Third North American Symposium on Assessing the Environmental Effects of Trade

Montreal / 30 November – 1 December 05

RESEARCH PAPER

Opportunities and Barriers for Renewable Energy in NAFTA

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Date: February 2006

Renewable Energy and International Law is in association with the Renewable Energy and Energy Efficiency Partnership, Baker and McKenzie's Global Clean Energy and Climate Change Practice and Yale's Center for Environmental Law and Policy, see http://www.reeep.org. Robert Howse is professor at the Faculty of Law, University of Michigan and Petrus van Bork is Principal at Outline Data.

Third North American Symposium
on Assessing the Environmental Effects of Trade

This research paper was prepared for the CEC Secretariat as part of its Third North American Symposium on Assessing the Environmental Effects of Trade (2005). The opinions, views or other information contained herein are those of the author(s) and do not necessarily reflect the views of the CEC or the governments of Canada, Mexico or the United States.

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Introduction

This paper provides an overview and perspective of both the renewable energy industry in North America and governmental measures in the NAFTA countries to support renewables. The paper goes on to examine the law of the North American Free Trade Agreement [NAFTA] and applicable GATT/WTO provisions with a view to considering whether NAFTA creates obstacles to governmental measures to support renewables but also whether there are opportunities under NAFTA to challenge regulatory barriers to the development of renewable energy markets. Where appropriate, this paper reproduces the analysis in REIL's recent submission to the US International Trade Commission (ITC) on non-tariff barriers and trade in renewable energy

Over the last two decades, trade and environment issues have typically been a source of intense controversy and conflict in both the world and regional trading systems, reflecting and intensifying cleavages between environmentalists and supporters of free trade, and between developed and developing countries. Renewable energy, however, represents an area where we believe that freer less-distorted trade and environmental protection have the potential to be mutually reinforcing.

Particularly within the United States and Canada, demonopolization and restructuring for competition in the electrical utilities sector has led to new opportunities for renewables and there is increasing interest in Mexico, which has very considerable renewable energy potential much of which might be suitable for export. The removal of barriers to trade in renewable energy equipment and technology promises to reduce the cost and increase the feasibility of meeting regional and global environmental obligations. It also helps to unlock the enormous potential of renewable energy in the difficult five percent of Mexico, where conventional power has not solved the problem of rural electrification. In addition, given the rapidly rising energy needs of the fastest growing developing countries, and hence, much enhanced competition for imported energy sources there is an urgent need for alternatives to fossil-fuel generation that are at once sustainable and reduce dependence on non-NAFTA zone energy sources – this is particularly germane for the US.

Finally, the eventual possibility of regional trading schemes in Renewable Energy Certificates would allow NAFTA countries with a comparative advantage in certain kinds of renewables generation — hydro-electric, geothermal-electric, wind or solar power, for instance — the opportunity to exploit that comparative advantage by providing users of energy elsewhere a means of satisfying obligations (or voluntary commitments) to use renewable energy in their own jurisdictions. This opportunity exists even in cases where trading the energy itself is not feasible.

This paper consists of three main parts, Part I, which is an overview of the state of the current and possible near and mid-term future, renewables market and industries in the NAFTA countries and particular effort has been made to be *inclusive* of all possible technologies rather than merely focusing on what are currently considered the 'major' players. Part II is an overview of government policies that affect renewables in the North American marketplace that may have trade law implications; and Part III, an analysis of those implications, under the NAFTA provisions on goods, services, energy (which has a special set of rules solely directed to that sector), and technical barriers to trade (standards), as well as provisions of NAFTA that deal with the environment, including the environmental side agreement.

North America's Current and Future Energy Budgets

Current Energy Budget

Current total demand in the U.S. is over 800 Gw., in Canada nearly 130 Gw. (Canadian demand does not scale to US demand due to industries such as aluminum smelting that use large amounts of inexpensive hydroelectric power in Canada), and in Mexico 51 Gw[1]. US and Canadian total demand is rising at approximately 2% per annum. This contrasts with rapidly industrializing and growing Mexico's forecast of demand rising at 6.4% (note however the CFE's estimate is only 5.5%[2]) per annum[3] through at least 2009 – and barring major economic crisis, in all likelihood far longer as Mexico continues to catch up to its northern partners.

In the US it is expected that the percentage of energy derived from non-Hydroelectric renewable sources will remain constant at approximately 7% of the total energy budget. Canada's non-hydroelectric renewables sector is likely to echo US trends but with large hydroelectric facilities both planned and under construction the overall percentage of renewable energy in the Canadian budget is set to rise. Again, by contrast Mexico will see renewables use *fall* on a percentage basis as it moves to utilize more of its abundant natural gas resources. Thus, through 2009 Mexico's energy budget will see fossil fuels rise from 75% to nearly 85% of usage.

It is worth noting that both Canada and Mexico are net energy exporters and Canada and the US both import and export electricity to each other on a large scale, and even Mexico already has a very limited connection to the US grid, exporting much more electricity than it imports. While the bulk of Mexico's energy exports are in oil and gas, it is conceivable that renewable energy to serve fast growing markets in the US – particularly the South and South-West - may be exported within five to ten years time if demand and capital are available.

Renewables Potential in NAFTA Countries

Many of the best renewable resources tend to be in the south and south west or west coast of the continent. This is due to the fact that the best resources for solar power are in the empty spaces of the southwest and parts of Mexico. As well the Pacific Ring of Fire

What is Intermittent Electricity? Why is it Different?

*Intermittent electricity is electricity generated by a source that is by its **nature** intermittent, i.e. wind, solar etc. One of the obstacles faced by proponents of such renewable power sources was that, traditionally power utilities rated generators by the maximum power that could be supplied or "dispatched" to the grid, at times of peak demand. As the wind may not blow or there may be no available sunlight, just when the utility has peak demand frequently utilities would consider renewable sources as having no value at all, as they were not reliable in terms that the utilities traditionally used. Furthermore, such intermittency creates some purely technical issues that grids and grid operators accustomed to working with more constant power sources had not had to address – luckily these issues are now understood and it is estimated by **some** - and contested by others - that up to 20% of the power […a very large quantity that is years, or even decades, away from being implemented] on a **strong** grid can easily come from intermittent sources of power without needing major capital investments and reengineering of systems by the grid operator.*

*Fortunately, the more intermittent facilities of generation you possess the easier it becomes to use statistical analysis techniques to predict when such power will be available. Moreover, intermittent power sources are often at their peak generating capacity just as demand peaks – for instance solar power on a hot summer afternoon when everyone wants electricity to power their air conditioners. Less fortunately is that when the amount of intermittent power provided to the grid **increases** beyond a certain point, problems of harmonics and other technical issues interfering with "high quality" i.e. stable power become serious. This is a **major** issue when in advanced economies even small fluctuations can cost large amounts of money in lost industrial production.*

underlies much of the southwest and west coast and is the fundamental resource required for effective geothermal-electric[4] energy extraction. Furthermore, many parts of the central states, the west and south west have excellent sites for wind power. The eastern parts of the continent have less attractive low temperature geothermal-electric resources, and fewer possible wind resource sites. However, the eastern portions of the continent have cold water energy extraction sites and on the east coast, itself, tidal, current and wave resources – which would, of course, be true for the west coast as well.

Currently, the two key renewable energy sources which are not limited on the supply side to small fractions of national energy budgets are: solar and wind. Both of these and especially solar have huge potential – at least when the sun shines or the wind blows! As other renewable technologies are more suitable for base-load (for instance geothermal-electric at 97% availability), and the NAFTA countries are blessed with these other sources as well, a combination of renewable technologies rather than a focus on one or two would seem the best approach. The total amount of renewable energy available is very large (in excess of current national energy budgets) but the amount that is economically viable to extract in the near and mid-term with available technologies, in that same time span, is much smaller, particularly in light of the fact that nearly all 'renewable' technologies currently require tax payer subsidies. Furthermore, there are issues of availability[5] and scheduling with many renewable power sources, particularly wind and solar[6]. An example, according to the US Solar Energy Industry Association (SEIA[7]) for solar power (PV) it takes five Gigawatts of deployed solar power plant to be the equivalent of one gigawatt of nuclear plant[8]. This relates to the intermittently available nature of the resource. It follows that a 'Gigawatt' of a given renewable resource may be far from equivalent of a Gigawatt from a conventional source. Therefore it behooves readers to be very careful in making comparisons between so many gigawatts of one power source versus another as they may not be comparing 'apples to apples' at all.

Renewables as a Share of NAFTA Energy Budgets

Excluding hydroelectric power (8.9% of US electrical supply) approximately 7% of the US national energy budget in 2000 AD was from renewable sources. According to the US Department of the Interior the current trend in growth of 'green' energy supply was zero on a percentage basis. That is to say, that as the US national energy budget grows renewables are maintaining but not *increasing* their share[9]. Renewables, excluding hydroelectric power (15.1%[10] of Mexico's electric supply and 57%[11] of Canada's) were a significantly smaller share

[4] For an in-depth discussion of Geothermal-electric, What is Geothermal-electric Energy? Mary H. Dickson and Mario Fanelli, *Istituto di Geoscienze e Georisorse, CNR , Pisa, Italy*
Prepared on February 2004 [International Geothermal-electric Association, at: http://iga.igg.cnr.it/geo/geoenergy.php]
[5] A good discussion of the problems of intermittent power particularly at higher levels of supply to the grid, http://www.countryguardian.net/Laughton.htm
[6] Excluding solar from geo-synchronous power satellites.
[7] www.seia.org
[8] Solar Energy Industry Association, "Our Solar Power Future: The US Solar Photovoltaics Industry Roadmap Through 2030 and Beyond"p.6
[9]Green energy was approx. 4.8 quadrillion BTUS in 1975, and approx 6.8 in 2000 AD., source:
[10] Renewable Energy Potential in the U.S.A. and Mexico, Ralph P. Overend, NREL, North American Commission for Environmental Cooperation, (Montreal Oct. 28-29 2004)

of the energy budget of the US's northern and southern partners. For instance, while the US is the world's number one producer of geothermal-electric Canada produces none (100 Mw. is coming online in B.C. soon). Mexico is the world's third largest producer but the actual amount, at 855[12]-955[13] Mw. is not huge by either national or NAFTA standards.

Neither Canada nor Mexico have significant exploited wind resources as of 2005 AD, although this is changing, and US wind to grid is not a significant percentage of the national energy budget either. As we have previously stated, in Mexico renewables are a *declining* percentage of the energy budget (which makes intuitive sense as Mexico's energy demand is at once rising rapidly and natural gas is abundant and being emphasized in the national energy plan). No NAFTA nation has significant exploited solar energy resources (the US, has .34 Gigawatt deployed to grid, Mexico about 14 Megawatts of mostly off-grid supply, Canada 7.2 Mw.). Only the US is about to deploy significant commercially measurable amounts of solar to the grid in California and Nevada based on "concentrating solar power" (CSP) ie solar thermal electric[14] technologies. California has between 800 and 1.75 Gw. contracted[15] and Nevada contracted in September 2005 for 64 Mw[16].

One might ask why renewables have not grown as a percentage of national energy budgets, at least in the foreign-energy dependent US since the Carter administration? As is the case with so many similar policy and industrial questions the answer comes down to cost. The simple truth has been that renewables have not been competitive with conventional energy sources thoughout this time period. The reasons are manifold but the key reasons are: immature technologies with resulting low reliability and low efficiency levels and high cost of technology, combined with scheduling (intermittency) issues. Thus, in the last 20 years, the cost of wind power per kilowatt had declined 85% but is only now closely approaching (but not yet *quite* matching) the cost of conventional sources of energy. Equally as research has proceeded apace over the years intervening from the first and second oil crises of the 1970s the price of solar photovoltaics has fallen dramatically but is still ten times as costly to deploy per generated unit of power as a natural gas fired plant. This in contrast to concentrating solar power whose cost structures have declined over the same span to commercial or very near commercial levels.

The reason renewables are now becoming a larger factor in energy policy and hence, trade policy debates is that after many years of research and experimentation a number of these technologies are ready, or nearly ready, to be deployed en masse and on commercially competitive terms. Furthermore, increased environmental concerns, on the part of the public (reflected in local and sub-national government policies), sudden energy price spikes and uncertainty of supply have all contributed to a renewed urgency in understanding and supporting

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[11] Ibid.Renewable Energy Potential in the U.S.A. and Mexico, Ralph P. Overend, NREL, North American Commission for Environmental Cooperation, (Montreal Oct. 28-29 2004)

[12] http://www.eia.doe.gov/emeu/cabs/mexenv.html., U.S. Government, Energy Information Administration (EIA) Country Briefs, Mexico: Environmental Issues, January 2004

[13] USDoE, Fall 2003, cited in Ibid., p.

[14] There are three main types of CSP, dish and engine, trough and power tower. California is using a dish system with a stirling engine, Nevada has chosen a trough technology. In fact, there is a fourth contender "solar chimney" and a system is being contemplated in Australia

[15] With Sterling Energy http://www.stirlingenergy.com/news.asp?Type=stirling

[16] Supplied by Solargenix, http://www.solargenix.com/news_details.cfm?id=11

the role of renewable energy supplies in national energy budgets and a heightened sense of urgency in deploying these technologies[17].

Part I: The Renewables Sector Today and Tomorrow

Seen over the perspective of the last forty years an observer of what are broadly characterized now as 'renewable' technologies will note that certain technologies go in and out of fashion, over time. Perhaps a technology has received extensive media coverage after a technology breakthrough or breakthroughs – or there are no exciting breakthroughs just steady but unglamorous work. Perhaps a given technology holds particular promise to solve given policy problems that hold the public's attention – or do not. As nearly all 'renewable' technologies have been uneconomic over the last forty years (the huge exception is hydroelectric power, too often forgotten as a 'renewable' energy source) interest has primarily been driven by technologies that capture the imagination, dramatic innovation or dramatic declines in cost. Whether in the public eye or not, all renewable technologies have made significant and often very substantial progress in this time frame. This overview attempts to look at all the extant 'renewable' energy candidate technologies from the largely undeveloped and radical (i.e. undersea tide turbines and powersats) to the economic and near economic (i.e. hydro power, solar thermal-electric, biomass, geothermal and wind).

Due to major advances in materials technology and much research and practical experimentation, combined with computer technology (both in its manufacturing and software aspects) it would appear that several renewable energy technologies are poised for a breakthrough in terms of practical deployment (i.e. investor driven and without taxpayer subsidy) but this is – at least not yet – fully reflected in projections of sources of energy supply in North America in the next ten years. Each renewable energy source has pros and cons with significant implications for their connection to the grid and thus, their tradeability and, perhaps, even viability if the regulatory framework is not consistent and renewable technology friendly.

Recent major price rises in the cost of conventional energy sources will undoubtedly cause much reappraisal of the renewables sector on the part of the public and policy makers who are looking for alternatives to costly – and potentially insecure – imported energy sources. Furthermore, if the current prices for internationally traded energy are sustained at anywhere near these levels there will, undoubtedly, be much recalculation of what is 'economic' versus 'uneconomic' in the renewables sector in light of the major price increases being experienced in competing 'conventional' fuels and energy sources. It is not unreasonable to assume that the renewables sector will feel a strong positive impact from sustained high conventional energy prices and it would be wise to bear this in mind when looking at current industry numbers and projections – which are often based on statistics from one to several years ago. Thus, these numbers were often created in the more benign security, and lower energy cost, climate that existed as recently as two years since.

The overview will divide the technologies reviewed into *Current & Near Term*, *Mid-Term* and *Mid to Long-Term* categories followed by a brief look at the industry itself. Within each category technologies will be presented in order of their overall *potential* contribution to

[17] An inventory of renewable technologies being deployed in the NAFTA zone in 2003 was compiled for the CEC and can be found here, http://cec.org/files/PDF/ECONOMY/NARED-technical-report_en.pdf

North American energy supply and take note of their current and projected actual supply as well. Current is precisely that, Near Term means one to five years, Mid-Term five to ten years and Mid to Far Term is primarily the ten to thirty year time frame – necessarily a time frame wherein we move farther and farther from facts and solid extrapolation to hazier speculation. However, this time frame includes several potential major technologies that cannot be ignored.

Current & Near Term

The three technologies that are unequivocally current are: Hydro-electric, biomass and deep water cooling (i.e. cold water cooling energy substitution). Hydro-electric is often the 'forgotten' renewable as it is not a new technology and so much a part of our lives. However, it is a major energy source in North America and has been an important part of the grid since its inception a hundred years, and more, ago and still has major development potential especially in Canada (34 Gw. economically exploitable, 182 Mw. potential) and Mexico (7-8 Gw. exploited, 50 Gw, potential plus 3.25 Gw of small hydraulic[18]) with good potential in the US, (perhaps upwards of 30 Gw.[19]) particularly in smaller hydraulic projects. Hydro-electric is also of great importance to industries (such as aluminum smelting) that absolutely must have large amounts of low-cost electricity often from their own on-site plants. As hydro-electric is the lowest cost, very high availability (over 90%) source it is the choice for aluminum smelters which are frequently sited in the province of Quebec, in Canada, as a result.

Biomass as a source of current electrical energy (holding steady at 10.5Gw in the US over the last five years, i.e. Biomass -direct fire) is also primarily generated onsite in industries such as the lumber/sawmill industry which generates large amounts of biomass waste (about 55% of all energy consumed in this sector in the US and in Canada is generated from the sector's own wastes on a 'direct fire' basis as opposed to biomass from gas). Biomass generated electricity from farming, smaller sites and city landfills (i.e. Biomass from gas) can be considered a near-term technology and has considerable potential for electrical generation (a very rough estimate for magnitude purposes for non-industrial biomass might be 25-40 Gw. in the US alone and perhaps more). Biomass is of particular importance as it is the only renewable technology that can substitute for fossil fuels as a base feedstock in the creation of liquid carbon based fuels, chemicals and plastics.

"Deep water cooling," i.e. cold water energy substitution has currently been commercially deployed for the first time in Toronto Canada[20] and has considerable potential for urban areas sited near large bodies of cold water (for example the Great Lakes). This is an avoidance technology. By using the very cold bottom of lake (or potentially sea) water to cool offices, factories and homes, the cost of the electricity to power air conditioning systems is avoided. The system is effective, economical, and relatively easily and quickly deployed and should prove popular wherever there are large urban concentrations near bodies of water with cold underlayers relatively close to shore. There is no available estimate for overall North American potential for this technology as yet.

[18] http://www.canhydropower.org/hydro_e/pdf/Development_America_2005.pdf
[19] Ibid.
[20] http://www.toronto.ca/water/deep_lake/ In Toronto the initial plant saved 35 Mw., approximately 75% of the energy cost of the replaced air conditioning.

Solar power generation from solar thermal electric based farms[21] is moving from near term to current, as this paper is being written, with two major, *non-subsidized* contracts having been let, in California in the last several months[22] and another smaller one using a different solar thermal technology in Nevada[23] – these three contacts by themselves will represent the vast bulk of solar electric power deployed in North America, particularly solar to grid. In the near term, it may safely be assumed that deployments of solar on a scale to make a real difference to national energy budgets will be concentrating solar power (CSP), solar thermal electric based as Photovoltaic (PV) based systems are still extremely costly for utility scale generation. (see Mid Term)

Solar thermal electric generation has the potential to supply large quantities of power – it is estimated that the State of Nevada, alone could generate 600 Gw. As Nevada has an energy budget of approximately 3% of the estimated state solar capacity it is easy to envisage solar electric to grid as a major export commodity in not too many years as the major components of solar thermal plants are subject to standardization, modularization and mass manufacturing.

Geothermal-electric is also a current technology in limited deployment. It still requires some subsidy, however, but costs continue to fall and do not have to fall far to make it a self-standing technology. By 2007 it is estimated that costs per kilowatt hour will have fallen to the 3 to 5 cent range[24] making it very competitive. It has many advantages in the geologically active areas where it can be made available and a 97% availability rate making it ideal for base load. Overall, it can also, along with non-industrial biomass[25] be considered near term. Some proponents of wind would also claim that the many experimental windfarms constitute 'limited deployment' particularly as they do contribute to the grid to some extent. However, wind technology is still under very active technological development[26] with rapidly (and positively) changing cost structures and, for the purposes of this paper will be classed as "near term" – it is not the authors' intent however to minimize wind's contribution in that same time frame and onwards!

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[21] There are three main types of 'solar concentration power' (CSP) – dish & engine, trough and power tower. The California contracts where for dish type technology and the Nevada contract for trough type technology. Nevada alone is estimated to have a 600 Gw. potential for solar power generation, current Nevada energy consumption is approximately 3% of that figure. There is, actually, a fourth that may have its first commercial debut in Australia, that is a solar chimney system, called by its Australian proponents a "Solar Tower" – which uses rising warm air in a giant tower to generate electricity, www.enviromission.com.au. Interestingly, Dish/engine based on stirling cycle engines as in the California contracts can be scaled in the kilowatt range whereas the other CSP technologies only scale in the megawatt range.

[22] http://www.stirlingenergy.com/news.asp?Type=stirling

[23] http://www.solargenix.com/news_details.cfm?id=11

[24] Renewable Energy Potential in the U.S.A. and Mexico, Ralph P. Overend, NREL, North American Commission for Environmental Cooperation, (Montreal Oct. 28-29 2004)

[25] Landfill power generation is starting to be deployed, for instance at projects in NY State where the government has recently announced 15.5 million on funding for distributed generation and co-generation projects. New York Office of the Governor News Release Oct. 22, 2005.

[26] An example of this is the announcement by Terra Moya Acqua Inc., just as this paper was being written of commercial availability of a new *vertical access* wind turbine, which is not only simpler than conventional wind turbines but has all of its machinery at the base of the turbine not several hundred feet in the air. TMA alleges that their machines have less downtime, are cheaper to service and are also a good deal more efficient (up to 45%) than conventional wind turbines, they also have a much lower environmental profile, being shorter and, also solve the bird kill and electromagnetic interference problems associated with more conventional turbines. It will be interesting to see if the company's claims can be made good in commercial scale wind farms!

Near Term

Wind

There is great excitement currently surrounding wind as it is a technology long in development whose time is apparently coming[27]. The cost of wind technology has fallen 85% in the last 20 years (much of that drop was, however, near the beginning of that period of time) with current new technologies coming in around the .05/kWh mark[28] and the possibility of costs as low as .03/kwh for onshore wind power by 2012 and .05kWh for offshore windpower in the same year[29] [30]. Wind, in the US alone, has a potential of 812 Gw[31] not including another 907 Gw. available between 5 and 50 miles offshore and a potential, over time, to supply 20% of the US energy market[32]. Wind power sites are associated with three major terrain features: mountains, large flat plains and large bodies of water. North America has these in abundance.

The wind industry is gearing up for major deployments at numerous sites in the US and Canada[33] as well as one (the La Venta 101 Mw. project to be built for CFE being the main current example[34]) or more sites in Mexico which has seen no new wind capacity installed since 1999[35] at its one wind site in Oaxaca. Currently issues of subsidies are still important to wind industry investors but trade issues are on the horizon[36] as the technology gets deployed in a greater number of jurisdictions and scaled to commercial supply (which is, however, at least in 2005/06 not at all equivalent to *no* subsidy[37]). As issues of intermittency are similar, in trade terms (not necessarily *technical* terms), to those of solar power and wave power inter alia, dealing with trading in wind may also concurrently allow regimes to be established for other intermittent energy sources. Another key issue is the high upfront capital cost of facilities. A final issue is that there may be serious problems with deploying more than a certain percentage of wind to the grid before encountering serious to very serious issues of quality of power a

[27] An excellent and very current overview of wind in the US with much general information of use as well is the November 2004 Staff Briefing Paper for the FERC, "Assessing the State of Wind Energy in Wholesale Electricity Markets," http://www.ferc.gov/legal/maj-ord-reg/land-docs/11-04-wind-report.pdf#xml=http://search.atomz.com/search/pdfhelper.tk?sp-o=1,100000,0

[28] http://www.eere.energy.gov/RE/wind_economics.html

[29] Renewable Energy Potential in the U.S.A. and Mexico, Ralph P. Overend, NREL, North American Commission for Environmental Cooperation, (Montreal Oct. 28-29 2004)

[30] A 50 turbine offshore wind farm was announced in Texas in October 2005 and there are also offshore wind farms planned for off Long Island, NY and Cape Cod, Mass., however the Cap Cod, Nantucket Sound facility is mired in local political controversy.

[31] Based on Class IV or above areas of wind availability.

[32] Ibid.

[33] Five new wind projects were announced in autumn 2004 in Ontario alone. http://www.energy.gov.on.ca/index.cfm?fuseaction=renewable.wind

[34] http://www.eia.doe.gov/emeu/cabs/mexico.html

[35] http://www.eia.doe.gov/emeu/cabs/mexico.html

[36] The Vancouver Island Cable Project to move Vancouver Island windpower to users in Washington State is a case in point.

[37] To give an idea of the scale of current subsidies a good example is the new 75Mw. wind farm at Shelburne Ontario, in Canada, to open in March 2006. It is costing CDN120M of which CDN19.5M is a subsidy from the federal government.

matter that is not as often discussed as its importance merits; however, these are technical issues not within the scope of this paper[38].

Geothermal-electric

Geothermal-electric's costs continue to drop and should in the .03-.05 per kWh range by 2007. Its advantages are many: zero emissions, low environmental impact (small footprint facilities), extremely high availability (97% v. 90%+ for hydro, 75% for coal and 65% for nuclear), declining costs, low hazard of major onsite accidents and most of the best geothermal-electric sites located in areas of the continent that have fast growing populations. Geothermal-electric's biggest drawback is that there is not more of it with US potential estimated at 23 Gw.[39] and Mexican potential estimated at 8 Gw.[40] to 12 Gw.[41] It must be born in mind, however, that Geothermal is directly comparable to conventional sources so a "Gig" is a Gig – not just a "Gig" of nameplate capacity available intermittently. Thus, a gig of Geothermal is, for instance worth five gigs of solar! Canada has limited geothermal resources and only one (brand new) geothermal-electric project – its first, at Meager Mountain BC[42] which will produce 100 Mw. and might be extended to 200 Mw[43]. Geothermal-electric sources in eastern North America tend to be low temperature (50C or a little better) and not as suited for major power projects.

Middle Term

In the middle, five to ten year timeframe it is difficult to state if the technologies that are currently under development will be ready or not. These technologies are tidal power, both estuarine and offshore, and wave power. Tidal power has high energy density and good potential to generate large quantities of power, locally, with coastal sites in the US estimated as having potential of 10 Gw. and in Canada of 8.6 Gw. Canada has the only onshore tidal plant in operation in North America, the Annapolis Basin pilot plant on the Bay of Fundy, generating 20 Mw.

Offshore, underwater generated tidal power is much under study in Europe with 106 sites identified. In the UK alone offshore tidal is estimated to have a potential to provide 27% of UK power[44]. As there are many powerful currents available offshore in North America (for instance

[38] Here is a table listing several recent (2005) government and non-government sources from the UK where this is both a competitive market in electricity and much interest in wind power for the grid. http://www.countryguardian.net/

[39] source: Geothermal-electric Energy Association, Feb. 2005, http://www.geo-energy.org/UsResources.asp - there is some evidence that this estimate may be conservative as the estimate for the Newberry Caldera in Oregon is a range of 13-16 Gw for that one site alone - http://vulcan.wr.usgs.gov/LivingWith/PlusSide/geothermal-electric.html.

[40] http://www.eia.doe.gov/emeu/cabs/mexenv.html, U.S. Government, Energy Information Administration (EIA) Country Briefs, Mexico: Environmental Issues, January 2004

[41] "Backgrounder Mexico Renewable Energy, North American Commission for Environmental Energy, http://www.cec.org/files/pdf/GallupBkg-e_EN.PDF

[42] http://www.geothermal-electric.org/articles/canada.pdf

[43] To put this in perspective the authors note that B.C. is projecting increased demand in the range of 1 200-2 400 Mw. over the next ten to twenty years, 50% of which should be from 'green's sources, according to provincial government policy. 100 Mw. initial with another 100 Mw. to follow is not nearly enough even to satisfy more than a small fraction of the 50% that is to be from 'green' sources, for the low-population province of B.C. and gives an idea of the scale of demand versus currently planned supply.

[44] To put this in perspective the UK has a population of roughly 54 million.

the Gulf Stream) as well as riverine sources this may become a major power source in the middle or longer term.

Middle to Long Term

In the middle to long term of ten to thirty years out there will be two new solar based technologies to add to thermal-electric-based solar generation. These will be solar photovoltaic and solar power satellites (SPS or powersats) either using thermal-electric or photovoltaic technologies as their means of power generation.

Terrestrial Solar: Photovoltaic

Sharing, in future, with solar thermal electric based solar power the huge potential for solar power in general is solar photovoltaic generation. From today's price of .24-.30/kWh. costs are projected to fall dramatically with estimated costs of between .06 and .08/kWh. by 2020[45] and with further room to decline. This will still leave PV as substantially more costly than competing renewable alternatives both solar and non-solar for centralized utility scale generation[46] but quite competitive for distributed models of generation.[47] It must be borne in mind that distributed models of onsite renewables generation are unlikely to generate trade issues.

On the issue of the projections for PV in future *themselves* it is to be noted that these projections are based on the 'state of the art' in 2003-2004. In January 2005 the University of Toronto, in Canada, announced a major breakthrough. A team led by Professor Ted Sargent[48], has developed a plastic material sensitive to the infra-red portion of the light spectrum. Professor Peter Peumans of Stanford University states that "Our calculations show that, with further improvements in efficiency, combining infrared and visible photovoltaics could allow up to 30 per cent of the sun's radiant energy to be harnessed, compared to six per cent in today's best *plastic* solar cells[49]." [italics added for emphasis]. Plastic as opposed to crystalline cells can simply be rolled onto surfaces in solution allowing for very inexpensive deployment. However, heretofore, their generating capacity was too limited (at 6%) to make much headway in the marketplace. In passing, the authors note that the nano-technology used could even allow for solar generating clothing!

The US *Department of Energy's* (DoE) *National Renewable Energy Laboratory* (NREL), this year has suggested that power from PV based on "photovoltaic concentrator" technology (originally an NREL innovation and developed for satellites in the 90s by Boeing-SpectraLab Inc.) may be 'imminent' at a cost competitive level of US$3/watt within several years.

[45] Renewable Energy Potential in the U.S.A. and Mexico, Ralph P. Overend, NREL, North American Commission for Environmental Cooperation, (Montreal Oct. 28-29 2004)

[46] Economies of scale are hard to come by in PV installations, the California experience shows that large commercial installations tend to have nearly the same price per installed kW as residential systems.

[47] This is due to the fact that wide deployment of onsite solar PV, allows for savings from *avoided costs*, ie electric distribution infrastructure and plant which does not have to be built. Furthermore, there are no line loss issues. A kilowatt at the generating plant is not a kilowatt at the plug due to line losses. A kilowatt onsite is a full kilowatt that can be consumed. The line loss issue cannot be solved, completely short of much better high capacity superconductors being developed. A good discussion of these issues and many matters related to early deployment of PV can be found in "The Economics for Solar Power in California: A White Paper" August 23, 2005, Akeena Solar, which can be found at: http://www.akeena.net/about/whitepaper8-23-05.pdf

[48] University of Toronto News, http://www.news.utoronto.ca/bin6/050110-832.asp

[49] Ibid.

Photovoltaic concentrator technology focuses light on the cells in question and efficiency levels this year have crossed 39% (at 236 suns) and are projected to hit 40% by 2006. To achieve such levels additional light is focused on the generating, high efficiency multi-junction cells. This is measured in the number of 'suns' worth of light the cell(s) receive[50]. One constraint on this technology is that it is not suited for distributed generation in very small systems as is conventional PV.

It is the nature of immature technologies to be subject to the kind of sudden 'leaps' evinced in the developments outlined above – and for some of these 'leaps' not to emerge from the laboratory. Thus, photovoltaics as a viable power source may be available, in *quantity*, sooner than the third decade of the century – or may not. Terrestrial based solar will also continue to be hampered by issues of intermittency as are several other renewable technologies.

Orbital Solar: Solar Power Satellites [SPS] aka "Powersats"

Solar power satellites[51], generating power from sunlight in geosynchronous[52] orbits have all the advantages of solar power but magnified. They will have very high availability (no weather and no night to interfere with generation which also means no storage issues) they will be able to work with sunlight not attenuated by the filter of earth's atmosphere[53], they will have no footprint at all (except for power reception) and no potential for major accidents affecting the terrestrial environment. However, while there is a good deal of technology available its cost structures have not yet been addressed. Currently, the key obstacle for Power Satellite energy generation is the exorbitant loft-cost of mass to Earth orbit.

The issue of loft cost to orbit, which also hampers many other space-borne enterprises, *is* being addressed by the National Aeronautics and Space Administration (NASA). Perhaps of more interest – and likely producing more immediate results - is that various private entrepreneurs[54] whose original source of wealth is 'Silicon Valley' based have started private commercial launch companies and are vigorously addressing the issue of launch cost and doing so today. Cost to orbit has been a major focus of these companies who are applying the most advanced and effective industrial and manufacturing techniques to wring costs out of the manufacture of space vehicles and launch systems and are starting from 'clean sheets.'

While there are numerous legal, environmental and other issues[55] to be addressed we must emphasize that they are all very much subordinate to the issue of loft-costs. If as seems increasingly likely loft costs are set to drop dramatically[56] (on the order of ten fold within the

[50] http://www.nrel.gov/news/press/2005/2405_pv_concentrators.html

[51] http://www.space.com/businesstechnology/technology/solar_power_sats_011017-1.html - this gives a good layman's overview of the potential issues based on past and near current U.S. government studies.

[52] That is orbits that allow the satellite 'hover' over the same geographic area permanently.

[53] Effectively 8x as much sunlight, http://www.freemars.org/history/sps.html

[54] Notable amongst there are Paul Allen (co-founder of Microsoft), Elon Musk, (founder of PayPal), Sir Richard Branson, (founder of the Virgin Group of Companies), others include Mr. Bigelow a hotelier and the force behind Bigelow Aerospace.

[55] A full discussion of these is outside the scope of this paper, however some examples are: wireless transmission issues not only technical issues with doing this on a commercial scale but also the environmental issues related to deploying large and necessarily high power terrestrial microwave or other antenna farms, international legal issues may come into play as well as issues of social acceptability and so forth. However, given the world's insatiable demand for energy likely, when all is said and done, the real issue will remain cost.

[56] SpaceX is launching its brand new, Falcon 1, reusable launch vehicle and payload to orbit in late November or early December 2005 from its launch site in the Marshall Islands. SpaceX costs to orbit are a fraction of current

next several years according to SpaceX) and real competition ensues there may be dramatic changes in the equation as relates to power-sats within the mid-term horizon. This is *not to say* we would be constructing such devices within years but with the loft-cost problem solved or on the way to being solved, further research could be justified and clean, uninterrupted solar energy from orbit could be a reality in the ten to twenty year time frame (it is impossible to predict the level of energy successful high-tech entrepreneurs may bring to these enterprises except to note that companies like SpaceX have gone from incorporation to contracts with DARPA, the Defense department, commercial satellite companies and NASA in under five years for actual loft services using "clean sheet" custom–developed technology, engines and vehicles of their own[57].

Wave Power

Wave power was successfully connected to the grid in Portugal in the third quarter of 2005. Wave power has much potential and North America has a very large amount of coastline in the north of the continent and on the north eastern and north western coasts of North America that is suitable but the technology is currently at the feasibility demonstration stage. This is a power source that may be very significant in ten to twenty years and may, indeed, create major export opportunities for places such as the Maritime provinces of Canada – lightly populated, with lots of coastline and close to major US markets on the East Coast as well as wave power generated domestically in the US on its share of these coastlines. NREL estimates that each meter of the eleven hundred miles of western coastline in the US could generate 40-70 kilowatts.

Deep Sea [OTEC]

Deep sea power generation based on temperature differences between warm surface waters and very cold deep sea waters is no longer receiving research funding. Amongst several issues the key one is lack of feasible sites – nearly the only very good site for this technology among the NAFTA nations is in Hawaii where they have the specific combination of very warm surface waters and very deep cold sea water near at hand. OTEC type generation while proven to work is - in some future incarnation a 'long-shot' technology on the far horizon. OTEC systems require a very large upfront capital investment. Unusual benefits of OTEC systems include a source of cold water for airconditioning or other applications, desalinization of significant volumes of water from its operation and the creation of nutrient rich areas in the ocean like artificial "Grand Banks" suitable for high value aquaculture.

An Overview of the North American Renewables Industry

This section will exclude hydro and focus on newer 'renewables technologies. It will examine the state of manufacturing and distribution for each nascent technology which already has any manufacturing base associated with it. Thus, this section excludes such technologies as wave and tide turbines, powersats and OTEC devices. It also excludes solar water heating devices.

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prices and set to fall further. The president and founder of SpaceX is predicting costs as low as US$500/pound to orbit using SpaceX hardware.

[57] http://www.spacex.com/ - current launch manifest for SpaceX.

Concentrating Solar Power

Much research is being done in Europe, as well as the US, on CSP but the systems now being deployed in the US (there are none deployed yet in Mexico and northerly Canada, at best, has only marginal sites on its US border) are manufactured by US based companies. The two companies currently with commercial contracts are, respectively, Stirling Energy of California and Solargenix of Nevada[58]. These plants are, apparently the first, worldwide to have solid commercial contracts and may help bring North America a global leadership position in this technology.

Photovoltaic Solar Power

Photovoltaic cells were in invented in the 1950s in the United States at Bell Labs. Many people think of the glamorous solar cell when they think of 'solar power,' however other types of solar power from CSP to domestic hot water systems are not only 'solar' but already deployable. Unlike other renewable technologies when we speak of photovoltaics we may *think* of the traditional single crystal PV cell (made famous by NASA, still used extensively in space and anywhere high capacity is of more importance than cost. However, the photovoltaic power of tomorrow has a very good chance of not coming from 'cells' of any sort and is quite likely to come from economical coatings of photovoltaic materials applied to various surfaces, especially in smaller installations. Furthermore, there is no single formula for such cells. Many different chemistries and approaches are being tried (see the ground breaking efforts of the University of Toronto at p.12) as materials scientists come to understand the electrical properties of materials better.

The nascent "photovoltaic" proto-industry in North America makes much of the fact that leadership in this sector has passed overseas. As the most recently major breakthrough was in the NAFTA zone at the University of Toronto and it is hard to think of *any* major breakthrough in photovoltaics outside of North America this loss of leadership may be a little over-hyped. North America's incredible track record of innovation and the commercialization of innovation also casts doubt on where leadership lies when the PV technology/technologies that may eventually emerge as a winner or winners is not yet at all clear. This point also applies to discussion of expertise in installing PV plant.

The Japanese and Germans have spent large sums of taxpayer money subsidizing the installation of standard cell type systems but what use is this expertise if it turns out that completely different PV technologies prove to be the winners – ie technologies fundamentally easier of manufacture and intrinsically less costly than crystalline single cell technologies or their close relatives? North American based PV cell, panel and equipment manufacturers using a variety of technologies, chemistries and approaches are numerous if not all large. As the sector is still in most need of innovation and trial of many different technologies this would suggest, in and of itself, that North American 'leadership' is not the potentially lost cause some industry associations suggest. Overall market growth is in the neighborhood of 20% per annum or better.

A difficulty in Canada with PV equipment is that most of it is manufactured in the US and while it may meet US Electrical standards, has not been certified in Canada making it illegal

[58] Early, experimental trough based plants in California in the 1980s had many European manufactured components, it is not clear how many European made components new trough systems have.

for sale. Apparently the PV industry in Canada has not been pro-active in dealing with this issue and it is still of serious concern[59].

Wind Power

The current world leader by shipments in wind turbines is Denmark. However, there are a number of manufacturers of small turbines in North America and research and development in this field is active, particularly in the US. There is one manufacturer of large turbines (amongst the largest available world wide, ranging in capacity from 1.5-3.6 Mw.[60]) and that is GE Wind Energy, Tehachapi California[61]. Market growth, worldwide in the past five years has been approximately 32% per annum but is now set to increase further.

Geothermal Power

The world's top three geothermal power producers are the US, the Philippines and Mexico. This is a technology where there is strong US leadership in the actual manufacture of plant and a good deal of very concrete research going on to fine tune and improve nearly every aspect of the process of extracting usable power from underground heat.

Manufacturers include companies such as Barber-Nichols who specialize in low temperature waste heat generation and Geothermal plant able to operate down to 115 degrees C. Sites and projects are being actively identified in the US and there is one private Canadian producer in BC.

Biomass Power

Biomass power plants often resemble small conventional power plants – it is only what they burn that is different. For larger scale biomass plants as currently deployed in industries that produce large quantities of high calorie biowaste such as the lumber industry equipment is largely made by companies such as Barber Nichols and these facilities directly burn wood chips and other wood wastes as opposed to biogases.

Biomass from landfill, other waste sources, agricultural sources etc. require different types of generation equipment much of which needs to be economic on a smaller scale. Indeed, Stirling Energy – the manufacturers of the dish/engine technology CSP plants on contract in California is also touting stirling engine technology for small biomass plants. This marketplace is just starting to evolve and it is not clear who the major players will end up being on the manufacturing side. There is increasing support at the State level, as well as the federal level in the US for this technology (for instance in NY State) and biomass is set to grow.

[59] http://www.oja-services.nl/iea-pvps/nsr03/can4.htm, see last page.
[60] http://www.gepower.com/prod_serv/products/wind_turbines/en/index.htm
[61] they are selling well in Canada, as well as in the US the Melancthon-Grey Wind Power Project, a 67.5 Mw., 45 1.5Mw. turbine, CDN$120M project near Shelburne ON, is only one example of GE turbines being installed – the Shelburne project goes online end March 2006.
http://www.mgwindpower.info/faqindex2.htm#What%20is%20Canadian%20Hydro%20planning%20to%20build?

Part II: Overview of Government Policies

Renewable Energy's Participation in International Trade;

Despite the fact that there is no NAFTA-wide scheme, nor bilateral schemes, nor even intra-national schemes of certificates[62] or other modes to trade green energy, interest and activity in cross-border exports of 'green' energy is growing. Consumers and their local and subnational governments are more interested in renewable and 'green' energy than ever before and this is manifest in many local and subnational efforts. These efforts often include 'renewable energy portfolios' that given subnational jurisdictions have established. However, these portfolios often do not include all forms of renewable energy and the contents of the portfolios and definitions of what is renewable vary from one subnational jurisdiction to another.

Despite the current, undefined, situation actual cross-border trading activities in renewables are commencing. For example, in 2004 an application was accepted for review by Bonneville Power for a HVDC cable under the Juan de Fuca strait from Vancouver Island, in B.C. Canada to Port Angeles, Washington State for the purpose of the transmission of wind generated power. Much further work has been done since on what is now called the Vancouver Island Cable Project[63]. Furthermore, there is discussion, particularly in California of generating renewable energy in neighboring Mexico for use in southern California.

It is the authors' opinion that if there were a more standard NAFTA wide definition of what constituted renewable energy and a system of trading such energy[64], there would be considerable potential for business. As many of the best sites for both solar and wind power are remote from population centers that may have the greatest demand for renewable energy a green trading scheme ought to be a renewable energy industry priority[65]. Furthermore, geography often dictates that the country neighboring may have the resources in surplus supply that are urgently needed just across its borders – this is particularly true of Mexico and Canada with resources near the US border.

Renewable energy supply and demand to grid power in North America

Hydro-electric power which was, indeed, one of North America's first reliable sources of mains electricity is *still* one of its most reliable with an availability factor of over 90%. Hydro-electric power is easily and reliably schedulable, low cost and its facilities are longevous and low in maintenance. It provides 8.9% of US electrical supply, 15.1% of Mexico's (and with 50 Gw of potential could easily be *much* more) and over half of Canada's, at 57% (and Canada has 10 Gw. more planned or under construction as of 2005).

The US has 2.8 Gw of geothermal-electric capacity (Mexico has 855-955 Mw) and Canada has 100 Mw. coming online. Geothermal-electric with an availability factor of 97% is perhaps the ultimate in schedulable renewable energy sources, and as such has no technical

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[62] The State of New Jersey has an *intra*-state scheme.

[63] www.seabreezepower.com

[64] American Council on Renewable Energy (ACORE) is also championing a system of renewable energy credits (RECs) see footnote 40, below

[65] Indeed, the American Council On Renewable Energy is suggesting monetizing environmental benefits from green energy with a renewable energy credit (REC) trading scheme at the regional and national levels – it is easy to suppose that such a scheme could be extended throughout the NAFTA zone without too much extra effort as electricity is already traded across NAFTA borders (the Mexican grid is interconnected with the US grid on a limited basis).

problems with connecting to the grid. Tidal power – of which there is 20 Mw. in a pilot project at the Bay of Fundy in Nova Scotia, Canada, is also highly schedulable and reliable. Biomass where hooked to the grid is another example of an easily schedulable (and very likely reliable) energy source.

While some renewable energy sources are easily schedulable using existing technology and generate few issues the two biggest potential renewable energy sources currently on the horizon are very much less so – wind and solar. Furthermore, it is clear from current developments that these resources will, imminently be traded across national boundaries[66]. It is these two that are on the minds of energy policy makers when the topic of renewable energy comes up. Winds are notoriously unsteady and can easily vary by 40% even on very windy sites with accompanying major differences in generated power (such a variation can easily convert a 15 year capital amortization period into a 20 year period) depending on wind speed – if there is wind. Solar power is, by definition, intermittent (this only refers to terrestrial and *not* powersat sourced solar! See "Middle to Long Term p. 11) and is also subject to diminution by cloud cover and in many areas of the continent snow cover of the physical panels or thermal-electric dishes, troughs or mirrors. This intermittency presents considerable technical problems for utilities wishing to add capacity from wind or sun.

In the US these issues, at least in respect of interconnection, have been addressed by the Federal Energy Review Commission which recognized the needs of renewable energy providers (specifically wind in the current instance) for interconnectivity standards some years ago and started a process of hearings and review. As a result of this process, recently, the FERC released final national standards relating to interconnectivity with the grid both for small (>20 Mw) and large (<20 Mw.) wind generators, in May of 2005. It may be expected that similar standards will apply to other intermittent power producers.

In light of the potentially difficult and costly technical issues involved with connecting large quantities of intermittent power to the grid it is certain that utilities would prefer that intermittent renewable power were very cheap and/or more renewable power were of an easily schedulable nature. As it stands renewable power is *not* cheap and *is* often intermittent. Thus, demand to grid is driven by consumer desires and government mandates lubricated by plentiful tax credits and other subsidies.

Government Policies and Initiatives on Renewable Energy in the US, Canada and Mexico

No NAFTA government would do other than claim to be in favor of renewable or 'green' energy! However, action is another matter and even government commitments have not always translated to more dollars or pesos 'on the ground.' Here of course, it is important to distinguish between the programs and actions of national governments which tend to be focused on either research or subsidies for deployment of new renewable technologies. As might be expected, the US has been in the forefront of renewables research (although dollars spent have not risen substantially in 2005 despite the rising cost of energy), followed by Canada with Mexico's

[66] SeaBreeze Power Corporation of B.C. Canada, had a transmission line application accepted for filing by the Bonneville Power Authority in Washington State in 2004. The purpose of the submarine HVDC line is to transport wind power generated on Vancouver Island in the province of B.C. to Washington State consumers. This is now called the "Vancouver Island Cable Project."

limited research, often with the US as partner having focused on limited deployment issues for the most part.

US – Federal Level

The US national government has made a considerable effort to support research into, and trial deployment of, renewable energy sources since the years of the two oil crises of the 1970s. In 1978 the US Congress passed the Public Utilities Regulatory Policies Act (PURPA) which required US utilities to buy renewable or co-generated power at the avoided cost incurred by the utility. The late 70s also saw a surge in research into alternate energy technologies (many renewable) driven by a perceived need for energy self-sufficiency. Support for such research has waxed and waned over the years with support generally waning when conventional energy prices have been low and increasing when supplies were threatened or energy prices rose.

Today the US Department of Energy (DoE) supports a wide range of initiatives ranging from supporting ethanol based biofuels through to programs for nearly every conceivable form of renewable energy. Generally DoE support pays for research, development and pre-commercial demonstration and pilot plants.

Tax Credits and Subsidies for Installation of Renewable Plant in Homes and Businesses

Corporate Tax Credit

The EPACT 1992, made permanent a credit of 10% for business for solar equipment[67]. It is worth noting that these credits augment state-level credits offered by some states[68] – in N.C., allegedly the most generous – these credits can be worth up to 35% of the cost of installed renewable energy equipment for the home and even more for business[69] [70]. This is in contrast to the self-proclaimed "Sunshine State," Florida, where, for instance on solar equipment, all the support a resident gets is exemption from state sales tax.

In the EPACT of 2005 the number of technologies recognized was augmented and some will receive enriched credits for the next two fiscal years. Thus, from January 1, 2006 until December 31, 2007, the credit is 30% for solar, solar hybrid lighting, and fuel cells, and10% for microturbines, Geothermal's credit remains at 10% throughout this period[71]. What is ***not*** in the act: mandatory national interconnection standards on both distribution and transmission lines, a national Renewable Energy Portfolio and mandatory federal procurement of renewable energy. It might be noted in passing that the US renewables sector was somewhat disappointed with this bill.

A summary of tax credits and subsidies offered by the US Federal government is found below:

[67] Eligibility: Photovoltaics, Solar Hot Water, and Energy Storage equipment
[68] A guide to State level incentives for renewable energy, http://www.dsireusa.org/
[69] http://www.dor.state.nc.us/cgi-bin/search1-2001.cgi
[70] a more accessible summary of NC support for renewables, http://www.solarconsultants.com/taxcredits.php#other
[71] http://www.dsireusa.org/library/includes/incentive2.cfm?Incentive_Code=US02F&State=Federal&currentpageid=1

Renewable Energy Production Incentive (REPI)

For a ten year period it provides a subsidy of .015/kWh on Solar Thermal Electric, Photovoltaics, Landfill Gas, Wind, Biomass, Geothermal Electric, Fuel Cells, Anaerobic Digestion, Tidal Energy, Wave Energy, Ocean Thermal to public sector, tribal and not for profit generating entities[72].

Clean Renewable Energy Bonds [CREBS]

Bonds may be issued by government bodies, tribal governments and mutual or cooperative electrical companies. Bonds must direct 95% of raised funds to capital expenditures for renewable energy facilities. CREBS will only be available from Jan 1 2006 to December 31, 2007 and to a limit of $800 million, total[73].

Renewable Electricity Production Tax Credit

Allows businesses credits for the production of electricity from eligible sources of: 1.9¢/kWh for wind, solar, geothermal, closed-loop biomass; 0.9¢/kWh for others. The credits apply to first 10 years of operation[74].

Modified Accelerated Cost-Recovery System (MACRS)

Allows accelerated depreciation on renewable energy assets over periods ranging from 3 to 50 years. For example solar, wind and geothermal built after 1986 are eligible to be written down over five years[75]

Renewable Energy Systems and Energy Efficiency Improvements Program

Grants of up to 25% of the cost of eligible systems and a pending rule for guaranteed loans for up to 50%[76].

Residential Solar and Fuel Cell Tax Credit

A tax credit of 30% available from Jan 1, 2006 to December 31, 2007 on Solar Water Heat, Photovoltaics and Fuel Cells[77].

Residential Energy Conservation Subsidy Exclusion (Personal)

Subsidies direct or indirect from public utilities for the purposes of energy conservation are non-taxable as income[78].

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[72]http://www.dsireusa.org/library/includes/incentive2.cfm?Incentive_Code=US33F&State=Federal&currentpageid=1

[73] GEA August 12 2005 Update, p. 3, http://www.geo-energy.org/Updates/2005/GEA%20Update%20August%2012%202005.pdf

[74]http://www.dsireusa.org/library/includes/incentive2.cfm?Incentive_Code=US13F&State=Federal&currentpageid=1

[75]http://www.dsireusa.org/library/includes/incentive2.cfm?Incentive_Code=US06F&State=Federal&currentpageid=1

[76]http://www.dsireusa.org/library/includes/incentive2.cfm?Incentive_Code=US05F&State=Federal&currentpageid=1

[77]http://www.dsireusa.org/library/includes/incentive2.cfm?Incentive_Code=US37F&State=Federal&currentpageid=1

[78]http://www.dsireusa.org/library/includes/incentive2.cfm?Incentive_Code=US03F&State=Federal&currentpageid=1

Mandatory Requirements for Use of Renewables

With the EPACT of 2005 Congress mandated the first ever biofuels requirement. This will require a minimum of 4 billion gallons of ethanol and biodiesel to be used in 2006, rising to 7.5 billion gallons in 2012 and gives an enhanced credit of 2.5 gallons for each gallon of these fuels produced from cellulose based wastes as opposed to purpose grown crops such as corn (maize). The requirement calls for a system of tradeable credits to allow refineries to minimize ethanol transport costs and maximize efficiency.

Support for Research, Development and Demonstration Technology

Research, development and demonstration technology is largely coordinated and funded by the Department of Energy in its various manifestations. Research is contracted to many parties from universities to Boeing to Sandia Labs, to name a few examples. The government of the United States does not fund full-scale plant nor does it build such plant for its own use outside of military bases. Much renewable energy research is sponsored by the department's National Renewable Energy Laboratory[79] (NREL) which is the "primary national laboratory for renewable energy and energy efficiency research and development." NREL is operated for the DOE by Midwest Research Institute and Battelle.

Solar

Solar power research is quite heavily supported by the DOE under the aegis of the NREL[80] which supports research into all types of solar and has even set up a National Center for Photovoltaics[81].

Wind

Wind power has high hopes of imminent commercialization surrounding it and has its own institute funded by NREL. Research, as with geothermal is, for the most part, focused on the practical issues of deployment, wind site surveys, refining the actual technology etc[82].

Geothermal

Geothermal development is supported by DOE largely through a program, founded in 1999, coordinating all federal geothermal activities, *Geopowering the West,*. It is "A U.S. Department of Energy program that works with the U.S. geothermal industry, power companies, industrial and residential consumers, and federal, state, and local officials to provide technical and institutional support and limited, cost-shared funding to state-level activities.[83]" Various regional offices of the DOE are working to "establish geothermal energy as an economically competitive contributor to the U.S. energy supply." Most government funded activity at this point is to promote the technology as geothermal should cross the line to being a market viable technology in the next year or so, if it has not already. Research is mostly focused on the DOE's

[79] http://www.nrel.gov/
[80] http://www.nrel.gov/solar/
[81] http://www.nrel.gov/ncpv/
[82] http://www.nrel.gov/wind/
[83] http://www.eere.energy.gov/geothermal/government.html

Idaho National Laboratory – a key partner in GeoPowering the West. Private US universities also do research in the field (an example is Southern Methodist University's Geothermal Lab[84]).

R&D for geothermal is straightforward and hardware is being focused on practical development issues and oriented on refining the various elements of the technology to further drive down costs. Research is centered at NREL[85].

Biomass, Ethanol, Biodiesel

Biomass research and development is funded by the Department of Energy. The DoE's NREL is the lead laboratory on the virtual "National Biomass Energy Center." Currently funding focuses on both advanced and practical research and development.

Biomass is a potentially major source of energy in all NAFTA countries and is also, the only renewable energy source which can replace imported liquid hydrocarbon based fuels. Equally, it is the only source that can generate feedstocks for plastics and many industrial chemicals and materials now derived from petroleum and its byproducts. Biomass can also be used as a direct source of energy to generate electricity.

Ethanol and biodiesel are both liquid fuel products derived from biomass and apart from the research support enumerate above, these are receiving specific support from Congress in the form of – a first for the US Federal Government – actual mandatory production quotas for use of both by the US refining industry. (See the next section.) As noted, above, in the section on tax subsidies the US Federal government also includes biomass as a source of renewable energy eligible for both REPI and the Renewable Electricity Production Tax Credit

Other

At any given time various technologies from the relatively prosaic to the elegantly radical, such as Ocean Thermal Energy (OTEC) may be funded by the US government in one or another of its guises, in the case of OTEC by the DOEs National Renewable Energy Lab (NREL). However, these programs are not large and often exploratory in nature.

Electric Infrastructure Systems Research

It is worth noting that the US DoE, via NREL is supporting research into electric infrastructure systems. While not specifically research into any type of renewable energy, or even research into energy at all efficient electrical infrastructure is vital to a renewable future. This is particularly true as there are substantial issues that arise when large amounts of intermittent power are delivered to the grid. Modern societies and their industrial processes need not only substantial amounts of power but as vitally, *reliable* and *stable* sources of power, regardless of the form of generation.

Canada - Federal

Canada, a large nation with a small population over half of whose energy supply comes from low cost renewable hydroelectricity and which is furthermore, an oil and natural gas exporter, apart from having considerable reserves of uranium and a good quantity of coal has not felt as much impetus in past decades to support renewables research in a quest for imported energy substitution. Furthermore, Canada's population of 31.4 million makes it about equivalent

[84] http://www.smu.edu/~geothermal/
[85] http://www.nrel.gov/geothermal/

in size to the State of California but with a somewhat smaller GDP. Canada now does renewables research driven more by considerations of the environment than from a desperate domestic need for alternate forms of energy generation. A further impetus has been Canada' commitment to the Kyoto Treaty. Overall, to this date, Canada has very small programmes, where programmes exist at all, and there is little support in the federal tax code for the deployment of renewable technologies as there is in the US. However, Canada still manages to generate some interesting research in certain niches (for instance a program that has developed a process to process fat-laden biowastes into high cetane additives for diesel fuel) at the federal level.

Canadian universities also generate substantive research most recently the major breakthrough at the University of Toronto January 2005, where a university team working with nano-technologies discovered a way to tap the infrared spectrum of light allowing the efficiency of photovoltaic cells to be substantially increased. Despite claims by the US Solar Energy Industry Association in their report "Our Solar Power Future: The US Photovoltaics Industry Roadmap through 2030 and Beyond"[86] that the US has lost world leadership in research and development in photovoltaic technologies[87] the U. of T. work is prima facie evidence that the NAFTA zone is still leading the world in real innovation in this field.

Despite geothermal-electric resources Canada has no national geothermal-electric program and only limited provincial support (then again the resource is, apparently, fairly limited in Canada). There is a national wind energy program, the CANMET Wind Energy Research and Development program[88] (WERD) and limited pilot programs such as the Wind Power Production Incentive Program (WPPI)[89] whose funding has apparently[90] been quadrupled, in the 2005 Federal Budget from CDN$260M to 920M, over fifteen years in support of 5 Gw. as opposed to the original 1 Gw. to support the installation of wind power installations. This is, of course even at its increased level, a negligible amount of wind energy as a percentage o the national energy budget.

Canada's federal government also supports small research programs on biomass through departments and agencies such as the Canadian Forest Service and the National Research Council of Canada. As well it has a recently introduced subsidy program for the production of ethanol.

Mexico

Until very recently Mexico, blessed with abundant domestic oil and natural gas and substantial though often untapped hydroelectric reserves has not had a major focus, nationally, on renewable energy. Such projects as there have been have focused more on rural electrification using wind and solar as supplemental power sources (PRONASA projects in the early nineties) to the Sandia Labs managed 1994-2004 Mexico Renewables Program than federally funded efforts in research and development of indigenous renewable technologies. As Mexico's substantial renewable energy resources are similar in nature to its NAFTA partners it is

[86] p. 3, http://www.seia.org/roadmap.pdf
[87] Which is, in fact, contradicted, in the same report at the end, at p. 15, where it is suggested that the loss of research leadership is only imminent.
[88][http://www.nrcan.gc.ca/es/etb/cetc/cetc01/htmldocs/factsheet_wind_energy_r_and_d_program_e.html]
[89] http://www.on.ec.gc.ca/pollution/fpd/technologies/t-1000-e.html
[90] We write 'apparently' as the federal government website still referred to the old number at the time of writing.

reasonable to assume that there will be relatively quick diffusion of any technologies that become economically viable.

Mexico the third largest geothermal-electric energy producer in the world has a potential for eight to twelve gigawatts from this energy source, it also has fifty gigawatts of hydroelectric potential only about eight of which are currently exploited. Mexico also has large quantities of sun. This suggests that Mexico also has large opportunities for the export of green energy. Furthermore, as its national energy plan does not focus on green energy – seeking to exploit more of its plentiful and low cost natural gas reserves – the development of its 'green' resources may be a major trading opportunity – although more hydroelectric development may require heavy inflows of foreign capital to facilitate. This suggests that Mexican national 'green' policy might fruitfully be focused on trade opportunities. International trade in 'green' power will more rapidly drive a Mexican 'green' sector than reliance on the national energy plan, alone. As late as 2003 the Mexican government and energy authorities considered renewables as 'uneconomic' and in that same year there was no mandate for the national energy monopoly to build, buy or supply renewable energy[91].

It is worth noting in Mexico's case and while foreign investment in renewable energy has not been ruled out that the regulatory environment is very different than for its northern partners and may be a source of friction even in efforts to develop Mexican renewable energy for export.

Sub-national Governments

Subnational governments, in the US and Canada, have focused, primarily, on support for the deployment of renewable technologies, except in the largest states (such as California long a leader in renewable and 'green' technologies and, indeed, perhaps in a class by itself as an innovator and originator of green policies, legislation, research, early deployment etc.). This support has tended to take one (or more) of several forms. In many American jurisdictions (and more recently Canadian jurisdictions) there have been efforts to support reverse metering – allowing mandatory sale of surplus electricity generated in homes or businesses, from renewable sources, back to the electrical utility. This has been followed by measures (in some jurisdictions) to facilitate the connection of intermittent power sources such as wind and solar.

US - State Level

Considerable effort at both the national and state levels is going into supporting regulatory changes to accommodate 'green' power. This ranges from the FERC intervening to standardize interconnectivity for intermittent generators nationwide to individual states moving to support netmetering and distributed generation. Specific state programs in support of renewables tend to focus on state renewable energy portfolios, tax credits and low cost loans or subsidies to consumers and/or to renewable generators (such as wind farms) to install renewable technologies. Some of the largest states, such as California, even support research and development as well as deployment for locally available renewable sources. A good example is the "California Energy Commission Geothermal-electric Program"[92].

[91] Renewable Energy Financing in North America, Steven Probyn, p.4, Clean Power Income Fund, http://www.cec.org/files/pdf/ECONOMY/probyn_en.pdf
[92] http://www.energy.ca.gov/geothermal-electric/index.html

State Energy Portfolios

States concerned with renewable energy have tended to create "State Energy Portfolios," in the US which focus on mandatory or voluntary requirements to develop and use certain forms of renewable energy, typically with requirements that a certain percentage of current or future electrical energy supply in the jurisdiction come from these specified renewable sources. Similar types of programs are being implemented in Canada provinces[93]. Unfortunately, often the portfolios focus on the renewable energy sources available locally and do not include types of renewables that may be generated elsewhere and all too frequently they completely ignore hydroelectric power – the largest and cheapest source of renewable energy.

Overall, from a trade perspective it is likely that often issues will hinge more around how local jurisdictions may *count* things as green or not or *how* green they are. This leads to the need for rational and consistent standards for NAFTA countries in defining what "green" or "renewable" power is and how it is to be counted.

From the perspective of trade between NAFTA countries there are several issues related to portfolio type regulation. First, specific requirements for certain types of renewable energy may end up discriminating against renewable energy of other types – whether from neighboring subnational or national jurisdictions. Second, in a related point, many portfolios ignore, altogether, certain types of renewables when they are not generated locally. Subsidies to certain technologies only available to locally domiciled firms may also be an issue. These issues will be dealt with at length in Part III of this paper.

Canada - Provinces

Canada's provinces have, historically, not had much need to focus on renewable energy and, of course, gain a great deal of their energy from hydroelectric power (57% of Canada's total electric supply). Furthermore, Canadian provinces tend to have very small population bases (the very largest Ontario is approximately 10 million people and a third of the whole country in terms of population, Quebec is another 7.3 million). Only four provinces are large enough to compare to the average US state: Ontario, Quebec, Alberta and British Colombia.

At the provincial level there are various programs to encourage 'green' sources of energy (for example, BC requires 50% of new generation to be 'green.' Ontario requires the addition of 1% of baseload from wind and water each year until 2010) with a goal of 5% of electrical energy from 'renewables' by 2007 and 10% by 2010. A good example of the renewables mandate in smaller provinces is New Brunswick's policy of moving to 33% of energy budget from renewables by 2016 (up from 20% today). Much of this is intended to come from wind.

In the provinces with significant hydroelectric resources we are seeing a renewed emphasis on hydroelectric (10 Gw. now in planning or construction), efforts to allow netmetering and distributed generation and to allow the connection of renewables to the grid. Outside of hydroelectric wind is most focused on and biomass has good potential. Canada's northerly latitude and long winters militate against solar technologies such as CSP.

[93] A good Canadian example is the Province of Ontario which requires the addition of 1% of base load to be from renewable sources, each year through 2010 AD. Specifically, in Ontario's case 375 Mw./year to composed of 225 Mw. of wind and 150 Mw/year of water from Crown and private lands.

Regulation of Access of Renewable Sourced Energy to the Grid in Canada US Mexico

In the US and Canada energy is regulated in good part at the state or provincial level as well as at the federal level. In the U.S. the *Federal Energy Regulatory Commission* has extensive authority and in Canada the *National Energy Board*[94], "…an independent federal regulatory agency with jurisdiction over the export of electricity from Canada and over the construction and operation of international power lines" and *Natural Resources Canada* (the federal department with responsibility for energy issues) are the federal level arms of government concerned with energy. In Mexico, it is the *Energy Regulatory Commission* which has exclusive federal authority over electricity and regulates the two state owned utilities, *Comisión Federal de Electricidad* (CFE) and *Luz y Fuerza Centro* (LFC). At the international level, between the NAFTA partners, they have created the The North American Energy Working Group:

The North American Energy Working Group (NAEW G) was established in spring of 2001 by the Canadian Minister of Natural Resources, the Mexican Secretary of Energy and the U.S. Secretary of Energy, to enhance North American energy cooperation. The Group is led by officials from Natural Resources Canada, the Mexican Secretariat of Energy, and the U.S. Department of Energy.

The goals of the NAEWG are to foster communication and cooperation among the governments and energy sectors of the three countries on energy-related matters of common interest, and to enhance North American energy trade and interconnections consistent with the goal of sustainable development, for the benefit of all. This cooperative process fully respects the domestic policies, divisions of jurisdictional authority and existing trade obligations of each country.

To achieve these goals, the NAEWG exchanges views and shares information on factors affecting North American energy, including policies and programs, sector developments and anticipated demand and sources of supply. It also identifies issues that need to be addressed, such as regulatory structures, interconnections, technical specifications, and technology research and development.

The scope of the NAEWG's discussions includes the full range of energy development, production, transport and transmission, distribution and consumption in North America. It also considers the full range of energy sources, as well as the efficient and clean production and use of energy.[95]

While there has been strong support and significant efforts in the US to support distributed generation and the connection of renewable energy sources to the grid such efforts in Canada are much weaker and of much more recent vintage. Canada still has not been able to

[94] A bulletin describing the tribunal's complete responsibilities many of which are concerned with oil and gas, http://www.neb-one.gc.ca/energy/electr_e.pdf

[95]North America Regulation of International Energy Trade, The North American Energy Working Group, December 2002, http://www.fe.doe.gov/programs/electricityregulation/publications/electricitytraderegulation.pdf - this document is a chart summarizing the applicable legistation pertaining to energy exports and imports in each jurisdiction in side-by-side format.

effectively implement netmetering[96] despite recent provincial announcements of support as netmetering is illegal[97], violating various provisions of the *Electricity and Gas Inspection Act*. Currently *MicroPower Connect* (MPC) has a mandate to identify and eliminate these barriers, in collaboraton with *Natural Resources Canada* and hopes to do so by 2007[98]. Progress has been slow in Canada. Indeed, in Quebec it was as recently as 2003 that the first PV installation was connected to the grid. However, currently some Canadian provinces are revisiting netmetering and following their American state counterparts in enacting regulations permitting same.[99] [100].

Other recent interconnection efforts in Canada have resulted in a national guideline, published in 2003 for the interconnection of micropower inverter based systems to the grid[101]. (ie small distributed generation facilities). This guideline is part of a process to allow various provincial generators and regulators to create standards and guidelines for their jurisdictions. Jurisdictions which have acted are: BC, Alberta, Saskatchewan, Ontario and Quebec[102]. There is no single national standard on interconnection of renewable power sources to provincial grids such as the *FERC* has promulgated in the US. Each province, insofar as there *are* interconnection standards has its own.

Both the *FERC* and various states have made significant efforts to encourage the connection of renewable sources of energy to the grid with California, as always leading the pack. On May 12 and 25 2005 the FERC announced final regulations on interconnection for small wind and large wind generators, respectively[103] these extend on and expand on their regulations of 2003[104]. Fifteen states, as of 2003 had established clean energy funds, generally financed by small levies on transmission fees to be applied in support of various in-state clean energy technologies. As of the same year (the last year for which DOE data is available) 18 states had restructured their electrical sectors, 5 had their restructuring delayed and California had its restructuring suspended[105]. Many states, such as in New England, have formed regional power pools which maintain markets for many types of energy including wind and other renewables.

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[96] As of October 2004 there were no netmeters certified for use in Canada, http://www.oja-services.nl/iea-pvps/nsr03/can4.htm

[97] this caused Manitoba Hydro to have to drop its netmetering program

[98] http://www.micropower-connect.org/NetMeteringProject/index.htm

[99] Most recently the Province of Ontario on Oct 25, 2005, http://ogov.newswire.ca/ontario/GPOE/2005/10/25/c5929.html?lmatch=&lang=_e.html

[100] Requirements are unwieldy and bureaucratic which will likely interfere with uptake – as the unions are fearful for the lives of their workers and HydroOne is extremely conservative this may be the real purpose of the provisions. Nor does netmetering in Ontario allow more than credits against electricity taken from the grid, to be paid for your excess electricity requires another unwieldy process including application for a generator license from the Ontario Energy Board. This implies that it is very difficult for the home owner of small generator to offset capital costs with sales of surplus electricity. This measure may be more of a political "me too" gesture than a real netmetering policy. A summary of requirements in Ontario: http://www.hydroonenetworks.com/en/electricity_updates/renewable_technologies/default.asp#6

[101] Micropower Connect: Interconnection Guideline, Micro Power Connect, June 16 2003

[102] http://www.micropower-connect.org/standards/index.htm

[103] Dockets RM-02, http://www.ferc.gov/industries/electric/indus-act/gi/small-gen.asp and RM05-4, respectively, http://www.ferc.gov/press-room/pr-archives/2005/2005-2/05-25-05-E-1.asp#skipnavsub. Connection procedures for large generators, http://www.ferc.gov/industries/electric/indus-act/gi/wind.asp#skipnavsub

[104] Order # 2003-A, 2003 AD.

[105] http://www.eia.doe.gov/cneaf/electricity/chg_str/restructure.pdf

In Mexico the energy industry is state owned and regulated primarily by the federal government which in the *Public Electricity Service Act*, of 1975, gave itself exclusive authority over the electric industry. In 1995 the *Energy Regulatory Commission* was transformed into an empowered independent regulator of the electric and gas industries. This commission has power over imports and exports of energy and the building of private power generation facilities (which have to enter into an exclusive contract for their output with the CFE). A number of these private facilities (IPPs) have been built or are under contract to be built[106].

Part III: Analysis

The analytical section of this paper will look at ten different items. These are, in order:

National Treatment

In Chapter 6, Article 606 makes clear that "national treatment" will apply to provinces and states as well as national bodies. This is a potentially key point for renewables which are often largely regulated at state or provincial levels and state/provincial level programs, such as RPSs, which currently vary widely. In Chapter 3, Article 301 of the NAFTA, incorporates the whole of Art. III of the GATT including its interpretive notes. The NAFTA also incorporates Art. XX of the GATT (General Exceptions) in Article 2101:1(b). These provisons are highly relevant to any analysis of national treatment in relation to renewable energy sources. The rights and obligations under the WTO TBT Agreement are affirmed between the signatories in Article 903. As there are no relevant NAFTA complaints or panels to draw on, this paper will analyze the possible consequences of national treatment in light of experience in the context of the relevant GATT provisions.

Renewable Portfolio Requirements and their Criteria

In a document produced for the Commission on Environmental Cooperation under the North American Free Trade Agreement, Horlick, Schuchhardt and Mann have argued that US state renewable portfolio standard (RPS) laws, which require retail sellers of electricity to include in their portfolios a certain percentage or amount of electricity from renewable sources, may violate the National Treatment provisions in the GATT.[107] This conclusion is in large part based on the assumption that "Electricity produced from renewable resources has exactly the same qualities as electricity generated from other (conventional) resources and it is the same whether domestically produced or imported."

On the basis of this assumption Horlick, Schuchhardt and Mann apparently consider it a foregone conclusion that electricity from renewable sources would be found to be a like product to electricity from non-renewable sources. As has been pointed out in lengthy response to their study by the Union of Concerned Scientists, the legal analysis of Horlick, Schuchhardt and Mann is questionable in some respects. It seems based on the presumption that the WTO adjudicator

[106] http://www.eia.doe.gov/emeu/cabs/mexico.html
[107] Gary Horlick, Christiane Schuchhardt & Howard Mann, NAFTA Provisions and the Electricity Sector, (North American Commission for Environmental Cooperation, Article 13 Initiative, Background Paper, Electricity and the Environment, 8 Nov. 2001) [hereinafter CEC Background Paper].

could never find that two products with similar physical characteristics are nevertheless "unlike", for example, because the other factors probative of "likeness", such as consumer habits, point to a finding of "unlikeness."[108] As discussed in Howse, "Post-Hearing Submission to the International Trade Commission: World Trade Law and Renewable Energy: The Case of Non-Tariff Measures, May 2005" this presumption is not born out by a close reading of the doctrinal framework established by the Appellate Body in EC-Asbestos and Japan-Alcohol.[109]

While in these cases the physical characteristics of the products played a large role in the determination, the Appellate Body also went out of its way to stress that every case is different, and that the analysis of likeness is an inherently contextual undertaking of weighing all the relevant evidence (the Appellate Body also stated in EC-Asbestos that where physical characteristics are significantly different there must be considerable evidence on other matters weighing in the other direction to establish "likeness"; but it did not thereby endorse the reverse proposition that physical similarities establish even a rebuttable presumption of likeness. This reverse proposition would be incompatible in any case with the general burden of proof on the complainant in WTO litigation.) The evidence must necessarily include evidence of consumer preferences and habits, a factor that the Appellate Body has held must be addressed before making a determination of likeness. In this respect, the Union of Concerned Scientists notes: "The public's demand for renewables, as evidenced by the interest in diversity and the willingness to pay more for the product, demonstrates that the purchase decision has more dimensions than merely physical ones."

If the Appellate Body were of the view that physical similarities alone could always be an adequate basis for a finding of likeness, regardless of other kinds of evidence pointing towards "unlikeness," its requirement that all the evidence be weighed and all the factors considered in every case would make no sense: it would make a farce of judicial economy to require an adjudicator to go on to look at other factors and evidence, if indeed, physical characteristics, where sufficiently similar, could be simply dispositive of likeness. Even if renewable sourced energy were deemed to be a "like" product to nonrenewable sourced energy, a finding of Article III: 4 violation would require the additional step of a determination of "less favorable treatment" of imports.

Horlick et al. conclude that "the generating methods included in the renewable portfolios tend to disadvantage out-of-State producers, including foreign importers, because of different regulatory, topographic and environmental conditions which influence electricity generation in different regions and countries."[110] National Treatment, however, cannot possibly be interpreted to require a government in its regulations to neutralize the comparative advantage that some producers have over others due to such locational factors. This would be contrary to objectives

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[108] Scott Hempling & Nancy Rader, Comments of the Union of Concerned Scientists to the Commission for Environmental Cooperation in response to its "NAFTA Provisions and the Electricity Sector"

[109] See CEC Background Paper, supra note 12, at 9. Horlick, Schuchhardt and Mann admit there is no textual basis in the GATT treaty for their proposition: "There are no specific provisions in the text of the GATT 1994 itself which plainly discipline countries from making a distinction between traded like products based on criteria or factors which are not physically embodied in the product." As a scientific matter, it may well be misleading in any case to think of the process of producing energy as somehow not physically embodied in the energy itself. Energy is inherently dynamic—it is a process of transformation. The product is the process.

[110] Ibid. at 10.

of the WTO as stated in the Preamble to the WTO Agreement, including optimal use of the world's resources.

In EC-Asbestos the Appellate Body has suggested that the notion of "less favorable treatment" must be read in light of the purpose of avoiding "protection" stated in Article III: 1. It will not be appropriate to find "less favorable treatment" where the disadvantage to imported products stems entirely from foreigners' locational disadvantages in producing a product that meets a regulatory condition rationally designed to achieve a non-protective purpose. However, Horlick et al. point to definitional features of some States' portfolio standards that include within eligible renewable sources some kinds of renewable energy and exclude others, in such a manner as to favor, systemically, domestic producers. From the perspective of the environmental and energy security goals that underpin favoring renewables as such over nonrenewables, these definitional features are not rational or justified, according to Horlick et al. If this is indeed true — and this is a matter strongly contested by the Union of Concerned Scientists — a finding of "less favorable treatment" of the group of imported products under III: 4 might well be correct.

Along similar lines, the meaning of "like" product under III: 4 is able to address the concerns of Horlick et al., without resorting to their forced reading that renewable sourced energy is a like product to non-renewable sourced energy on account of physical similarities alone. Distinctions in renewable portfolio standard regimes that distinguished between different sources of renewable energy would be analyzed under Article III: 4 by first of all determining whether domestic energy from renewable source A (included in the portfolio standard) is a like product to imported energy from renewable source B (not included in the portfolio standard). A WTO adjudicator might conclude that as a general matter renewable sourced energy is an "unlike" product to non-renewable sourced energy, but, conversely, when comparing energy from two different renewable sources, find that the products are indeed "like." There is thus no need to force the reading of III: 4 to treat all physically similar energy as "like" in order to avoid the kind of arbitrary discrimination between different renewable sources that Horlick et al. may be quite legitimately worried about.

Article XX of the GATT: General Exceptions

Assuming that either fiscal or non-fiscal measures on renewable energy were found to violate one or more of the incorporated provisions of the GATT discussed above, they might nevertheless be justified under one or more of the exceptions in Article XX of GATT, which have been incorporated into NAFTA through NAFTA Art. 2101 in respect to trade in goods. Of particular relevance are the XX(b) exception for measures necessary for the protection of human or animal life or health and XX(g) measures in relation to the conservation of exhaustible natural resources. Under XX(b) it would be necessary to demonstrate that there is a real health risk from non-renewable energy and that measures to promote renewables are either an indispensable means of addressing the risk or 1) that there is a close connection between the renewables measures and solving the health risk and 2) the trade restrictive impact is not disproportionate to the contribution of the measure to addressing the risk (EC-Asbestos, Korea-Beef).

A range of documents from international organizations, and those that have emerged from intergovernmental conferences such as Bonn 2004, attest to the role of renewables in addressing the risks from conventional energy, and are evidence of wide and growing recognition of this role by the international community. A condition of maintaining measures based on an Article XX justification is that they might be applied so as to constitute unjustifiable

or arbitrary discrimination between countries where the same conditions prevail or a disguised restriction on international trade (this is based on the "chapeau" or preambular paragraph of Article XX). This condition, it must be emphasized, deals only with application through administrative or judicial action, not the scheme as such (US-Shrimp, US-Shrimp 21.5).

Unjustifiable discrimination may result from the application of a scheme which is rigid and unresponsive to different conditions in different countries. Arbitrary discrimination may occur if there is a lack of due process and transparency in the manner in which the criteria of the scheme are administered, if there are discriminatory effects on foreign interests (US-Shrimp). There is lack of clear judicial guidance so far on the meaning of "disguised restriction on international trade" (US-Reformulated Gasoline). Article XX(g) permits otherwise GATT inconsistent measures that are "in relation to the conservation of exhaustible natural resources." A specific condition of Article XX(g) is that the trade measures to be justified must be taken in tandem with comparable measures on production or consumption that apply to the domestic market (evenhandedness). The air is an exhaustible natural resource according to GATT/WTO jurisprudence. As a general matter, the meaning of "exhaustible natural resources" is to be guided by emerging legal and policy norms on sustainable development and biodiversity (US-Shrimp). Unlike with XX(b) where the connection between the measure and its aim is expressed by the term "necessary" leading to the requirement that the measure either be indispensable or have a close connection to its aim and a not disproportionate trade impact, the language "exhaustible natural resources" expresses the concept of a rational nexus between the measure and its aim, a "real" connection (US Shrimp). Additionally, the measure must not be disproportionately wide in reach or scope (US-Shrimp). A longstanding issue is whether, under Article XX, a WTO Member can justify measures aimed not only at dealing with local, i.e. domestic environmental externalities, but also with global environmental commons challenges and, further, whether such measures can include measures aimed at inducing other states to adopt appropriate policies to protect the commons.

In US-Shrimp, the AB made it clear that in principle Article XX was available to address other states' policies (Paragraph 121). At the same time the AB did not resolve the question of whether some kind of territorial nexus between the country taking the measure and the environmental problem is needed. Given the long term effects of the use of non-renewable energy sources are universal, and given the many immediate transboundary effects, if such a nexus were indeed required, it would not be hard to show in the case of renewables measures. Notably, in US-Shrimp, the AB suggested that, even supposing a territorial nexus were to be required it was satisfied by the mere fact that some members of the endangered species of sea turtles were to be found in US waters some of the time. This means that even if the AB or some members of the AB had been leaning towards a "nexus" requirement, what was being considered was a kind of "minimal contacts" test.

Technical Standards

Technical standards continue to grow in importance in a world that is not only increasingly interconnected but increasingly reliant on shared technologies. As tariffs have fallen, technical standards have provided a potential area for the creation of new non-tariff trade barriers. In light of the above, technical barriers to trade (TBTs) have become of increasing concern worldwide.

Due to the closeness of the partners in the NAFTA zone and the steadily increasing integration of economies that were already close before the inception of the NAFTA issues of standards are of even greater importance than between the NAFTA countries and their other trade partners. Repercussions of standards set or a measure taken in the most remote state or province may have immediate effects in NAFTA partner countries.

The Technical Standards chapter of the NAFTA, chapter nine, article 902 states: "Each Party shall seek, through appropriate measures, to ensure observance of Articles 904 through 908 by state or provincial governments and by non-governmental standardizing bodies in its territory." It further states that all parties to the NAFTA reaffirm their commitments to the TBT Agreement under the GATT.

The chapter does not in any way abrogate member states rights to set or maintain standards nor to exclude the products or services of partner states that *fail* to meet those standards. However, the chapter states that "National Treatment" will be extended to NAFTA zone exporters – that is to say, any vendor from anywhere in other NAFTA countries will be treated exactly the same as national vendor, in meeting the requirements of national standards. Moreover, in no case shall NAFTA exporters of goods and services be treated less well than exporters from any country outside the NAFTA zone.

Chapter 9 also prohibits use of standards to create "unnecessary obstacles to trade" within the constraint of "legitimate objectives" as defined in the annexes to chapter 9. Such legitimate objectives include:

(a)safety,

(b)protection of human, animal or plant life or health, the environment or consumers, including matters relating to quality and identifiability of goods or services, and

(c)sustainable development,

considering, among other things, where appropriate, fundamental climatic or other geographical factors, technological or infrastructural factors, or scientific justification but does not include the protection of domestic production[111]

In Chapter 9, an international standards body is defined as: "**…**a standardizing body whose membership is open to the relevant bodies of at least all the parties to the GATT Agreement on Technical Barriers to Trade, including the International Organization for Standardization (ISO), the International Electrotechnical Commission (IEC), Codex Alimentarius Commission, the World Health Organization (WHO), the Food and Agriculture Organization (FAO), the International Telecommunication Union (ITU); or any other body that the Parties designate." Article 903 affirms that the parties to the NAFTA will maintain and recognize their existing obligations to international standards bodies. Indeed, Chapter 9 specifically considers that any technical standard that conforms with accepted international standards is a standard compliant with the NAFTA.

If a new exporter finds s/he has to comply with standards in his target market it is much easier for him/her if s/he finds that by complying with local standards they are in compliance with NAFTA standards. If compliance is important it is easiest and most effective yet to comply

[111] http://www.mac.doc.gov/nafta/chapter9.html

to an international standard thus allowing not only NAFTA exports but also easing the way to international exports outside of the NAFTA zone in one easy step. Furthermore, it is easiest for national standards authorities to look to one international standard and by complying with that standard *knowing* they are in compliance with their NAFTA obligations.

Technical barriers to trade fall into several categories:

1. New barriers to trade often created by sub-national bodies
2. Pre-existing barriers where harmonization efforts have not yet reached
3. Existing barriers caused by legislation either national or subnational where no importer or exporter has made the effort to get the law(s) changed and has simply gone about his business.

As this paper is concerned with renewables – a sector that did not exist when the NAFTA was instigated pre-existing barriers currently being harmonized, insofar as such might still exist in the energy sector are of little interest. The technical barriers to trade in renewable energy mostly arise from new barriers created by sub-national bodies and the third item, which arises as trade in renewable energy hardware is often conducted on a small scale with equally small scale importers and exporters only marginally concerned with regulatory compliance.

Sub-national bodies such as state or provincial energy regulatory authorities are often cavalier in their nominal responsibilities to be in compliance with the standardization provisions of the NAFTA. This may be due to limited resources, inadequate informational support for the NAFTA provisions that are relevant by the appropriate national authorities, simple ignorance or even unwillingness to recognize obligations beyond a given state or province's border when traditionally the regulatory agency had a free hand to do as it pleased within the areas of its competence.

A good example of the third type of existing legal barrier embodied in national and provincial legislation is the trade in solar photovoltaic equipment between Canada and the US. Unfortunately, there is no mutual recognition of the standards set by the UL and the CSA in electrical matters. The vast bulk of PV equipment imported into Canada comes from the US and the importers have been lax in applying for CSA electrical approval of their equipment. This may be because the trade is small or because CSA requirements are onerous to small importers, in the electrical area. The consequence has been that most PV equipment (if not all) installed in Canada has been technically illegal for use as, while it might comply with US standards, it has not been certified by the CSA or other competent Canadian electrical standards setting bodies. There are also issues of connecting to provincial grids as provincial electrical authorities and utilities have varying standards that the equipment has also not been certified as being in compliance with[112]. It might be noted, in passing that this type of barrier is mostly caused by the small scale of the imports. A question might also be usefully asked here by inquiring *why* UL and CSA standards are still not interchangeable for electrical and electronic goods many of which are imported, in any case, from third party countries?

While there are a number of barriers that have been created in recent years at the state/provincial level of energy regulation many of these could, in all likelihood, be remedied by proposing and encouraging the application of a model Renewables Energy Portfolio that

[112] http://www.oja-services.nl/iea-pvps/nsr03/can4.htm, see last page for a discussion of this matter.

remedies the defects of rather ad hoc state and provincial legislation. There have been US efforts to pass a *federal* and binding renewable energy portfolio. At least to date, these efforts have failed. There are also efforts to come to a North America wide definition of what renewable energy is.

A solid model portfolio and a uniform definition of "renewable energy" would be a very good start in helping remedy the defects in sub-national renewables portfolios. It might also be noted that as utilities and investors build more renewable capacity and wish to trade same that NAFTA inspired litigation might also concentrate minds in state and provincial capitals, who to this point have considered renewables portfolios more as efforts in public relations than as serious legislation for a major industry segment in the energy industry.

In the Standards chapter of the NAFTA it states at Article 902(2) that, "Each Party shall seek, through appropriate measures, to ensure observance of Articles 904 through 908 by state or provincial governments and by non-governmental standardizing bodies in its territory." This article makes clear the obligation of the signatories to use "appropriate measures to *ensure* [authors' italics] observance…by state and provincial governments." Key clauses that one hopes that the states and provinces might be encouraged to observe in this chapter are:

In Article 904 in the section on "Unnecessary Obstacles"

> 4. No Party may prepare, adopt, maintain or apply any standards-related measure with a view to or with the effect of creating an unnecessary obstacle to trade between the Parties. An unnecessary obstacle to trade shall not be deemed to be created where:
>
> (a) the demonstrable purpose of the measure is to achieve a legitimate objective; and
>
> (b) the measure does not operate to exclude goods of another Party that meet that legitimate objective.

Here many provisions of state and provincial level renewable portfolios may be construed to constitute unnecessary obstacles to trade.

Apart from issues raised by 904(4) there are issues of compatibility and equivalence in the standards chapter at 906(6):

> **Compatibility and Equivalence**
>
> 1. Recognizing the crucial role of standards-related measures in achieving legitimate objectives, the Parties shall, in accordance with this Chapter, work jointly to enhance the level of safety and of protection of human, animal and plant life and health, the environment and consumers.
>
> 2. Without reducing the level of safety or of protection of human, animal or plant life or health, the environment or consumers, without prejudice to the rights of any Party under this Chapter, and taking into account international standardization activities, the Parties shall, to the greatest extent practicable, make compatible their respective standards-related measures, so as to facilitate trade in a good or service between the Parties.

Combined with the provision against unnecessary obstacles of 904(4), 906(2), the requirement to "make compatible" their respective standards related measures "to the greatest extent practicable…so as to facilitate trade in a good or service…"" will have force in arguing for uniform standards on renewable energy and harmonized energy portfolio standards. There has been no juridical action on these matters to date either at the NAFTA or WTO levels, for the good and sufficient reason that private sector interests have – to date – not been significantly impacted. As renewable energy sources are more widely deployed and traded it is easy to envision that generators and traders of renewable energy will start to focus on these trade related issues in all seriousness.

In light of the fact that complying with international standards automatically puts one in compliance with one's NAFTA obligations and in light of the fact that trade in energy is an increasingly international business – let alone the fact that in the NAFTA zone current efforts are being made to interconnect to grids *south* of Mexico – it only makes sense to focus efforts on harmonization at the multilateral level which at one and the same time satisfies NAFTA zone needs and opportunities for energy imports and exports to and from the NAFTA zone.

Agriculture

The Agriculture Chapter of the NAFTA contains nothing that refers to biofuels or ethanol. Indeed, the chapter is primarily concerned with the basics of tariffs and phytosantary measures. Agriculture at the time of the drafting of the NAFTA was 'agriculture' in the traditional sense – neither a nascent energy industry nor a nascent chemicals and plastics feedstock production industry.

NAFTA's Energy Chapter

Chapter 6 of the NAFTA on Energy and Basic Petrochemicals applies to trade in electrical energy: the definition of energy includes "goods" under, inter alia, 27.16 of the Harmonized System, which is the classification for electricity. "Subject to the rights and obligations" of the NAFTA itself, Art. 603 (1) incorporates the provisions of the GATT "with respect to prohibitions or restrictions on trade in energy and basic petrochemical goods." This is a clear reference to Article XI of the GATT, entitled "Quantitative Restrictions." Article XI of GATT, also bans "prohibitions and restrictions" on imports and exports.

In the *India-Autos* case, the GATT panel took a very broad view of the measures covered by Article XI, which included de facto prohibitions and restrictions that did not formally restrict imports. However, in all of the cases where a broad view of the measures covered by Article XI was articulated, even if the measures in question did not have the form of a prohibition or restriction but some other kind of regulatory or administrative action nevertheless the action was targeted at imports or exports. In other words, even on the expansive view of Article XI, quantitative measures that apply to both domestic and imported product should be examined under Article III:4 of GATT, not Article XI.

The essential distinction is articulated by Prof. Joost Pauwelyn: "The prohibition in Article XI was only intended to prevent quantitative restrictions imposed solely on imports (such as a ban or quota on shoe imports to protect domestic shoemakers). To apply the Article XI prohibition to all measures, including domestic regulation, on the sole ground that they restrict

imports would fly in the face of GATT's presumption in favor of regulatory autonomy and nullify the rights of WTO Members under Article III of GATT."[113]

In the case of NAFTA Chapter 6, there is an explicit understanding that Art. XI of the GATT as incorporated into the NAFTA prohibits "in any circumstances in which any other form of quantitative restriction is prohibited, minimum or maximum export-price requirements and except as permitted in enforcement of countervailing and antidumping orders and undertakings, minimum or maximum import-price requirements." (603.2)

In Europe, in particular, requirements that a quantity of energy be purchased at a minimum price have been adopted in some jurisdictions as a means of countering the price disadvantage of renewal sources of generation. To our knowledge, this kind of pro-renewables measure has not been implemented in North America. If such a measure were enacted, and it applied to imported energy, an issue would arise as to whether the minimum-price requirement constituted an "import-price requirement" within the meaning of 603.2. In our analysis, the answer would be negative, where the minimum price requirement applies not only to purchases of imports but also to purchases of energy from domestic sources; in such an instance the issue would be one of National Treatment of imports in generally applied internal regulation. This analysis is a logical extension of the view of the relationship between Art. XI of the GATT and the National Treatment obligation expressed by Prof. Pauwelyn.

Art. 608 provides: "The Parties agree to allow existing or future incentives for oil and gas exploration, development and related activities in order to maintain the reserve base for these energy resources." The effect of this provision would, most obviously, appear to be to exempt from discipline under National Treatment those tax incentives that are not already exempt from National Treatment as "subsidies" within the meaning of Art. III:8 of the GATT, as well as conditions for the receipt of subsidies or tax incentives, which may be "internal regulations" within the meaning of GATT Art. III: 4. (See the section of this paper on subsidies and tax measures). The provision perpetuates the traditional bias in favor of fossil fuels and is regrettable from an environmental perspective.

It should be noted that Chapter 6 contains a limitations clause that makes the provisions of the Chapter of limited applicability to the Mexican electrical utility sector.

Financial Services

There is a strong argument for characterizing tradable renewable energy certificates or credits as financial instruments; they are essentially intangible assets—in this case derivatives, whose ultimate value derives from the environmental benefit of generating energy from renewable sources, as recognized either in government-mandated or voluntary commitments to use renewable sources—commitments that, in a trading system, can be fulfilled through the purchase of the certificates by an energy user. As noted earlier in this paper no current operational interjurisdictional trading scheme for renewable energy certificates yet exists, even *within* individual NAFTA countries (i.e. between federal sub-units or regions).

[113] Joost Pauwelyn, Rien ne va plus? Distinguishing Domestic Regulation from Market Access in GATT and GATS (Dec. 2004) (unpublished manuscript, Duke Univ. Law Sch., Durham, NC). As Pauweyln notes, the Working Party Report on The Haitian Tobacco Monopoly refused to consider quantitative measures that were not targeted at imports to be a violation of Art. XI.

The NAFTA financial services chapter (Chapter 14) applies, inter alia, to "cross-border trade in financial services." (Art. 1401.1.c). In Art. 1416, "financial service" is broadly defined as "a service of a financial nature, including, insurance, and a service incidental or auxiliary to a service of a financial nature." The NAFTA disciplines with respect to financial services, differ depending upon whether the service was of a kind that existed and was permitted at the time the NAFTA came into effect or whether it is a "new financial service." Clearly, if they are a financial service, tradable renewable energy certificates would be a "new financial service" within the meaning of the NAFTA. Thus, in addition to National Treatment, the key obligation is contained in Art. 1407, which provides: "Each Party shall permit a financial institution of another Party to provide any new financial service of a type similar to those services that the Party permits its own financial institutions, in like circumstances, to provide under its domestic law. A Party may determine the institutional and juridical form through which the service may be provided and may require authorization for the provision of the service. Where such authorization is required, a decision shall be made within a reasonable time and the authorization may only be refused for prudential reasons."

Art. 1407 appears to go *beyond* National Treatment in requiring that a NAFTA Party (let's say the US) to allow the financial institutions of another Party (let's say Canada) to provide a new financial service even if that service is not provided by domestic (in this case US) institutions, provided that the service "is of a type similar" to services that domestic (US) institutions are permitted to provide under domestic (US) law. The language "is of a type similar" raises the question of whether renewable energy certificates are analogous to any other existing, permitted financial services in NAFTA Parties. Whether such certificates are "similar in kind" for example to tradable emissions permits is a debatable issue, but such an analogy is certainly plausible.

The right of a NAFTA Party to determine "the institutional and juridical form" through which the services may be provided" by the financial institutions of another NAFTA Party means that, if for example, an Ontario institution wants to sell renewable energy certificates in Maine, Maine and US federal authorities may stipulate the kind of institutional vehicles for trading in, and the legal status of the certificates themselves, in Maine. However, to continue this example, Art. 1407 says nothing on its face as to whether and under what circumstances Maine may be required to *recognize* certificates from Ontario in fulfillment of any government-mandated renewable energy sourcing requirement in Maine, or as fulfillment of conditions for any incentives tied to generating or sourcing renewable energy in Maine.

This issue of recognition is instead, at least partly, a question of National Treatment. Art. 1405 of the NAFTA explicitly provides that National Treatment is a matter of equal competitive opportunities for domestic financial services providers and institutions and those of other NAFTA Parties in "like circumstances." Consider the following scenarios, which differ considerably from the perspective of equal competitive opportunities:

1) Maine does not include hydroelectric power as a means of satisfying its mandatory renewable energy sourcing requirements but the Ontario certificates do not distinguish between energy generated from hydroelectric power and other sources. Therefore, Maine does not recognize the Ontario certificates. However, if Ontario providers were to create a certificate based on Maine's definition of renewable sources, recognition would be forthcoming.

2) Maine refuses to allow renewable energy generated outside the state as counting towards the fulfillment of its mandatory requirements for renewable energy sourcing. However, Maine does not prevent Ontario *providers* from devising and selling certificates based on the generation of renewable energy *in* Maine.

3) Maine will only recognize certificates from in-state providers of renewable energy certificates, or providers from elsewhere in the US.

Scenario 1) arguably does not entail any violation of National Treatment with respect to crossborder financial services. To the extent to which the Ontario certificates—by including hydroelectric power—do not allow Maine to be assured that its own more restrictive renewable sourcing requirements are being met, the providers of these certificates are not "in like circumstances" with in-state providers. They are not selling a service with like characteristics. Nor is there a violation of National Treatment with respect to trade in energy itself, in this case hydroelectric power, because the energy itself is *not* being traded across the border, only the certificate. At first glance, however, Maine's conduct could be disciplined by the norms in NAFTA Ch. 9 on Standards-Related Measures, which apply to measures, "that may, directly or indirectly, affect trade in goods or services between the Parties, and to measures of the Parties relating to such measures."(Art. 901.1) Art. 904.4 provides "No Party may prepare, adopt maintain or apply any standards-related measure with a view to or with the effect of creating an unnecessary obstacle to trade between the Parties." However, Maine's measure excluding hydroelectric power from the renewables sources that can meet its mandatory requirements would not be an unnecessary obstacle to trade in *financial* services here, because it does not "operate to exclude *goods* of another party" and thus under 904.4 must be deemed not to be an unnecessary obstacle. However, Maine's approach may raise issues with respect to another provision of Chapter 9, 906.4, which provides that "Each importing Party shall treat a technical regulation adopted or maintained by an exporting Party as equivalent to its own where the exporting Party, in cooperation with the importing Party, demonstrates to the satisfaction of the importing Party that its technical regulation adequately fulfills the importing Party's legitimate objectives." Thus, if Ontario certificates are consistent with Ontario's own definition of renewable energy, there would be an argument that they must be recognized by Maine, if Maine's legitimate environmental objectives are equally served by including hydroelectric power among the permissible sources of generation. However, Maine's objective may include furthering the development of alternative, higher-cost sources of renewable energy, in recognition of the need for such sources to meet future demands for "green" power.

Under scenario 2), it is also questionable whether there is any violation of National Treatment with respect to the provision of financial services. Given Maine's policy decision to make mandatory sourcing of renewable energy from within the state, the provider of a certificate based on generation of renewable energy in Ontario is not in "like circumstances" with a provider of a certificate that guarantees in-state generation. *But* this does not mean that Maine's policy would be consistent with National Treatment with respect to trade in energy itself, whether as a good or service; it is just that here what is being *traded* is the certificate, the intangible asset, and not the energy itself. Finally, however, since as noted already Art. 906 of NAFTA on Compatibility and Equivalence applies to trade in services including financial services, Maine's non-recognition of certificates based on Ontario-generated renewable energy could violate 906.4, were Ontario able to show that generation of renewable energy in Ontario satisfies Maine's legitimate environmental objective. Thus, it will depend on whether Maine's

objective is to contribute to the solution of emissions problems within the state, or at a national, regional or global level. Obviously, the generation of renewable energy in Ontario does not of itself reduce the amount of fossil-fuel-generated energy in Maine, so if the environmental objective is local, then Maine will be justified in its non-recognition of certificates based on Ontario-generated renewable energy.

By contrast with scenarios 1) and 2), scenario 3) seems to constitute a clear violation of National Treatment: both Ontario and Maine (or US) providers are offering the same service, and yet Ontario providers are disadvantaged in the Maine marketplace. They can still sell the certificates, for example to enterprises who might want to fulfill a voluntary promise to use renewable energy, and thus there is no violation of 1407, but the fact that the certificates are not recognized as means of satisfying Maine's mandatory requirements makes the competitive opportunities of Ontario providers clearly unequal those of Maine providers.

Government Procurement

The NAFTA government procurement chapter, chapter 10, applies to listed federal government entities and enterprises of NAFTA Parties, as set out in Annex 1001. Besides requiring transparency in procurement and bid challenge procedures, chapter 10 also contains a National Treatment obligation, which requires that suppliers from other NAFTA parties receive treatment "no less favorable" than that provided to local suppliers in procurement. Art. 1006 prohibits "offsets," which are defined as "conditions imposed or considered by an entity prior to or in the course of its procurement process that encourage local development or improve its Party's balance of payments accounts, by means of requirements of local content, licensing of technology, investment, counter-trade or similar requirements." Art. 1007.1 requires that "Each Party shall ensure that its entities do not prepare, adopt or apply any technical specification with the purpose or the effect of creating unnecessary obstacles to trade." "Technical specification" is defined in Art. 1025 as "a specification which lays down goods characteristics or their related processes and production methods, or services characteristics or their related operating methods, including the applicable administrative provisions," as well as specifications that deal with labeling, packaging, etc.

Where a covered federal entity of a NAFTA party is purchasing energy, none of these various obligations would prohibit it from favoring energy from renewable sources. The issues raised by the "like products" concept with respect to trade in goods (see above at p. 36, in "Renewable Portfolio Requirements and their Criteria") and the analogous language of likeness in the National Treatment obligations in the services and investment chapters of NAFTA, are not present here, because "likeness" is absent from the National Treatment obligation in 1003, which refers merely to "treatment no less favorable than the most favorable treatment that the Party" accords to "its own goods and suppliers." Thus, the National Treatment obligation 1003 only requires non-discrimination on the basis of national origin. With respect to "offsets," environmentally-related conditions in procurement are not within the definition of "offsets" in 1006. Problems would only arise if a NAFTA Party mixed local development and environmental goals in the way that it defined renewable energy or in determining the extent of an offset.

The NAFTA disciplines on "technical specifications" (Art. 1007) may be relevant to the manner in which eligible renewable sources are defined in a procurement program that favors renewables. Issues are most likely to arise where criteria or standards are such that traded

electricity is disfavored. These criteria or standards may be scrutinized to determine whether they are "necessary" to the government's legitimate environmental objective. Finally, Chapter 10 contains an exception for measures "necessary to protect human, animal or plant life or health," which is structured in much the same way as Art. XX of the GATT.

Subsidies and Tax Incentives

There are no stand-alone disciplines on subsidies in the NAFTA. Chapter 19, however, allows the Parties to retain their existing countervailing duty laws, subject to certain conditions and procedures, including NAFTA panel review of determinations by domestic agencies as against the *domestic* law of the NAFTA Party imposing the duties. This, however, does *not* mean that a measure in the form of a subsidy or tax incentive cannot be challenged as a violation of provisions in the various individual chapters of NAFTA. The NAFTA does not contain a definition of "subsidy." In some cases, "subsidies" and/or tax measures are explicitly excluded from the ambit of measures that may be challenged under provisions of a specific NAFTA Chapter. For instance, the National Treatment obligation in the Investment Chapter, Chapter 11 does not apply to "subsidies or grants provided by a Party or a state enterprise, including government-supported loans, guarantees and insurance."(Art. 1108.7) Article 2103 contains a list of provisions in NAFTA which apply to taxation measures, and under what conditions. The default rule is that NAFTA provisions do *not* apply to tax measures unless explicitly indicated in 2103.

Clearly, as is shown in the second part of this paper, subsidies and tax incentives are pervasive forms of policy support for renewables, especially in the US and Canada. A careful analysis of how these kinds of measures interact with NAFTA disciplines is therefore important.

A logical beginning point is National Treatment with respect to trade in goods. As has been discussed, the NAFTA incorporates the GATT Art. III provisions on National Treatment, including any exceptions. One such exception is GATT Art. III:8, which exempts from the GATT National Treatment disciplines on fiscal and other internal measures, "payment of subsidies exclusively to domestic producers". Since many subsidy measures adopted in North America for renewable energy are targeted at *users* or *consumers* of renewables, the Art. III:8 exception will arguably not apply, and therefore the measures in question may be subject to the National Treatment obligations of Art. III(2) (taxation) and Art. III:4 (other internal measures) of the GATT.

Art. III:2 of GATT requires identical taxation of "like products" and "not dissimilar" taxation of "directly competitive or substitutable products." As discussed above in this paper, Art. III:2 comes into play in the NAFTA context where a NAFTA Party chooses to tax renewable energy as a *product* differently from fossil fuel energy. In the case of tax incentives, however, generally speaking, Art. III:4 will be applicable; the question is the compatibility of the *condition* for receiving the benefit with National Treatment, and the condition is considered on its own terms as an "internal law, regulation or requirement" within the meaning of III:4. In other words, a condition that must be fulfilled to receive a benefit is viewed in the same terms as a mandatory government regulation. Therefore, the National Treatment discussion earlier in this paper as regards renewables portfolio requirements applies mutatis mutandis to the case of tax incentives conditioned on the purchase and/or use of renewables. But the GATT Article XX exception would also apply, as incorporated into NAFTA.

In the case of NAFTA provisions with respect to trade in **services**, "subsidies or grants provided by a Party or a state enterprise, including government-supported loans, guarantees and insurance" are excluded. The situation with respect to taxation measures is, however, more complex. The National Treatment obligation in the Services chapter, Art. 1202, applies to "taxation measures on income, capital gains or the taxable capital of corporations."(2103.4) The National Treatment obligation in services applies to other taxation measures as well, unless they existed at the time NAFTA came into force, are renewals or amendments of existing measures, or are new measures "aimed at ensuring the equitable and effective imposition or collection of taxes and that does not arbitrarily discriminate between persons, goods or services of the Parties or arbitrarily nullify or impair benefits according under the National Treatment obligation.

We have already noted the subsidies exception in the investment chapter, Chapter 11. Chapter 11 does not, generally speaking apply to taxation measures, except that the National Treatment obligation in Chapter 11 applies, subject to certain conditions and limitations, to taxation measures *other than*, inter alia, those on income, capital gains or on the taxable capital of corporations. Thus, typically, renewable energy tax incentives would be excluded from Chapter 11 disciplines.

Services

As already discussed in this paper, the trade in electricity in the NAFTA is treated, at least in part, as trade in goods based on the Harmonized System classification of electricity. To the extent, however, that a shift to competition in some jurisdictions has led, or will lead, to the unbundling of traditional vertically integrated electrical utilities into generation, grid, transmission, distribution and retail enterprises, the trade in services provisions in the NAFTA may be applicable. While the sale of power from a vertically integrated utility in Ontario to a similar utility or even to a power pool in New England may be seen as trade in electricity as a good, it is likely that sales by an Ontario provider of retail or wholesale electricity contracts in New England would be considered as trade in services.

The trade in services provisions of NAFTA, Chapter 12, include a National Treatment obligation that requires that "Each Party shall accord to service providers of another Party treatment no less favorable than it accords, in like circumstances, to its own service providers." In the *Mexico-Trucking* case, a NAFTA panel interpreted the key terms in the National Treatment obligation. The United States, the defendant in that case, argued that the language "like circumstances" provided a basis for the US treating Mexican trucking service providers as a whole differently from US providers of the same services, based on safety concerns, i.e. that "like circumstances" was not simply a market-based test as in GATT/WTO jurisprudence but could encompass as well public policy matters. The panel held: "the proper interpretation of Article 1202 requires that differential treatment should be no greater than necessary for legitimate regulatory reasons such as safety, and that such different treatment be equivalent to the treatment accorded to domestic service providers."(Para. 259).

Along the lines of our analysis of "like products" in the discussion above on National Treatment in trade in goods, we do not believe that, even on a strictly market-based approach, a service provider selling retail or wholesale energy including from renewable sources is in "like circumstances" to one providing only electricity from non-renewable sources of generation. Due to concern for the environment, where the structure of the market and technological facilities (e.g. metering) allow them to do so, consumers may well prefer to purchase renewable rather

than non-renewable generated electricity. If renewable and non-renewable generated electricity have not been differentiated by consumers in the marketplace in the past, it is due to the lack of capacity afforded to consumers to make a choice. This being said, as interpreted by the Mexico-Trucking panel[114], the National Treatment obligation with respect to services allows an additional margin of appreciation for policies that favor renewables: differential treatment is allowed provided it is "no greater than necessary for legitimate regulatory reasons."

It is in any case, requirements that electricity retailers or wholesalers' portfolios include a certain quantity of renewable energy that may be considered as non-discriminatory "quantitative restrictions" within the meaning of Article 1208, rather than in terms of National Treatment. It is notable that liberalization of such non-discriminatory measures is limited to the commitments that NAFTA Parties list in their schedules, and that no such liberalization commitments have been scheduled in relation to electricity.

Finally, the general exception in NAFTA Art. 2101.2 applies to the Services chapter. This exception concerns "adoption or enforcement by any Party of measures necessary to secure compliance with law or regulations that are not inconsistent with the provisions of this Agreement, including those relating to health and safety and consumer protection." The exception was the subject of interpretation in the Mexico-Trucking case. Relying heavily on GATT/WTO jurisprudence, the NAFTA panel viewed the essential issue of whether alternative, less trade restrictive, measures were available to achieve the goal of the Party invoking the exception, in that case trucking safety. The panel viewed this as a "strict" standard of justification.

Investment

Most relevant to the renewables context is the National Treatment, in the Investment Chapter of NAFTA, Chapter 11. Unlike other Chapters of the NAFTA, with a few rare exceptions (investment-related provisions outside Chapter 11), the Investment chapter allows a private right of action for damages against a NAFTA party, through the facility of investor-state arbitration.

The National Treatment obligation, Art. 1102 requires that no less favorable treatment be accorded to investors and investments of other NAFTA Parties than is accorded to domestic investors and investments "with respect to the establishment, acquisition, expansion, management, conduct, operation, and sale or other disposition of investments." The meaning of this provision has been the subject of confused and rather inconsistent jurisprudence among different investor-state arbitral tribunals (S.D Myers, Pope and Talbot, Feldman, Methanex)[115]

A general common ground between at least most of these tribunals is that the determination of "like circumstances" requires an inquiry into whether the investors or investments being compared are in the same economic sector or compete in the same marketplace. In the *S.D. Myers* case, the investor operated a PCB waste disposal business, which involved the transport of such waste from Canada for processing in the USA. The Canadian government moved to prohibit the export of such waste, requiring its processing in Canada. In

[114] In the Matter of Cross-Border Trucking Services, Final Report of the Panel February 6 2001, Secretariat File No. USA-MEX-98-2008-01, http://www.sice.oas.org/DISPUTE/nafta/english/U98081ae.asp
[115] Methanex Corp. v. United States of America, http://www.state.gov/s/l/c5818.htm

this case, there was material evidence that the actual motivation of the Canadian actions was the protection of the domestic industry, not the environment.

The tribunal seemed to oscillate between a focus on discriminatory intent and an objective conception of whether the Canadian and American enterprises were in 'like circumstances', which the tribunal considered from the perspective of whether they competed in the same sector.

The tribunal in the Pope and Talbot case appeared to suggest that public policy considerations might in some way also be relevant to the inquiry into like circumstances, as did the Mondev tribunal. In the Methanex case, a Canadian company challenged a California ban on MTBE, of which a key ingredient is methanol, the substance produced by the company, under both the National Treatment and expropriation provisions of the NAFTA (as well as other provisions). Methanex claimed that the ban was a result of corrupt dealings between California politicians and industries producing substitute products, while California maintained that the ban was a legitimate environmental and health measure, which addressed the harmful effects from MTBE seeping into California drinking water. However, quite apart from intentional discrimination based on corruption, Methanex also claimed that it was in like circumstances to producers of a substitute product to methanol, namely ethanol. Thus, by banning methanol and not ethanol, California was affording less favourable treatment to an investor "in like circumstances" with US ethanol manufacturers. The NAFTA investor-state panel rejected this argument of Methanex, holding that Methanex should be compared to those domestic US investors with which it had the *closest* competitive relationship, namely US producers of the exact same product that Methanex produced, MTBE; these of course were *equally* affected by the ban on methanol by California.

The Methanex panel's view that an investor is *only* in like circumstances with the *one* domestic investor or investment to which it has the closest competitive relationship is not supported by the text of the NAFTA; however, what is important and correct in the Methanex panel's analysis is the recognition that just because products are substitutes in the sense that they can perform the same function or end use does not mean that the products or their producers are in direct competition in the same way that identical products are in direct competition. Similarly, while renewable-generated electricity can in many respects serve the same purposes or functions as non-renewable-generated electricity, there are differences that make the *market* for renewables different from the *market* for fossil-fuel generated energy, differences that include the environmental preferences of consumers.

Finally, it is to be noted that there is no general GATT Art. XX-type environmental or conservation exception that applies to the obligations of Chapter 11, apart from the disciplines on performance requirements.

Monopolies and State Enterprises

In many jurisdictions within North America it remains the case that electricity is purchased and sold by public or private monopolies. Thus, the provisions in Chapter 15 of the NAFTA on monopolies and state enterprises may be relevant to trade in renewables. In particular, Art. 1502(3) requires that each NAFTA party ensure, through regulatory control, administrative supervision, or the application other measures, that any privately–owned monopoly that it designates and any government monopoly that it maintains "acts solely in accordance with commercial considerations in its purchase or sale of the monopoly good or

service in the relevant market, including with regard to price, quality, availability, marketability, transportation and other terms and conditions of purchase and sale." In Art. 1505, "in accordance with commercial considerations" is defined as "consistent with normal business practices of privately-held enterprises in the relevant business or industry . . ." This provision would appear to prohibit private and governmental monopolies from taking environmental considerations into account in sourcing decisions concerning bulk power, i.e. when they are obtaining power other than from their own generating sources, unless environmental considerations are also "commercial." Many private enterprises now have "green power" programs, reflecting the environmental values of their customers, so it cannot be said that taking into account environmental goals is not consistent with the "normal business practices of privately-held enterprises." In addition, Art. 1502(3) does allow non-commercial considerations to be taken into account where the government mandates these as "terms of . . . designation" of the monopoly, provided the "terms of . . . designation" do not entail discriminatory or anti-competitive practices.

Conclusion

While it is not the purpose of this paper to make specific predictions about the future nor to chose winners and losers in the renewables sector the near term future is now clear enough that it can be stated that renewables will be deployed to the grid in sufficient quantity over the next several years that it will be able to distinguish renewables as a real and growing commercial sub-sector of the energy, and more specifically, in this time frame, electrical industry.

We have seen that cross-border projects to supply renewable energy are already in the advanced planning stages and that much potential supply of renewable energy is just across national borders from centers of demand, in the US, particularly.

Treating the NAFTA zone as a region or sub-region competitive in global trade, more can be done for the world competitive situation of manufacturers of renewable energy equipment in North America by taking rapid steps to harmonize market regulation and technical standards, at minimum for technologies now being deployed and, ideally, for all technologies than more subsidies. Renewables wherever generated in North America need to be welcome in every sub-national jurisdiction where they are consumed.

The authors are skeptical, on a practical basis, of claims that "world leadership" in renewables technologies has slipped away from North America, in some sectors. Too many of these claims have been advanced by industry groups hopeful of inducing governments to provide or extend subsidies to their particular sector, and they can be discounted. In Geothermal it is simply not true, in the wind sector, one of the world's largest, most successful and most aggressive industrial companies, GE, is a player in the large turbine sector where the most action is now. With GE's enormous resources behind it – and GE's institutionalized hunger for growth – it is hard to imagine that GE's wind turbine division faces any major obstacles in becoming as large a player as it wishes to be, given sufficient profit driven motivation.

The authors would also like to point out the fact that the innovators at the beginning of a new industry are *seldom* or *never* the major players when the industry matures[116] Finally, there

[116] Of the hundreds of companies, in North America who started up to exploit the new technology of television name even one who has a significant market presence today. Another more recent example is in the personal

are few – if any – places in the world with the mind-set and institutional and capital infrastructure and "know-how" to rapidly commercialize genuinely new ideas. Furthermore, there is no place in the world, other than North America, where there are many high tech private sector 'start-ups' in the renewables sector.[117]

The lessons of Silicon Valley teach us that in new sectors that are still in the throws of significant technological change that leadership in the sector can change, nearly overnight, as new startups come to market with improved or wholly different approaches or technologies to any given problem[118].

In general, it is our view that existing government programs for renewable energy are not likely to be in conflict with the legal provisions of the NAFTA. However, a paper such as this can only treat these programs very generically and our general conclusion does not constitute a legal opinion, obviously, on the details of any one program. The Energy Chapter of NAFTA was clearly drafted in a pre-renewables world; it is regrettable that the one explicit exception in NAFTA for energy development incentives is exclusively focused on non-renewables.

Many of the trade law issues that arise under NAFTA in respect of programs for renewables are ultimately connected to National Treatment obligations, whether in respect of goods, services or investments. Necessarily, measures for renewable energy imply that renewable energy is being treated differently than non-renewables. Such different treatment may be justified for a number of reasons, including the reversal of the traditional bias towards fossil-fuel sources of energy in many older government policies. Fundamentally, however, the authors do not believe that, in the application of the National Treatment standard, it makes sense to regard renewable energy sources as "like" non renewables; there are too many differences in the economic and environmental characteristics of the energy and the generating processes properly to conclude that renewable and non-renewable energy are "like." We believe our approach is consistent not only with the GATT/WTO jurisprudence on National Treatment but also recent NAFTA case law, such as the Methanex decision, which dealt with the National Treatment obligation in the investment context. In any case, with respect to trade in goods, environmental exceptions would be applicable even if a finding of "likeness" were to result in renewable energy measures being held to violate National Treatment.

The treatment of subsidies and tax incentives is quite complex under NAFTA: in many cases such programs are simply exempt from NAFTA norms but there is some risk that they may be NAFTA non-compliant if they contain criteria or conditions that are discriminatory against other NAFTA parties. Similarly, in the case of government procurement, the one clear area of

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computer industry. Who now remembers the early companies such as Osborne, Sinclair etc.? Furthermore, who now remembers that it was Xerox which invented most of the technologies that define the modern PC at their Palo Alto research park? In another dramatic example, MITI in Japan, wanted to shut down the nascent automobile manufacturing industry in that country as fundamentally uneconomic and uncompetitive.

[117] Even in technologies that have already been identified as important, such as CSP, despite predictions that the EU would deploy CSP plants first it is in the US that these plants are now already being put into commercial production. Simple support of a technology does not create the conditions for rapid deployment and hence, alleged early mover advantages (of which the authors are skeptical) in industry leadership.

[118] It is in the US where Silicon Valley money is now starting to move on and shake up manufacturing industry in other sectors. Two examples in the aerospace sector of 'clean sheet' startups taking on heavy manufacturing are Eclipse Jet and SpaceX. Both are challenging sub-sectors of the aerospace industry much steeped in current and past practice by the wholesale application of new technologies starting from a 'clean sheet.'

concern would be criteria and conditions that cannot be justified in terms of environmental objectives for example and that are discriminatory against other NAFTA parties.

NAFTA provisions on technical barriers to trade, if vigorously implemented can help to eliminate important regulatory barriers to trading renewable energy and renewables technologies. The provisions of the NAFTA financial services chapter arguably require that NAFTA parties open their own markets to tradeable renewable energy certificates from other NAFTA parties; however these provisions do not solve the issue of recognition of certificates from one NAFTA party for purposes of satisfaction of a renewable sourcing requirement imposed by another NAFTA party. That issue is arguably one of technical standards under the NAFTA (the technical standards chapter applying to both goods and services).