There is no Free Lunch
(Except for Wind Farms Owners)

By
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Our Liberal MPP recently scolded us for our unwillingness to save the world from Climate Change. There were over 300 of us at a public Forum held on proposed and in-process Industrial Wind Turbine projects in the Algoma region of Ontario.

We were told we must save the world from Climate Change, which is said to be created by the release of Green House Gases (GHG). GHG refers to a number of compounds, which when released into the atmosphere trap heat and, over time, result in an increase in the global mean atmospheric temperature. These gases include, in descending order of effect, water vapour, methane, Carbon Monoxide and CO2 or Carbon Dioxide. These Green House Gas emissions are measured collectively as tons of CO2e, CO2 equivalents, emitted by our vehicles, homes, factories and power generating stations.

The thrust of this MPP's argument was that by not accepting the destruction of our property values, health, tourist industry jobs, communities, natural heritage and environmentally important flora and fauna, we were selfishly standing in the way of our Provincial Government's noble struggle to save the planet. We were merely NIMBYs who couldn't see the big picture. The biggest culprit, the most nefarious threat to Ontario, were the emissions from our coal-fired electricity generating stations. They not only emit greater amounts of CO2 but also emit particulates which cause 1,900 deaths and 9,800 hospital admissions in Ontario every year! He reproached us for endangering lives by not supporting Industrial Wind Power and by opposing the strengthening of our electric grid which Industrial Wind Turbines would bring about.

Well, such reasoned and impassioned arguments must be accorded the attention they deserve. The problem was, of course, that there was no independent scientific research, facts or data presented to support any of these assertions.

Which got me thinking, will Industrial Wind Generation reduce the overall CO2 emissions from Ontario's power generating stations? Will Industrial Wind Turbines strengthen the Ontario electrical grid? Will we save thousands of lives each year by replacing our coal-fired generating stations with Industrial Wind Generating Stations? What will the renewable energy from Industrial Wind Turbines bring Ontario residents and Ontario companies other than energy poverty? Am I a really a NIMBY?

So let us consider some of these questions.

Will eliminating our coal-fired generating stations save thousands of lives each year? Actually the question is misleading. We don't know that particulate emissions from Ontario coal-fired generating stations do in fact cause any deaths in the Province. In fact air pollution in Ontario has been decreasing for decades, as witnessed by the Province's Air Monitoring Stations. The deaths attributed to Ontario's coal-fired generating stations by the Ontario Medical Association are based on statistical models designed to produce the desired result and not on any real evidence:

"People are continually told that air pollution levels are rising and pose a health risk. But the reality is our air pollution levels have fallen to very low levels by historical standards. The consulting reports that government agencies have used to claim thousands of people die or get sick from air pollution use statistical models with cherry-picked coefficients that yield reliably high morbidity and mortality rates from our current low air contaminant levels. The simplest way to show they can't be correct is to

feed in pollution levels from the 70s and 60s, and watch as they start predicting more deaths from air pollution than there were deaths from all causes."
R. McKitrick: http://www.bishop-hill.net/blog/2010/11/1/mckitrick-on-coal-and-wind.html#comments

Furthermore, modern analytical techniques suggest that there is no significant connection between air pollution and human mortality. In 2004 Koop and Tole published one of the first Bayesian model averaging studies of Toronto air pollution and human mortality. They found that while superficial data analysis can be made to "prove" that air pollution causes human mortality, a more thorough analysis shows this is unlikely to be true[1,2]

Moreover closing our coal-fired generating stations would have a minimal impact on Ontario's air quality:

"Analysis of smog and weather data strongly indicates that the U.S. Mid-West and Ohio Valley Region of the U.S. Continue to be significant contributors to elevated O3 and PM2.5 concentrations in southern Ontario during the smog season."
Ontario Provincial Air Quality Report 2007

There is no evidence that modern coal-fired power plants influence human mortality let alone that Ontario's coal-fired generating plants cause thousands of deaths per year and should be closed to protect the public. Replacing Ontario's coal generation with wind generation would have absolutely no effect on public health whatsoever. Furthermore, if, for the sake of argument, coal generation did harm human health through the emission of particulates or nitrogen and sulphur oxides would the correct solution not be to mandate the installation of existing high efficiency pollution controls rather than implement an inefficient technology that does impact human and animal well-being.

Furthermore, the Gas-fired Generating Stations which are required to back up Industrial Wind Power produce much finer particles than Coal-fired Generating Stations do. Finer particles have been shown to harm human health. So inasmuch as human health is concerned we are replacing one type of air pollution with another which is more harmful.

How will Industrial Wind Power impact the Ontario electrical grid's stability? Apparently quite negatively, based on the European experience. The intermittency and variability of wind power makes it extremely difficult to predict and manage the power output from Industrial Wind Generating Stations. Either wind generation cannot meet the demand or it's output exceeds demand and the electricity produced must be dumped, often sold extremely cheaply or given away to neighbouring countries. Due to the inability of Wind Power to meet base load energy demands, that need is met by conventional generating systems and the energy derived from Wind is exported. This pattern is repeated in all the countries that have a large installed base of Wind Power. The Danish case is typical. Nineteen percent of Danish electrical generating capacity is represented by Industrial Wind Power. Denmark could never justify this high a percentage of Industrial Wind Power without strong interconnections to the hydropower based Nordic system and to the European mainland. Output from the country's Industrial Wind Generating Stations can vary from zero to 3100 mW swinging back and forth in only a few hours. As a result the Danes have to export 30% of their annual power production to the European mainland and import 30% of their annual power consumption from the Nordic electrical system. The rest of their balancing comes from domestic coal-fired power plants. Furthermore 70% of all imbalances in the power system are the result of Industrial Wind Power[3.]

1 McKitrick, Ross R. (2004). "Air Pollution, Health and Mortality: Separating Fact from Fiction." Presentation to the Association of Major Power Consumers of Ontario, Toronto, April 2004.

2 Koop, G.M. and Tole, L.A. An investigation of thresholds in air pollution–mortality effects. Environmental Modeling and Software, 21 (12). pp. 1662-1673. ISSN 1364-8152

3 Maj Dang Trong, Energinet.dk: "Wind power - Danish wind industry may need a new balancing act." in Modern Power System, Friday, September 25 2009

And Liik points out that:

"The Danish power system has much higher total capacity with increasing share of new natural gas power plants, which enables to absorb larger amount of windmills, but the main answer is the use of Norwegian and Swedish hydro plants for the compensation of fluctuations and also strong transmission links with German power system. We analyzed the Danish wind energy data [7] and found strong correlation between the wind electricity production and export of electricity (see Figure 2). It is easy to conclude that the major part of wind-generated electricity has been exported."
O. Liik ⁎ , R. Oidram, M. Keel: "Estimation of real emissions reduction caused by wind generators"; International Energy Workshop 24-26 June 2003, IIASA, Laxenburg, Austria.

This is already apparent in Ontario where there there is a direct correlation between Ontario's Wind Power Generation and exports of power to the US:

"We have already seen in coal and natural gas that there is no change in the profile of them to compensate for or lack of wind. Including the other sources of power (Hydro and "Other"), checking each one against wind, there is no correlation with wind output. So that leaves only one place for wind to be going. It is all exported all to the US, or other power is supplied in kind. In either case it simply contributes to the total energy available for export."
Wakefield, J.R., et al (2010), Ontario Wind Performance. http://ontariowindperformance.wordpress.com/

As a matter of fact, the only use our IESO finds for Wind Power is to export it. In other words Ontario rate payers and taxpayers are paying Wind Power Generation Companies $80 to $140 per mWh for power which is then sold for much less, or given away:

"The data is clear, the $800 million paid for wind power by Ontario consumers all went to the US. It was either given away in the form of Zero Cost Power, Low Cost Power, or we paid US customers to take it off our hands when the surplus was too great. Yes, there are times when there is so much surplus power that we actually pay US customers to take the power! How does it feel that our Green Energy Act is helping our US neighbours reduce their carbon emissions, supply them with cheap or free power so they can save on coal?"
Wakefield, J.R., et al (2010), Ontario Wind Performance. http://ontariowindperformance.wordpress.com/

Either that or we pay these companies to not produce power when the wind is blowing:

"For the wind turbine power plants under the Feed-In-Tariff program (but not those under the earlier Renewable Energy Standard Offer Program) the IESO is offering financial incentives to the wind operators to shutdown their plants during times of SBG." (Surplus Baseload Generation)
Donald Jones, P.Eng.: "IESO – Will Ontario's wind turbine power plants reduce greenhouse gas emissions?"; BULLETIN, the journal of the Canadian Nuclear Society, September 2010.

So Wind Power will bring us a grid that is difficult to control, with all those attendant problems, and energy which can only be sold in the export market at a deep discount to it's cost. What then happens as the U.S. also rushes headlong into Wind Power Generation in its North Eastern States? The Danes already see this problem developing and recognize that they will soon be unable to rely on international markets to provide them with balancing power or absorb their excess, Wind generated, power[4]

Denmark will have a much harder time dumping its excess wind power to its neighbours and it will also have a harder time buying power to supply its own needs when the wind isn't blowing. So will Ontario, once it has a larger percentage of its generating capacity coming from Industrial Wind Generating Stations. Ontario won't be able to give its power away. When the wind isn't blowing Ontario will either have to buy power, at a premium, from the U.S. or build new thermal or nuclear generating plants to supply base load requirements. Furthermore Industrial Wind Farms are being built in locations remote from the cities where the power is used. Our existing transmission grid is inadequate to

4 Maj Dang Trong, Energinet.dk: "Wind power - Danish wind industry may need a new balancing act." in Modern Power System, Friday, September 25 2009

the demands that will be placed on it. We will need to build huge new transmission corridors through wilderness areas in order to move the power generated from wind farms in the north down to the southern cities and the U.S. These transmission corridors must be designed to carry the full energy output of these wind farms, despite the fact that their median capacity factor is only 14%.

So we are going to pay a very large premium for energy generated from wind and then we are going to pay for very expensive infrastructure to move this power around - energy which we can't use and will have to pay our southern neighbours to take off our hands. We don't need this power, we already have a surplus in the Province, so why are we doing this again?

Oh, that's right, to reduce CO2 emissions to that we can save the planet!

So let us consider the CO2 balance sheet of Industrial Wind Turbines (IWT) and Industrial Wind Generating Station. It is not that I think the carbon footprint of an IWT more important than social justice, human health or environmental protection, but these are goals the current Liberal Government in Ontario is obviously prepared to sacrifice in order to afford the CO2 reductions Industrial Wind Turbines are supposed to bring us. Therefore, inasmuch as CO2 reduction is the justification, we must investigate the truth of the claim.

There are already many reputable, peer reviewed, papers out there which suggest that Industrial Wind Turbines will only marginally reduce CO2 emissions, if at all. Liik states that:

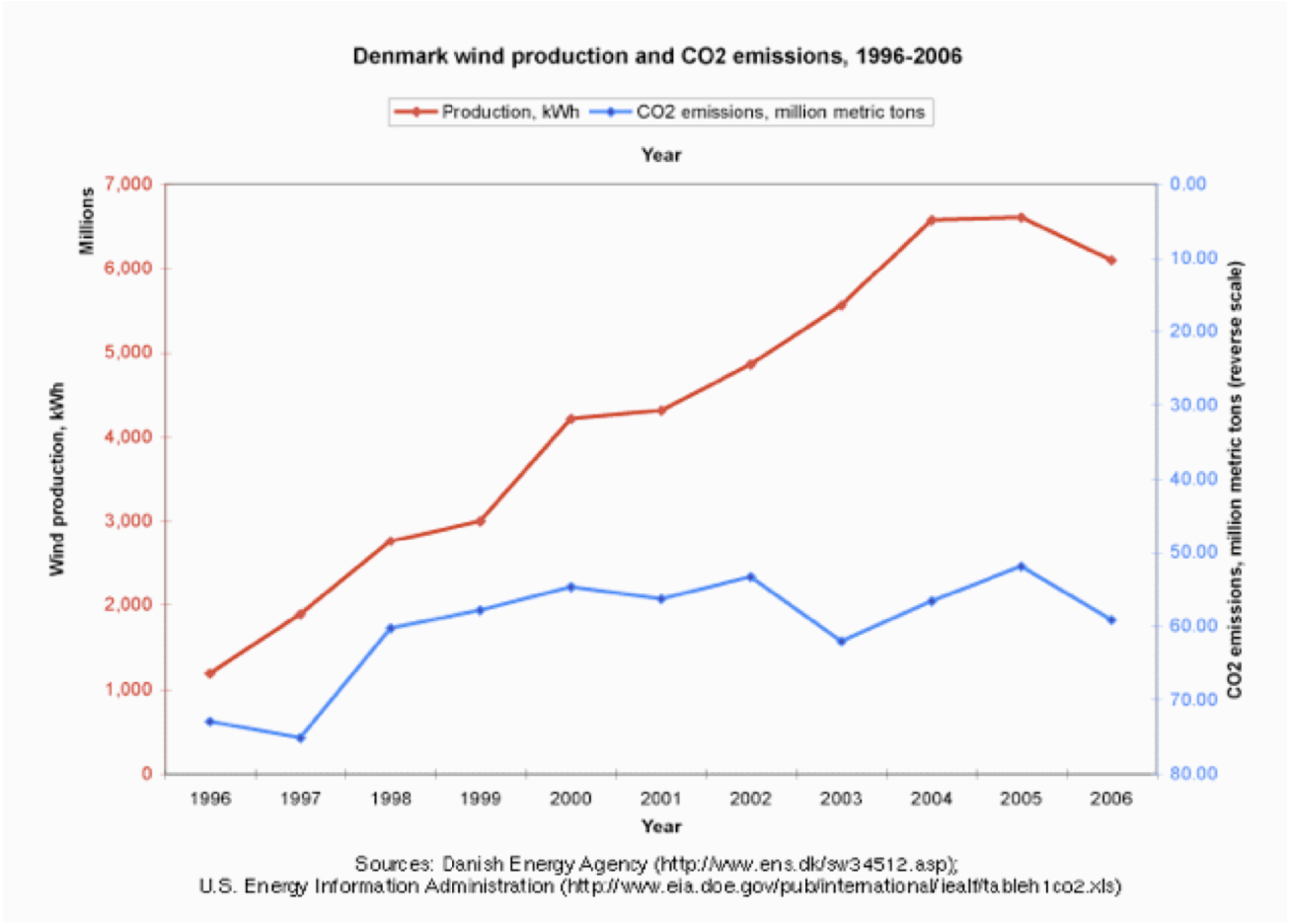
"Estonian case study shows that the integration of considerable capacity of wind turbines would increase the fuel consumption and emissions of thermal stations about 8-10%, which will reduce the environmental effect of windmills substantially. There can be situations where probably no environmental gain can be achieved at all."
O. Liik * , R. Oidram, M. Keel: "Estimation of real emissions reduction caused by wind generators"; International Energy Workshop 24-26 June 2003, IIASA, Laxenburg, Austria.

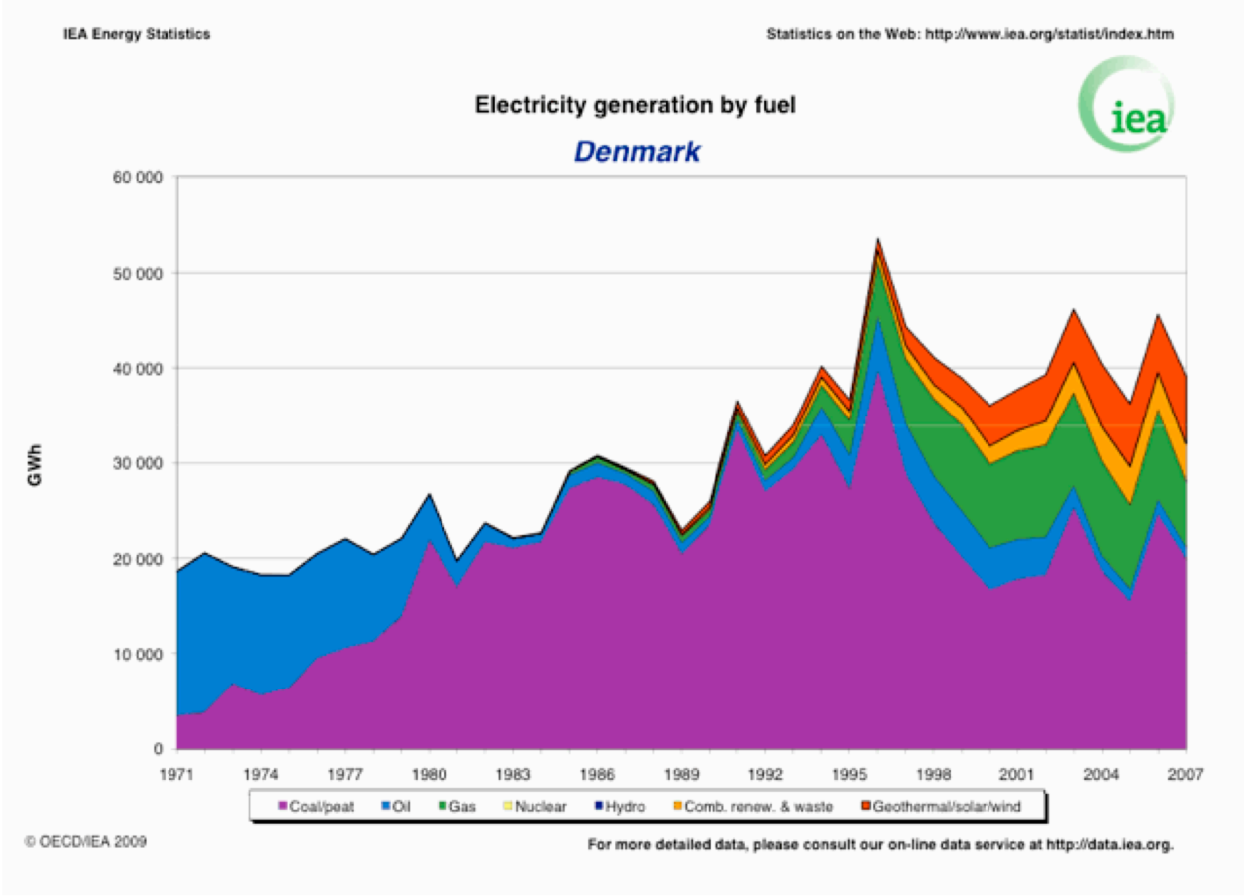
Furthermore Jones points out that:

"A sudden drop in wind would bring on the peaker simple cycle gas turbines, and hydro if available, until the combined cycle gas turbines on standby can power up enough to respond to dispatches. [...] For gas to provide the same dispatchable power as coal, with both operating at their respective minimum loading points, several times as much gas generation would have to be on line meaning very much more GHG emissions."
Donald Jones, P.Eng.: "IESO – Will Ontario's wind turbine power plants reduce greenhouse gas emissions?"; BULLETIN, the journal of the Canadian Nuclear Society, September 2010.

Furthermore Denmark, the poster child of the Industrial Wind Industry, hasn't significantly reduced its CO2 emissions with Industrial Wind Power nor has it closed any of its coal-fired power plants. As a matter of fact in 2008 the European Environment Agency reported that between 1990 and 2006 Denmark's overall CO2e emissions increased by 2.1 percent. The Danish Center for Political Studies, CEPOS, stated that “exported wind power, paid for by Danish householders, brings material benefits in the form of cheap electricity and delayed investment in new generation equipment for consumers in Sweden and Norway but nothing for Danish consumers” yet Danish coal consumption was exactly the same in 2007 as it was in 1999 and nearly the same as in 1981. Despite huge subsidies for Industrial Wind, and years of hype about how “green” Danish energy policies are, the Danes now have the world's most expensive electricity and in 2007 their CO2 emissions were almost the same as they were in 1987[5]. The following graphs reveal this plainly.

5 Robert Bryce: Power Hungry: The Myths of “Green” Energy and the Real Fuels of the Future, PublicAffairs, Perseus Books Group, 2010, eISBN 978-1-586-48853-6


Denmark wind production and CO2 emissions, 1996-2006
Production, kWh
CO2 emissions, million metric tons
Year
Millions
Wind production, kWh
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
0.00
10.00
20.00
30.00
40.00
50.00
60.00
70.00
80.00
CO2 emissions, million metric tons (reverse scale)
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
Year
Sources: Danish Energy Agency (http://www.ens.dk/sw34512.asp);
U.S. Energy Information Administration (http://www.eia.doe.gov/pub/international/iealf/tableh1co2.xls)


IEA Energy Statistics
Statistics on the Web: http://www.iea.org/statist/index.htm
Electricity generation by fuel
Denmark
iea
GWh
60 000
50 000
40 000
30 000
20 000
10 000
0
1971
1974
1977
1980
1983
1986
1989
1992
1995
1998
2001
2004
2007
Coal/peat
Oil
Gas
Nuclear
Hydro
Comb. renew. & waste
Geothermal/solar/wind
© OECD/IEA 2009
For more detailed data, please consult our on-line data service at http://data.iea.org.

Let's see if we can put some actual numbers to some of these claims and counterclaims. Perhaps numbers, actual data, can cut through all the spin.

First, what is the carbon footprint of an Industrial Wind Turbine? In other words how many tons of CO2 equivalent are generated or released by building, installing and operating an Industrial Wind Turbine? There are many different types, makes and sizes of Industrial Wind Turbine, so for the sake of simplicity and because the majority of the Industrial Wind Turbines proposed for the Algoma region of Ontario are 1.5mW turbines, that is the size I proposed using in my analysis.

Vestas and GE are the two largest manufacturers of Industrial Wind Turbines in the world and have supplied the majority of the IWTs installed worldwide. Vestas manufactures a 1.6mW unit and GE a 1.5mW unit. A cursory use of Google revealed that Vestas has completed a Life Cycle Analysis of a number of their wind turbines, including the 1.6mW unit. No LCA for the GE 1.5mW unit could be found.

The LCA, or Life Cycle Analysis, is important to us because, especially in the case of Vestas, it gives a very detailed list and description of a large percentage of the emissions, waste and CO2 equivalent released into the environment during the life cycle of one of their 1.6mW turbines. They list the weights of all the materials in their turbine and express the amount of CO2 released as a percentage of the per capita CO2 burden of the average EU citizen. This is not really a very useful number for our purposes and they make some assumptions which are perhaps unwarranted for turbines to be used in Ontario. One of the assumptions they make is that their turbine will operate at a capacity factor of 40%. In other words that it will produce, on average, 40% of the full 1.6mW nameplate capacity. This is an unwarranted assumption for turbines here in Ontario, which have only produced an average of 26% of their nameplate capacity each year since 2006[6]. I decided to use the empirical data for the turbines installed at the Prince Wind Farm near Sault Ste Marie, Ontario. The true capacity factor, in other words the actual percentage of the nameplate capacity these turbines produced since they became operational, from October 26, 2006 until October 26, 2010, is 26.5%. This number was calculated using the production statistics found on the IESO's (Ontario's Independent Electricity System Operator) website[7]. Another assumption I found problematic in their calculations was the end of life recycling of the turbines. The track record here in North America indicates that these turbines are simply abandoned by the operators when they reach the end of their productive life and not recycled. In any case, a sensitivity analysis shows that while recycling does have an impact on the final CO2 footprint of IWTs it is not sufficient to change the end result.

The CO2 footprint of the turbines was calculated using Vesta's weights for the turbine components and their energy inputs for the fabrication, transport, erection, operation and maintenance of the turbine. CO2 equivalents for all of these items were then applied and totaled in order to arrive at the turbine's CO2 equivalent footprint. The CO2 factors used were taken from relevant sources such as AISC (American Iron and Steel Institute), the Portland Cement Association etc...

To the CO2 equivalent footprint for the turbine was added the CO2 equivalent created by the deforestation required for the roads, transmission corridors and erection site required by the turbine, prorated based on a 182 turbine wind farm. Eighty kilometers of new transmission corridor were allocated to this theoretical wind farm because all of the projects proposed in the region between Montreal River Harbour and Batchawanna will require new transmission capacity, except perhaps Bow Lake. In any case, all this new development, as we discussed above, will require huge new high tension corridors to get the energy tom the south, as the map herewith shows and which haven't been accounted for in these calculations.

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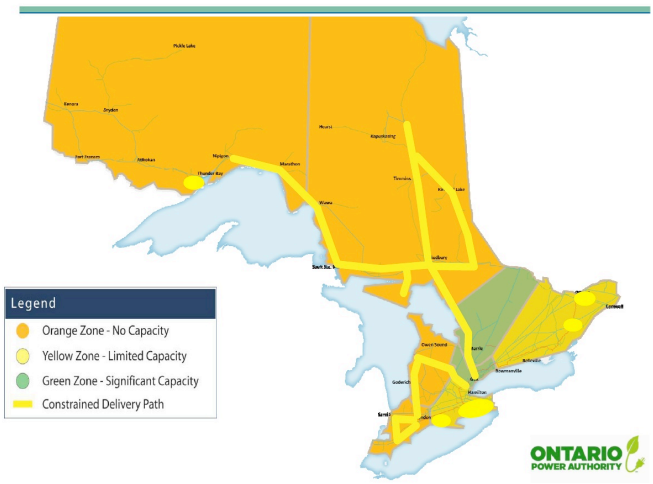
6 Wakefield, J.R., et al (2010), Ontario Wind Performance.
http://ontariowindperformance.wordpress.com/
7 ESO: http://www.ieso.ca/imoweb/market/mi_index.asp



To the IWT CO2e footprint augmented by the deforestation CO2e was added the CO2 equivalent emissions from the required back up natural gas generating stations. There is no dispute or disagreement regarding the necessity for back up generating capacity to support the grid when the wind isn't blowing. There is debate as to what percentage of the Industrial Wind Power Installation's nameplate capacity should be provided as back up by conventional generating sources. Some people advocate 80%, some, other amounts. I chose 30%, a number that is only slightly higher than the actual capacity factor of wind power in Ontario over the past 4 years. I don't believe 30% is actually enough, but there is no consensus as to what the correct number should be and there was no need to set the backup capacity too high.

The sum of the CO2e created by the IWT, plus the CO2e from deforestation required for the Wind Farm and transmission corridor, plus the CO2e from back up natural gas generation equals the carbon footprint of the IWT.

From the carbon footprint of the IWT we need to subtract the amount of CO2e a coal-fired power generating station would have emitted producing the same amount of energy as the wind turbine will during it's 20 year life span. This power is the nameplate capacity of the IWT times the actual capacity factor, in this case 26.2%, less an estimate of the power consumed by the IWT to run. IWTs require power to magnetize their stator, power their lubricating oil cooling and circulating systems, power for heaters and fans required to maintain manufacturer specified internal ambient conditions, power for the yaw mechanism required to keep the blades facing into the wind at all times. Power is consumed for pitch control required to adjust the angle of the blades with respect to the wind, power for lights, controllers, communication, sensors, metering, data collection and heating the blades, which some estimate may require 10%-20% of the turbine's rated power. Finally power is consumed using the generator as a motor helping the blades start to turn when the wind speed is low. It seems possible that the grid-magnetized stator must work to help keep the 40-ton blade assembly spinning, along with the gears that increase the blade rpm some 50 times for the generator, not just at cut-in, but at least some of the way up towards the full rated wind speed; it may also be spinning the blades and rotor shaft to prevent warping when there is no wind. All these power requirements undoubtedly add up to a percentage of the turbine's nameplate capacity, however it is impossible to know what this is. GE and the other manufacturers of IWTs don't publish this data and there are no electricity meters measuring how much power IWTs consume as they operate. Some people claim that at times the power consumed equals the power produced, others maintain that the energy consumed by IWTs could be anywhere between 20% and 50% of the IWT's nameplate capacity. I chose to use 10% of nameplate capacity for the turbine's power consumption. We know it consumes power and 10% seems like a reasonable amount of power, in the interests of fairness, and failing disclosure by the manufacturers.

The results of all these calculations are summarized in the table at the end of this document which shows that we will actually ***increase*** CO2 equivalent emissions by at least 13% or 320 tons per year per turbine using wind power to replace coal-fired power generation. This is mostly due to the life cycle CO2 equivalent emissions of the gas-fired power generating stations required to back up Wind Power. Ideally hydro or nuclear power should be used to back up wind power, as they have very low CO2 footprints. However our hydro and nuclear generators are currently supplying base load energy to the grid and we have no ability to bring new hydro or nuclear power generation facilities online for a number of years. Coal represents approximately 6.6% of Ontario's generating capacity. If we replace coal with wind we will need to build new gas-fired generating capacity equal to at least 30% of actual Wind Power generation as back up to the Wind. This is self-evident: if we already had sufficient

spare capacity in the system to back up wind power and leave us with reserve capacity why not just shut down coal-fired generation and not build IWTs? That way we would eliminate the CO2 emissions from coal without incurring the additional expense of Industrial Wind Power Installations. For that matter, why build the Wind Power Installations at all? Why not just build the gas-fired power plants and save ourselves the cost, financial and environmental, of building the IWTs which will only add their CO2 cost to that of the new gas-fired power plants we will have to build anyway to back up Wind Power? Even better, build new Hydropower or Nuclear Generating Facilities, forget IWTs and really reduce our CO2 emissions.

There is another way of looking at it, let us suppose we in fact intend to replace all coal-fired generation with energy from wind farms: how many wind turbines and how much added gas-fired generating capacity would be required? Ontario produces approximately 152 Terra Watts hours of electricity per year. In 2009 coal represented 6.6% of that, which is 10,032,000 mega Watt hours of energy. We would need 4,337 Industrial Wind Turbines having a nameplate capacity of 1.5 mega Watts and an actual capacity of 2313 mWh/year. Their annual nameplate energy production would amount to 56,988,180 mega Watt hours of electricity per year. At 30% nameplate capacity (let's not even add in the minimum 10% inefficiency of the gas fired plants due to partial loads plus stopping and starting) we would require 17,096,454 mega Watt hours of back up energy per year. Based on IESO data the calculated median capacity factor of Wind Generation in Ontario is 14%. Therefore the actual back up power generated would be approximately 14,702,950 mega Watt hours per year and at 0.54Kg CO2 per kWh would generate 7,939,593 tons of CO2 per year. The Industrial Wind Turbines would eliminate 10,533,600 tons of CO2 that would have been produced by coal in that year. The total CO2 equivalent cost to produce the IWTs would have been 7,944,518 tons, not including any CO2 burden for deforestation or transmission corridors. Therefore the net amount of CO2 added to the atmosphere by using 4337 Industrial Wind Turbines would be (7,939,593 + 7,944,518) - 10,533,600 = 5,350,511 tons per year!

Have I exaggerated the amount of energy required from the back up gas-fired generators? Most likely I have understated the amount of back up generating power required. Cambridge Energy Research Associates asserted in a 2008 report that every megawatt of wind capacity needs to be matched up with a megawatt of dispatchable capacity[8]. However for the sake of argument, let us consider that Gas-fired power generators only operate 28% of the time. The CO2 cost of generating back up power only 28% of the time would be 2,589,082 tons per year. We would then neither increase nor reduce our overall CO2 emissions: (2,589,082 + 7,944,518) - 10,533,600 = 0. However we know from the IESO's data that 28.5% of the time since 2006, Ontario's Wind Farms hourly capacity factor is 4%, or less of their nameplate capacity. It seems highly unlikely therefor that our backup generators will only need to produce 28% of their rated energy. While they may not run 86% of the time they will definitely run more than 28% of the time and therefore we will increase our CO2 emissions by using Industrial Wind Turbines to produce electricity for Ontario's grid.

These 4337 turbines we would need to install would require anywhere from 60 to 300 acres of land per turbine depending on the terrain. For the sake of argument let us call it 180 acres per turbine. Our 4337 turbines would then occupy 780,700 acres or 3159 square kilometers of land. Typically Wind Generation companies fence off the land around their Wind Farms. Inasmuch as a lot of these turbines are being installed on Crown Land that would deprive the citizens of Ontario of access to vast tracks of land they are legally entitled to access. Furthermore one of the arguments Wind Power proponents advance for siting their turbines and asserting that they will perform globally far better than they actually do, is that the wind is always blowing somewhere in the Province. First of all, the IESO data shows that widely separated wind farms experience no wind at the same time and that moreover 75% of the time when one wind farm is becalmed another one elsewhere in the province will also be becalmed. Even if that were not true, are we going to install 3 to 5, or more, times the number of turbines required in order to assure ourselves of enough power. In other words, if we need 4337 Industrial Wind Turbines to replace coal are we going to install 4337 in each of 3 to 5, or more, widely separated areas of the Province in the hopes that somewhere the wind will be blowing hard enough to generate the electricity we need. How much sense does that make, installing 21,685 In-

8 Robert Bryce: Power Hungry: The Myths of “Green” Energy and the Real Fuels of the Future, PublicAffairs, Perseus Books Group, 2010, eISBN 978-1-586-48853-6

dustrial Wind Turbines around the Province, removing 15,795 square kilometers of land from public access and seriously impacting the environment and natural heritage of those lands while still being unsure that the energy they produce will meet our needs.

To sum up, Industrial Wind Power will **increase** our CO2 emissions. It will devastate great tracts of wilderness. It will seriously damage habitats, wetlands and the boreal forest. It will kill many thousands of birds and bats every year, many of which are endangered species that are supposed to be protected by the very laws our Provincial Government is flouting. It will require spending huge amounts of money building transmission corridors to carry the power to the south. The power produced by these Wind Farms will be exported, sold at a deep discount to the cost of production or given away. The Ontario taxpayer will shoulder the burden of this ill conceived energy plan through higher taxes and astronomical electricity bills as well as from the loss of industries which will flee the Province for places with a saner Energy policy and reasonable electricity rates.

Anyway you look at it, and the more you look at it, Industrial Wind Power Generation doesn't make sense. Oh, and I don't want Industrial Wind Turbines in anybody's back yard – if that makes me a NIMBY, I can live with that.

Total materials in 1 Turbine Life span = 20 Years	Tons	CO2 generated per ton	Total CO2 generated, Tons	
Based on 182 1.65MW Turbine Vesta Wind Farm				
Materials & CO2 emissions Total for 1 IWT	1,077.42		1,524.44	
CO2 generated by manufacturing, transport, installation, maintenance for 1 IWT			307	
Total CO2 emissions for 1 IWT			1,831.71	
IWT Nameplate capacity MWhr/year	14,016	mWh/Yr		
Actual gross power produced per year at 26.5% efficiency	3,714	mWh/Yr		
Power used to operate 1IWT at 10% of Nameplate Capacity	(1,401.6)	mWh/Yr		
Net Power Generated	2,313	mWh/Yr		
Gross CO2 avoided by IWT from Coal generation @1.05Kg/kWh	(2,428)	Tons per year	(48,565)	Tons over 20 Yrs
Mixed forests can absorb about four kg of C02 per m2 and per year				
Carbon emissions from deforestation over 20years	SQM	Tons CO2/Yr		
Tons CO2 from 2.5 Acres cleared for IWT in SQM	10,117	40.47		
Tons CO2 from SQM cleared for 46 Km road pro-rated to IWT (Prince project)	280,600	6.17		
Acres cleared for transmission lines, pro-rated to IWT 64m x 80Km in SQM	5,120,000	113		
Total CO2 generated by deforestation			3183.25	Tons over 20 Yrs
	30% nameplate capacity for 20 years in mWh +10%	Kg/kWh of CO2 from gas generation		
CO2 from added gas generation plants required to back up wind at 30% of nameplate capacity with 10% inefficiency added in	92,506	0.54	49,953	Tons over 20 Yrs
	Per Year			
Net Tons of coal generated CO2 (saved) or added by IWT	320		6,403	Tons over 20 Yrs

Bibliography

R. McKitrick: http://www.bishop-hill.net/blog/2010/11/1/mckitrick-on-coal-and-wind.html#comments

McKitrick, Ross R. (2004). "Air Pollution, Health and Mortality: Separating Fact from Fiction." Presentation to the Association of Major Power Consumers of Ontario, Toronto, April 2004.

Ontario Provincial Air Quality Report 2007

Maj Dang Trong, Energinet.dk: "Wind power - Danish wind industry may need a new balancing act." in Modern Power System, Friday, September 25 2009

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Wakefield, J.R., et al (2010), Ontario Wind Performance.
http://ontariowindperformance.wordpress.com/

Donald Jones, P.Eng.: "IESO – Will Ontario's wind turbine power plants reduce greenhouse gas emissions?"; BULLETIN, the journal of the Canadian Nuclear Society, September 2010.

Vestas: Life Cycle assessment of electricity produced from onshore sited wind power plants based on Vestas V82-1.65 MW turbines, December 12, 2006
www.vestas.com/Files/Filer/EN/Sustainability/LCA/LCA_V82-1.65_MW_onshore.pdf

IESO: http://www.ieso.ca/imoweb/market/mi_index.asp

Canadian Nuclear Association: Electricity Generation and Greenhouse Gas Emissions - Life Cycle Analysis of Base Load Electricity in Ontario (Nuclear, Coal & Natural Gas)
www.cnc.ca/english/pdf/studies/ceri/LCA-Summary.pdf

ESB National Grid: Impact of Wind Power Generation in Ireland on the Operation of Conventional Plant and the Economic Implications; February 2004, www.wind-watch.org/documents/wp-content/uploads/EirGrid=WindImpact-Main.pdf

FELLS: A Rebuttal for Seekers of the Truth of the British Wind Energy Association's Top Myths about Wind Energy; June 2008, www.wind-watch.org/documents/wp-content/uploads/fells-bwea_top_myths.pdf

Hannale Holttinen, VTT Processes: The Impact of Large Scale Wind Power Production on the Nordic Electricity System; December 17, 2004, www.wind-watch.org/documents/wp-content/uploads/Holttinen-NordicImpact.pdf

Eric Rosenbloom: A Problem with Wind Power; September 5, 2006, www.wind-watch.org/documents/wp-content/uploads/ProblemWithWind.pdf

Thomas Ackermann: Wind Power in Power Systems; John Wiley & Sons, Ltd., 2005, ISBN 0-470-85508-8

Robert Bryce: Power Hungry: The Myths of “Green” Energy and the Real Fuels of the Future, PublicAffairs, Perseus Books Group, 2010, eISBN 978-1-586-48853-6

Wind Concerns Ontario: www.windconcernsontario.wordpress.com/

The Society for Wind Vigilance: www.windvigilance.com/page002.aspx

Wind Watch: www.wind-watch.org/