20 year period which makes it viable for generators to finance their projects. The City, therefore, would essentially have to compete with OPA's program for similar terms and price.

Over a 24 year period, the City would invest approximately \$598 million into four (4) different renewable energy sources. The long term investment for each type of green electricity is shown in the following Table 2.

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Table 2 - Investment Over 20 Years

Year	Retail Green Power	Biogas	Solar	Wind	Total
1	\$600,000			\$21,520,000	\$22,120,000
2	\$600,000			\$21,520,000	\$22,120,000
3	\$600,000	\$11,676,000	\$1,648,500	\$21,520,000	\$35,444,500
4		\$11,676,000	\$3,697,000	\$21,520,000	\$36,893,000
5		\$11,676,000	\$7,394,000	\$21,520,000	\$40,590,000
6		\$11,676,000	\$7,394,000	\$21,520,000	\$40,590,000
7		\$11,676,000	\$7,394,000	\$21,520,000	\$40,590,000
8		\$11,676,000	\$7,394,000	\$21,520,000	\$40,590,000
9		\$11,676,000	\$7,394,000	\$21,520,000	\$40,590,000
10		\$11,676,000	\$7,394,000	\$21,520,000	\$40,590,000
11		\$11,676,000	\$7,394,000		\$19,070,000
12		\$11,676,000	\$7,394,000		\$19,070,000
13		\$11,676,000	\$7,394,000		\$19,070,000
14		\$11,676,000	\$7,394,000		\$19,070,000
15		\$11,676,000	\$7,394,000		\$19,070,000
16		\$11,676,000	\$7,394,000		\$19,070,000
17		\$11,676,000	\$7,394,000		\$19,070,000
18		\$11,676,000	\$7,394,000		\$19,070,000
19		\$11,676,000	\$7,394,000		\$19,070,000
20		\$11,676,000	\$7,394,000		\$19,070,000
21		\$11,676,000	\$7,394,000		\$19,070,000
22		\$11,676,000	\$7,394,000		\$19,070,000
23			\$5,745,500		\$5,745,500
24			\$3,697,000		\$3,697,000
25					
Total	\$1,800,000	\$233,520,000	\$147,880,000	\$215,200,000	\$598,400,000

1. Retail Green Power

The City purchases green power from retailers who own or invest in green energy production and development. The purchase would spur the investment of further renewable energy generation. Under this contract, the City would be purchasing 20,000 MWh per year for a 3 year period for a total premium cost of \$1.8 million. By year 4 and 5, the City would have developed enough green power requirements from other sources and would not need to enter into further retail purchase contracts.

2. Biogas

Landfill Methane Gas: The Green Lane landfill site has a potential generating capacity of about 4 MW and is assumed to grow to 8 to 10 MW over the life of the site. This capacity would generate about 32,000 MWh per year. Toronto Hydro Energy Services Inc. (TH Energy) has been in discussion with Solid Waste Management Division to develop a co-generation plant at the site. The electricity generated from the methane gas would feed directly into the grid. To obtain this green

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power, the City would have to sign a long term (20 years) PPA with TH Energy and the estimated premium cost would be approximately \$89 million.

Digester Gas: The City has a number of biogas generation sites that have potential for electricity generation. The Waste Water Treatment Plants (Ashbridges Bay and Highland Creek) have a combined capacity of 9 MW and potentially can generate about 72,000 MWh per year. The proposed digester plants at Dufferin and Disco Road have a combined capacity of 4 MW and potentially can generate about 32,000 MWh per year. The combined output from these 4 sites would be about 104,000 MWh, and the cost of a 20 year PPA to pay for the green power premium would be approximately \$144 million. TH Energy is preparing feasibility studies for these sites.

In the table above the power purchase arrangements would start in year 3 since these projects are likely to take about 3 years to develop before any power is available for purchase.

3. Solar

Solar photovoltaic generation is by far the most expensive investment per MWh output.

Commercial Solar: The City would invest in and/or partner with commercial developers to install solar panels on land or buildings that would generate about 3,000 MWh starting from year 3 and ramp up to 10,000 MWh by year 5. The City would be required to sign a 20 year PPA and the estimated total premium cost would be approximately \$110 million.

Community Solar: Similar to the Commercial Solar, the City would invest with community partners to install solar panels on residential homes, community facilities or other public buildings. This cooperative approach would generate about 1,000 MWh starting from year 4 and increase to 2,000 MWh by year 5. The premium cost is estimated to be about \$38 million and the City would be required to sign a 20 year PPA for this power.

The City's current Solar Neighbourhood program is geared to solar thermal application such as hot water use. This program could be expanded to include solar photovoltaic.

4. Wind

City Joint Venture: The City would invest directly or through TH Energy in the development of a wind farm that would generate approximately 320,000 MWh. The wind turbine project would cost approximately \$215 million over a 10 year period. The project would take about 3-4 years to build and the investment would start in the first year. Under this arrangement the City would own the wind farm and would take full responsibility of the turbines as owners. The advantage of this option is that the

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wind farm will continue to generate electricity after 20 years and at that point would be very inexpensive.

The strategy shown above requires large capital and long term commitments to build green electricity assets. The City's investment in these projects will further demonstrate the City's commitment and leadership in green and renewable energy. The investment to purchase approximately 500,000 MWh of green and renewable electricity would reduce the City's carbon footprint by about 123,000 tonnes of CO₂.