



EXHIBITION PLACE

November 14, 2000

To: The Board of Governors of Exhibition Place

From: Joe Pantalone, Chair

Subject: **The Waterfront Windmill Project**

Recommendation:

It is recommended that the Board of Governors agree to pursue the Waterfront Windmill Project at Exhibition Place and request staff to work with the project team to investigate this possibility and report back to the Board.

Background:

In an effort to showcase a rapidly-growing form of emissions-free electrical generation that can help address urban smog and global climate change, I have been approached by Joyce McLean, Manager/Toronto Energy Services, and Ed Hale, Executive Director/Toronto Renewable Energy Co-op to build a windmill at Exhibition Place

Discussion:

A copy of the above-noted project is attached. I would recommend that staff meet with Ms. McLean and Mr. Hale and report to the Board to formally present this project.

Conclusion:

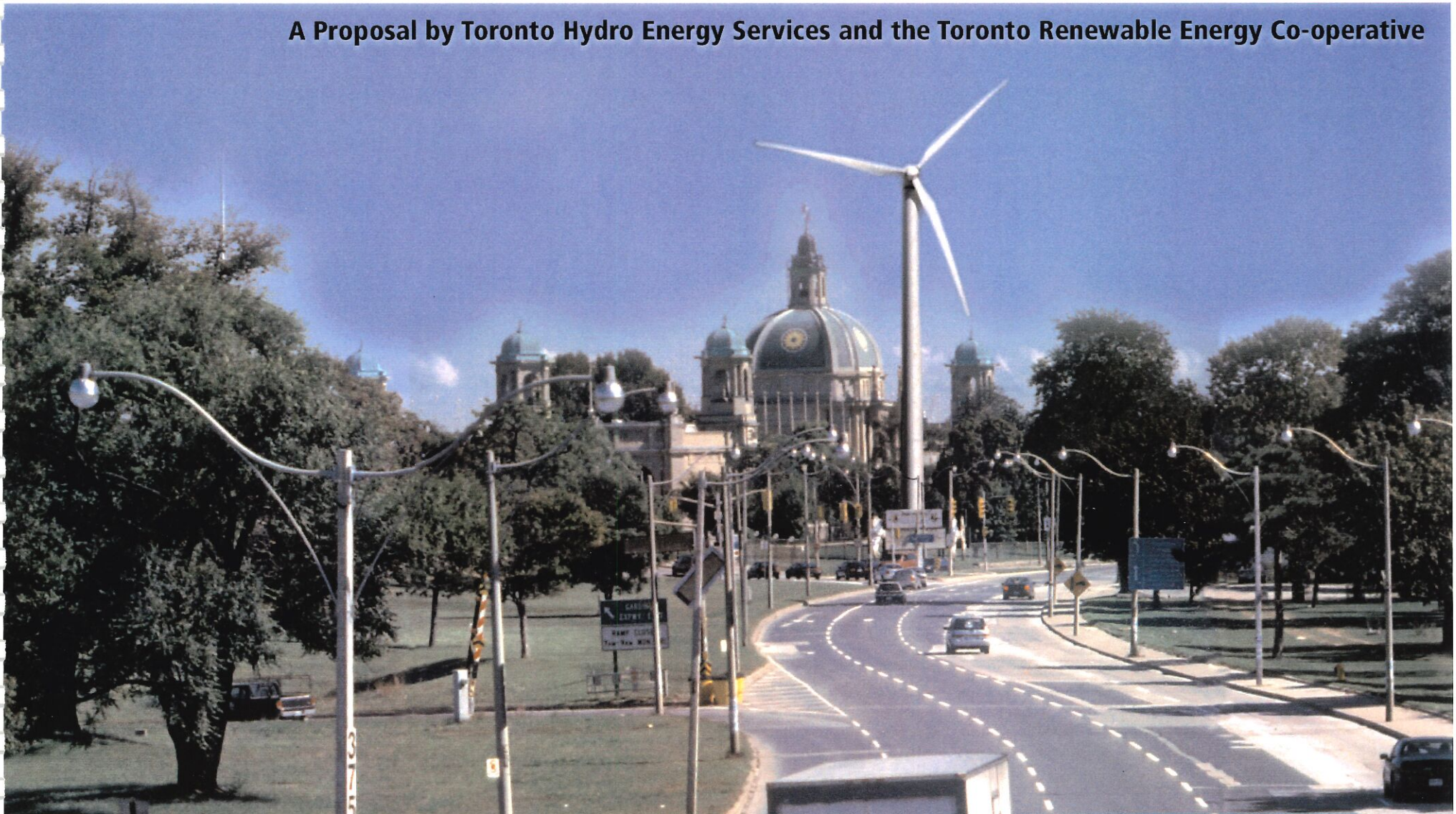
As Chair, I would like to demonstrate the Board's efforts and consciousness in energy conservation and pollution reduction through various activities such as is proposed in this report and I recommend that the Board approve that the Waterfront Windmill Project at Exhibition Place be pursued.


Joe Pantalone, Chair

atts.

The Waterfront Windmill Project at Exhibition Place

A Proposal by Toronto Hydro Energy Services and the Toronto Renewable Energy Co-operative



Summary

Toronto Hydro Energy Services and the Toronto Renewable Energy Co-operative (TREC) are proposing to build a windmill at Exhibition Place.

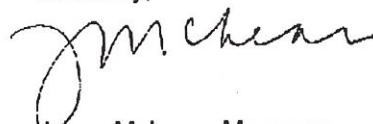
The turbine is part of a joint venture to install up to three windmills on the Toronto waterfront. It is part of an effort to showcase this rapidly-growing form of emissions-free electrical generation that can help address urban smog and global climate change.

A turbine at Exhibition Place would generate enough energy for the equivalent of approximately 250 four-person households without the harmful emissions associated with coal power plants such as Lakeview Generating Station in Mississauga. A "Mill at the Ex" would complement the wind turbine that City Council has approved for the Ashbridges Bay Treatment Plant at Leslie and Unwin.

This proposal provides an overview of both the overall Waterfront Windmill Project and the specific proposal to site one turbine at Exhibition Place, including the tremendous benefits this 21st century icon could bring to the Ex, with its long tradition of showcasing important technological advances.

We at Toronto Hydro Energy Services and TREC look forward to discussions with the staff and Board of Governors of Exhibition Place.

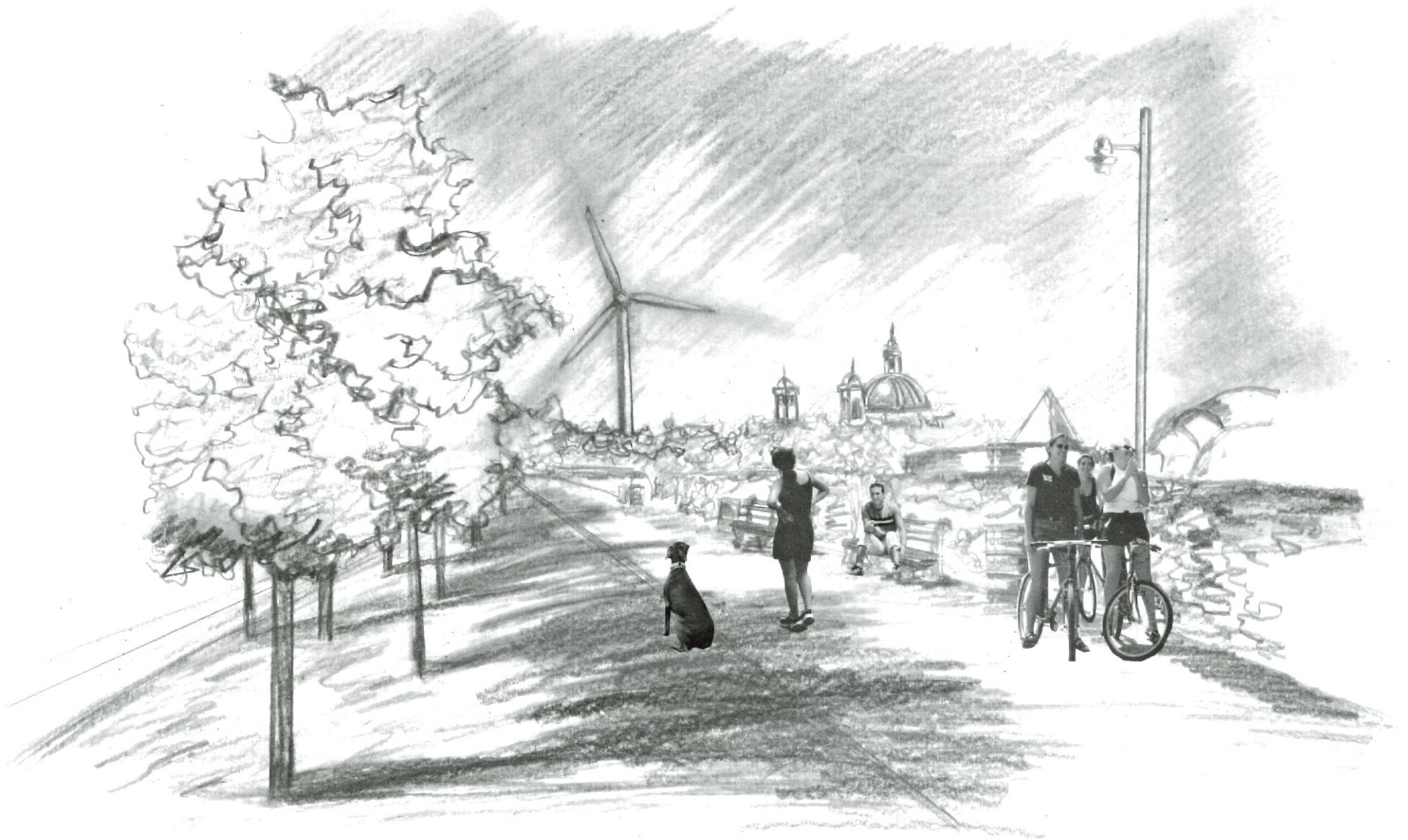
Sincerely,



Joyce McLean, Manager
Green Energy
Toronto Hydro Energy Services



Ed Hale
Executive Director
Toronto Renewable Energy Co-op



An artist's conception of how the turbine could appear from the promenade heading west from the Better Living Centre

Project Overview

A Community-Corporate Partnership

The proponents announced a joint venture to construct up to three utility-scale wind turbines on the Toronto Waterfront in June 1999. TREC and Toronto Hydro Energy Services are equal partners in this innovative community-utility partnership, and each will own half of the project and its resulting 'greenpower' once the project is complete.

The mandated deregulation of the electricity sector is providing new opportunities for the generation of electricity from pollution-free sources such as wind and solar power. This also means that for the first time in Ontario, consumers will be offered a choice as to their supplier.

Half of the electricity generated will be sold to Toronto Hydro Energy Services subscribers as a green power product. The estimated 1000 members of the Toronto Renewable Energy Co-operative will own the other half of the electricity. This is the first community-based greenpower co-op in the country, drawing from a highly successful Danish model. Members of TREC will receive a credit for their share of the energy produced by the project in an arrangement called 'net metering.'

City of Toronto's Role

The City has been a strong supporter of the Waterfront Windmill Project, first through the Toronto Atmospheric Fund, and then through positive decisions taken by the City's Works Committee and by City Council. Additionally, Works and Emergency Services Air Pollution Control staff has been helpful in facilitating discussions with the various City agencies for over a year. The rationale for the City's support for this project has been two-fold, with commitments to:

- reduce the City's CO₂ emissions by 20% by 2005 as part of Canada's Kyoto commitment on greenhouse gases;
- purchase green energy and facilitate the development of renewable energy and energy efficiency measures.

The City's initiatives on smog and climate change has positioned Toronto as a leader among world cities. This is happening at a time when attention is being focused on making our waterfront an important factor in the City's economic development, while enhancing the environment.

Current Scope and Status of Project

Toronto City Council gave approval for our first turbine site at the Ashbridges Bay Treatment Plant (ABTP) in August 2000. Construction of this first turbine at the ABTP is slated to begin in Spring 2001. A request for proposals for the wind turbine

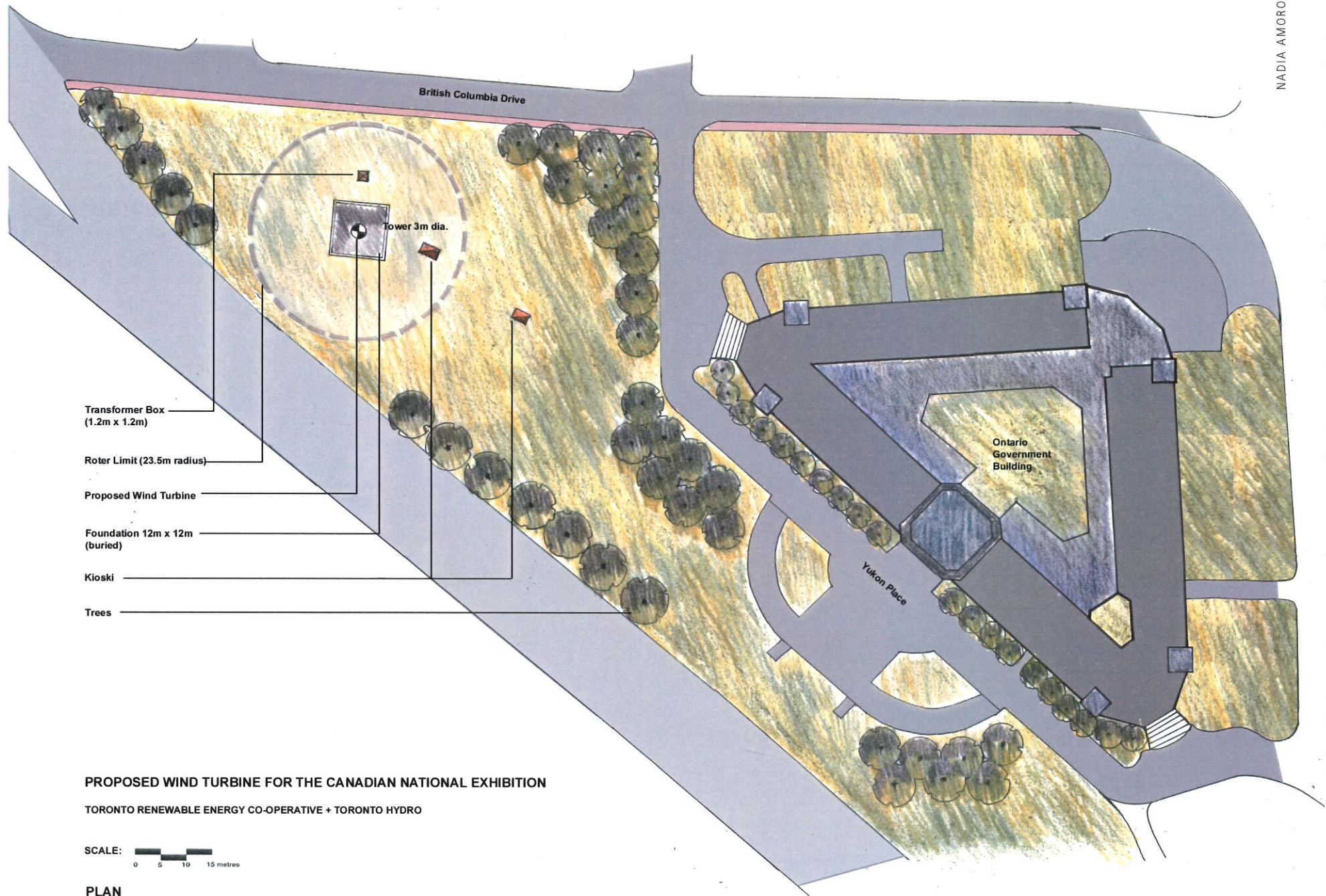


Turbines as they would appear at the ABTP and TEDCO locations
at Leslie and Unwin Streets, looking north from the Leslie Street Spit

equipment has been released and it is expected that we will select a supplier in November 2000. Leasing discussions with the City and the Toronto Port Authority are proceeding well and a final agreement is expected by December 2000.

TREC and Toronto Hydro Energy Services are planning for an additional turbine on a portion of land owned by the Toronto Economic Development Corporation (TEDCO). This property abuts the ABTP, and sits on Leslie Street at Unwin. Discussions with TEDCO and local stakeholders are ongoing.

With a Federal commitment to fund the TREC side of the project, a Federal EA was triggered. A final positive decision on the existing candidate sites is expected in the Fall of 2000.



A Wind Turbine at the Western Gates

Exhibition Place as an Optimal Site

Our key siting criteria for the siting of a turbine include:

- Strong wind resource
- Public visibility
- Public accessibility

The Ex meets and, in fact, exceeds criteria thresholds in each case. The Ex is a Toronto icon, and a turbine would be visible to millions of visitors and passers-by annually. The site defines accessibility, and affords a prime opportunity for interpretive programs related to renewable energy, climate change and smog. The wind resource at locations with a clear fetch to the lakeshore is among the best in the Toronto region. The Ex grounds certainly meet this criteria and would offer clear unfettered access to waterfront winds.

A “Mill at the Ex”: Continuing the Ex’s Tradition for Innovation

From electric lighting to the telephone and the x-ray, the Ex has endeavoured to showcase new technologies that later became the stuff of everyday life. It was the first Fair Grounds to light electrically at night and the second electric railway in the world. And we hope that the “Mill at the Ex” will be seen as a prime opportunity to continue this tradition of showcasing innovation, with its strong potential to serve as a significant landmark for the Grounds, just as the Bulova Tower once did.

A Defining Feature for the Western Gate

A turfed section of the Ex Grounds near the Western Gate is an excellent location for the installation of a wind turbine. This triangular section of land has very good exposure to lakeshore winds with plenty of open space. A turbine at this location would also provide a notable focal point at the Western Gate for automobile and train traffic eastbound, and for pedestrian traffic whose views from the promenade leading to the Ontario Government Building or from British Columbia Drive would be excellent.

Because of its high visibility, a key benefit of a turbine at the Western Gate would be its ability to help define the Western Gate. With its prominence on the skyline and its accessibility of the public, the “Mill at the Ex” would, like other turbines in high profile settings, be a strong draw to the Ex. Visitors would be able to walk around its perimeter and up to the turbine, and interact with interpretive kiosks, which are often install at wind turbine installations because of the deep curiosity expressed by the public about this emissions-free form of electrical generation.

From initial proponent assessments, there are adequate nearby interconnection points and no known conflicts with the Toronto City Centre Airport, or with existing services such as sewer, water, or gas lines, making the site an excellent choice from a technical perspective.

Pollution from
Ontario Power Generation's
Controversial Lakeview Generating Station



Project Rationale

Community Roots

TREC, a community-based business initiative, was launched in 1997 out of a desire to demonstrate citizen concern about smog and climate change induced in part by coal-fired power and the inherent dangers of nuclear power.

Corporate Commitment

THESI, a wholly owned corporation of the City of Toronto, has a mandate to help the City reduce the CO₂ emissions. Because of the opportunities afforded by the provincial Electricity Sector Deregulation process, THESI has chosen to make its first generation project emissions-free.

Solutions to Smog

This Waterfront Windmill Project partnership will create a profile for windpower never before seen on this continent. These will be the first urban-based turbines in North America, joining progressive cities such as Copenhagen in their commitments. This project will be seen by millions a year, and will be testimony to what our City and its citizens are committed to doing to meet the smog and climate change challenge.

The Costs of Smog

And this is no small challenge. The Board of Health has raised the alarm about the true impacts of smog on our City with a recent report stating that in Toronto alone 1,000 people die prematurely, and another 5,500 are hospitalized annually as a result of smog-induced ailments. An even more recent Ontario Medical Association has tallied up \$2.4 billion in economic damages to the Toronto economy as a result of smog. A full 40% of smog is a result of electrical generation.

Windmills and People:
Café Life on the Copenhagen Waterfront with Part of the
Co-op/Utility Mittelgrunden Project in the Background.
The project will consist of 20 turbines of 2MW each.



Project History and Timeline

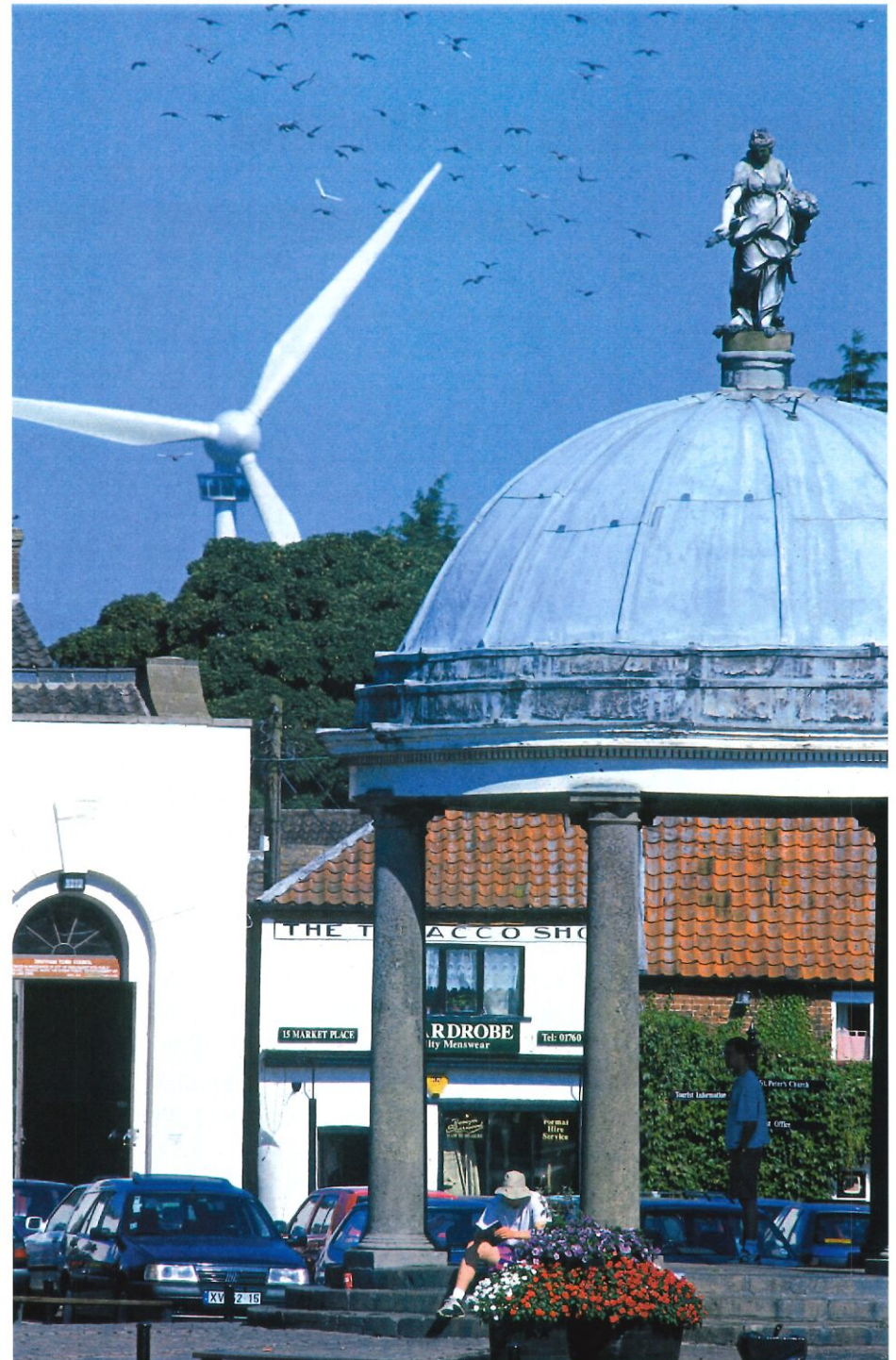
| Date | Milestone |
|-------------|--|
| 06/99 | TREC/Toronto Hydro Energy Services Joint Venture announced |
| 06/99-09/00 | Federal Provincial Environmental Assessment & Public Process |
| 06/99 | Siting Process for Ashbridges Bay Treatment Plant (ABTP) begins |
| 10/99 | City Council approves up to 3 turbines on City-owned land |
| 07/00 | Unanimous Works Committee approval of ABTP site |
| 08/00 | Council Approval of ABTP Site |
| 10/00 | Proponents release RFP for turbine on ABTP site |
| 11/00 | Provincial and Federal EA decisions on ABTP and TEDCO sites expected |
| 11/00 | Supplier selection of ABTP turbine expected |
| 12/00 | Lease agreement with TPA expected completion |
| 01-04/00 | Foundation engineering and site prep |
| 04/00 | ABTP Foundation construction |
| 05/00 | ABTP Turbine delivery, commissioning and launch |

Our first site is located at the Ashbridges Bay Treatment Plant in the eastern half of a recently decommissioned and filled ash lagoon. Construction of the pile foundation will commence in the spring, with delivery of the turbine from the US or Europe expected at that time. After the foundation is set, erection by crane of the turbine, tower, and rotor, along with grid connection will take less than a week.

Site Scoping Process

The scoping process for this project began in 1997 with the collation of existing wind data for the waterfront, and the examination of several waterfront sites. Site selection criteria were derived through examination of the proponents' needs and stakeholder requirements and/or preferences. One example of a stakeholder requirement included airport height restrictions that govern the Toronto City Centre Airport. Several of our early preferred sites, such as Gibraltar Point on Toronto Island, though popular with residents, was ruled out because of airport height restrictions at this location.

Windmills as Attractions in the Old Norfolk Town of Swaffham, England. Note the confluence of heritage architecture with the modern wind turbine. The Enercon wind turbine pictured was specially constructed with an observation deck.



Siting Wind Turbines on an Urban Waterfront

Few cities are blessed with both an attractive urban waterfront and an excellent wind resource. Siting wind turbines in an urban context can, however, be a challenge for a number of reasons. First, urban environments are often congested and wind turbines need a significant amount of open space to best convert kinetic energy from the wind into electricity. Second, urban environments are often characterized as 'rough' in meteorological terms because the variations in heights of buildings typical in cities make for winds that cannot convert as readily into electricity. Smooth wind environments are found in open settings or along coastlines, where prevailing offshore winds come off the water unobstructed by 'surface roughness' or barriers.

Toronto's Waterfront Winds

According to reports completed by Zephyr North, meteorological analysis consultants, the wind resource of the Toronto region is dominated by the relatively energetic winds from the southwest. These winds quickly lose their energy as they penetrate inland. As a consequence, the best sites for wind energy generation will be found at or close to shorelines with good exposure to the southwest and, ideally, good exposure over low-roughness fetches in as many directions as possible. Strictly based on the wind resource alone, and not on other factors such as airport height restrictions, examples of sites which meet these criteria are very close to the Toronto waterfront such as the Leslie Street Spit, Toronto Island, the Ashbridges Bay Treatment Plant and nearshore locations at Exhibition Place.

Wind Monitoring and Assessment

We have collected 18 months of site-specific data from Ashbridges Bay and the Etobicoke waterfront, and over 2 decades of data from the Toronto City Centre Airport and from Leslie Street Spit. Projections from this data tell us that we can expect on average about 1,400,000 kilowatt-hours per year from each 660 kilowatt rated turbine that we install on the Toronto Waterfront. That is enough energy for up to 250 homes, and displaces over 1,000,000 kg of CO₂ every year that would otherwise be coming from coal-fired power plants like Mississauga's Lakeview Generating Station. That is equivalent to 700 roundtrips by minivan from Toronto to Miami.

Environmental Assessment Screening Process

TREC and Toronto Hydro Energy Services have completed a combined Federal/Provincial Environmental Assessment Screening process for the existing candidate sites to ensure that the public was offered opportunities to express their concerns about the project. The process involved a dozen publicized public meetings and documentation related to any concerns raised by the public. In an initial decision already released by the Federal Government, it has been stated that the project will not result in any significant negative environmental effects. A final response is expected from both levels of government by the end of October.

Ontario's only wind turbine: A 600-kilowatt wind turbine
at the Bruce Nuclear Power Plant.
Quebec alone has Over 130 such wind turbines.



Proposed Wind Turbine Technology

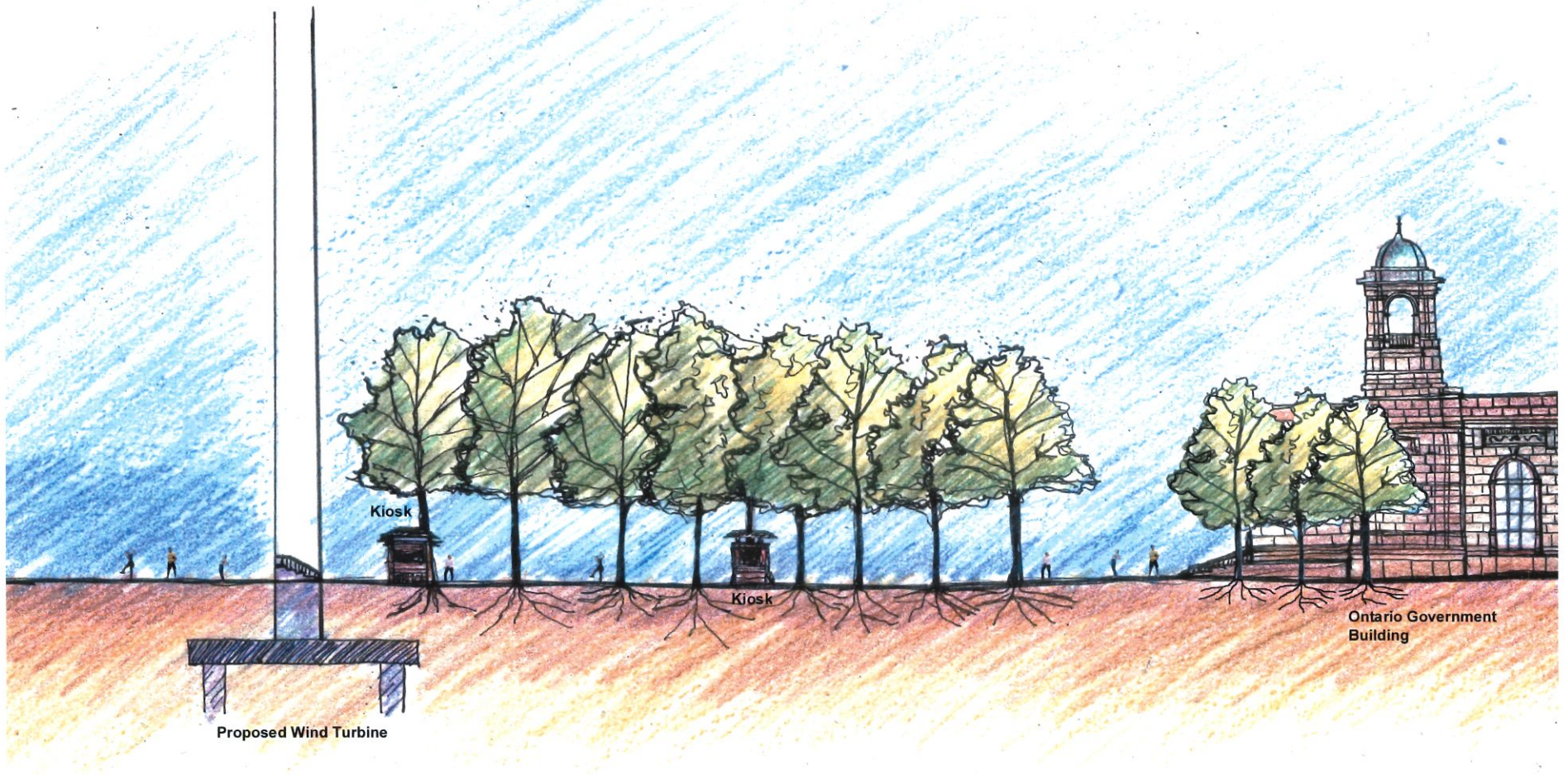
Wind turbines constitute the fastest growing form of energy generation in the world today. In fact, wind technology represents 15% of Denmark's GNP, and supplies 13% of the country's electrical needs. Last year, installed capacity worldwide grew by an astonishing 61%, with Denmark, Germany, the US and several other countries leading the way.

Canada has an excellent but under-used wind resource, with only approximately 140 MW installed capacity, only 0.6 MW of which is in Ontario. Each 660-kilowatt wind turbine can generate enough electricity in our environment for approximately 250 homes. Larger turbines of 1 MW or more would generate incrementally more energy.

Typical modern wind turbines are efficient and have 3 blades mounted on a hollow tubular steel tower. All wires and services to the tower are usually located underground, and a small transformer approximately 1m³ is located close to the turbine at ground.

| Summary Specifications | |
|--------------------------|-----------------------------|
| Tower Height | 60-80m |
| Tower Diameter | 4m |
| Total Height | 80-100m |
| Rotor Diameter | 47-60m |
| Foundation Size | 12m ² , concrete |
| Rated Capacity | 660-1100kW |
| Rotation | Up to ~28rpm |
| Lighting | Top white strobe |
| Anticipated Service Life | 20-25 years |

Each 660-1000kW turbine costs approximately \$1.2-\$2.5 million and is entirely financed by the proponents at no cost to the host.



PROPOSED WIND TURBINE FOR THE CANADIAN NATIONAL EXHIBITION

TORONTO RENEWABLE ENERGY CO-OPERATIVE + TORONTO HYDRO

SCALE: 0 5 10 15 metres

ELEVATION

Pre-Construction Logistics

Visual Assessment

This stage involves visual site assessment for potential impacts of buildings, topography and other geographical features, which could impair turbine performance.

Meteorological Assessment

It is at this stage that local wind data is collected to ascertain expected turbine performance. Sufficient data on most Toronto Waterfront locations has been gathered and analyzed. It demonstrates a very satisfactory wind regime for turbine operation.

Potential Airport Impact

An Aeronautical Clearance Form must also be filed with NavCan and Transport Canada where there are potential implications on aerodromes or approach instrumentation. Transport Canada has provided a preliminary indication that an 88.5 metre turbine would meet guidelines at this location.

Provincial and Municipal Approvals

As was true in the case of the ABTP turbine, an environmental assessment screening process and land use change would likely be required.

Lease

A lease with Exhibition Place for a portion of the lands that the turbine would occupy would be necessary before proceeding to the next step.

Geotechnical Assessment

Site-specific borehole information is gathered for the purposes of ascertaining foundation design. In the case of fill land, a pile foundation is generally used.

Interconnection

Toronto Hydro Electrical System Limited is informed of the proposed project and advises the proponent on the nearest feasible interconnection point.

Request for Proposals

The proponents are undertaking a request for proposals process for each of the three turbines. The successful supplier of the equipment will be take responsibility for the project on a turnkey basis. Because of overseas delivery and high international demand, orders must be placed 6 months before the planned commissioning.

Supplier Selection

Once the RFP competition has closed, the proponents will select the supplier based on a weighted set of criteria including safety, performance, output and price. Once a down payment on the generator has been placed, the supplier becomes a turnkey developer of the project on behalf of the proponents.

Foundation Engineering

The supplier contracts out the design of a turbine foundation, executed in consultation with the firm responsible for the geotechnical evaluation.

Site Preparation

These activities will include preparing a point of access to the site (i.e. temporary road), preparation of the site (e.g. placement of temporary snow fencing if applicable), and the mobilization of construction equipment.

A Vestas 1.5 MW turbine under construction.
The "nacelle," or generator is being lifted by crane
to the top of the turbine.



Construction Logistics

By limiting construction activities to normal working hours, construction noise impacts can be significantly reduced. The construction period would be no more than 2-3 weeks, broken down as following:

| Construction Schedule Summary | |
|-------------------------------------|----------|
| Excavation | 1 day |
| Foundation construction | 1 day |
| Foundation setting | ≥7 days |
| Turbine construction | 2 days |
| Transformer installation | 5 days |
| Turbine connection to grid | 1-2 days |
| Site remediation and demobilization | 2 days |

Foundation Construction

Depending on the type of base to be constructed, some degree of excavation will be needed. Foundation holes will be excavated using a backhoe. Excavation will likely be completed in less than one day. Alternatively, piles may be driven depending on the geotechnical conditions. A concrete pad will be anchored on the piles. The foundation will then be left for at least a week to cure.

Delivery and Final Construction

The wind turbine, including tower, will be brought on site by the supplier in sections on flatbed trucks. A large crane will lift and bolt tower sections into place. The nacelle, which contains the gearbox, generator and yawing mechanism, will then be placed onto the top of the tower. The next step will be to assemble or partially assemble the rotor (i.e. the blades of the turbine) on the ground. It will then be lifted to the nacelle and bolted in place. A small crane will likely be needed for the assembly of the rotor while a large crane will be needed to put it in place. It will take approximately 2 days to erect the turbine.

Transformer Installation

A transformer, that will be approximately 1m³, will be sited at the base of the tower. This transformer will have approximately a 30-year life span. An underground cable will connect the transformer to the closest Toronto Hydro interconnect point.

Connect Turbine to Power Grid

The trench for the power cables will be dug using heavy equipment. The trench will be 1.5 metres below the surface to carry the bus duct and associated power cables. The power cables will then be placed in the trench and the trench filled. The power cables will be installed at the turbine and connected with the grid. It is expected that the conduit would be placed in existing road allowance to the extent possible. This activity will take approximately 1 to 2 days.

Conduct Commissioning

Prior to the start up of the wind turbine, a series of checks and tests will be carried out. This will include both static and dynamic tests to make sure the turbine is working within appropriate limits. Grid interconnection and unit synchronization will be undertaken to confirm the turbine and unit performance. Physical adjustments may be needed such as changing the pitch of the blades. The schedule for this activity will be subject to site and weather conditions.

Demobilization and Site Grooming

All construction equipment and temporary fencing are removed. The concrete pad supporting the turbine is backfilled and landscaped in consultation with the landowner. Shrubs, other vegetation and an interpretive kiosk are some of the many possibilities.

Launch Event

There is a prime opportunity for media exposure for the proposed windmill project and the Ex at a launch event after the turbine is commissioned. Room for the required parking, and tents in the event of rain or hot sunshine would be a problem for a heavily-visited site such as the Ex.

Operational Impacts on the CNE

Ongoing Operation

The wind turbine will be operational except under extreme weather conditions or during maintenance. Under normal operating conditions (typically >98%), public access to the site would be encouraged. Interpretive displays or kiosks could provide a powerful educational focal point for school groups and the public visiting throughout the year.

Maintenance

The wind turbine will be subject to periodic maintenance and inspection. Any waste products such as lubricating oil will be disposed of in accordance with municipal and provincial waste management regulations. Existing roads adjacent to the site will provide sufficient access for service vehicles.

Noise

The first question many ask about wind turbines is about noise. Today's wind turbines are, in fact, quite quiet, though like any machine, they do produce some noise. In an attempt to formulate policy related to noise and wind turbines the City developed noise setbacks guidelines for wind turbines, which have since been approved by City Council.

| City of Toronto Noise Setback Guideline for Wind Turbines | | Distance from Proposed Turbine to Actual |
|---|------|--|
| Residential | 250m | 280m |
| Hi-rise residential | 300m | 363m |
| Sensitive natural areas | 50m | - |

A turbine located at Exhibition Place would more than fulfil the City's new guideline. In the case of the site at the Ashbridges Bay Treatment Plant, City staff worked closely with the proponents on potential noise impacts and have said that the ambient noise levels at the Ex are at least as high as those in the industrially-zoned Plant owing to the proximity of the Gardiner, the railway and Lakeshore Boulevard.

The following chart outlines typical comparative noise levels associated with a selection of sources. Note the place of wind turbines in the ordered list.



A simulation of how a wind turbine could appear as viewed from the Lakeshore Boulevard pedestrian bridge near Jameson.

| Category | Typical Sound Pressure Level (dBA) |
|--|------------------------------------|
| Freight train 40-48 kph (25-30 mph) @ 30m (100 ft) | 90 |
| Heavy highway traffic @ 30m (100 ft) | 80 |
| Conversational speech @ 0.9m (3 ft) | 62 |
| Urban residential | 58-62 |
| Quiet suburban residential | 48-52 |
| Standard modern wind turbine at 200m | 45 |
| Interior of average residence | 45 |
| Whispering | 20 |

Avian Impact

As is the case with all buildings, there is the potential for bird colliding with the planned turbines, TREC and Toronto Hydro Energy Services retained a renowned and respected ornithologist, Dr. Ross James to study the issue. In the resulting study Dr. James, former head curator of ornithology from the ROM found that the impact of each turbine on birds would be insignificant, a position that has been sanctioned by the Canadian Wildlife Service.

Rental Revenue

Though the turbine has a very small footprint, there would be a small revenue stream for Exhibition Place for the long-term lease of the lands. Typically, lease amounts for land occupied by turbines are often based on a percentage of gross turbine output, converted to dollars.

An Added Attraction

The main benefit of a Windmill at the Ex would be its prominence and visibility to all vehicular and pedestrian traffic, reminiscent of the old Bulova Tower, and could provide a new focal point at the Ex for Torontonians.