Summary of the "Technical Meeting on Approaches to Estimating Environmental Benefits of Renewable Energy and Energy Efficiency"

17–18 July 2003, Washington, DC

Executive Summary

The "Technical Meeting on Approaches to Estimating Environmental Benefits of Renewable Energy and Energy Efficiency" brought together experts from across North America working on the development of approaches to estimating the environmental benefits of renewable energy and energy efficiency. The purpose of the meeting was to share information and to discuss the necessary steps to producing credible, and agreed upon, estimates of the environmental benefits of renewable energy and energy efficiency. The meeting was organized by the Commission for Environmental Cooperation with the help of the collaborating organizations of Conae and the Ministry of Energy of Mexico, Environment Canada and the US EPA.

Forty-two people from the environment and energy ministries of the three NAFTA governments, representatives of environmental NGOs, and private sector electricity producers and marketers, as well as private sector practitioners of these calculation methodologies attended the one and one-half day meeting in Washington.

The eighteen presentations spanned different aspects of the calculation of environmental benefits—and more specifically, calculating displaced emissions. The first session included general overviews by representatives of the three governments of work the NAFTA countries had done in this area. This session also provided an overview of the characteristics and challenges of various calculation methodologies, from the more elaborate dispatch and planning models used to estimate marginal emission rates, to the relatively simpler methods for estimating average system emission rates. The relative costs associated with the different methodologies were also compared. After the general government overviews, the background paper was presented, followed by specific examples of methodologies that had been used in the three countries. Various people and organizations then described how they could use displaced emissions calculations. The second day comprised two sessions. In the first, experts reflected on the presentations of the previous day, and gave their opinions of the next steps needed to work towards comparable and credible displaced emissions calculations in North America. During the second session, representatives from the three NAFTA governments and the CEC discussed future work in this area.

From a methodological standpoint, there was little debate that dispatch modeling of marginal system emission rates produced the most accurate estimates of displaced emissions from renewable energy or energy efficiency (leaving issues of geographic scope and the time frame of analysis aside). However, obtaining results from these models is resource intensive and that the accuracy they provide may not be required in all cases, be they regulatory compliance, policy development or market-based mechanisms in support of renewable energy and energy efficiency.

The purpose of the calculations is very important for two reasons. First, given the variety of ways to calculate displaced emissions and the wide range of uses for such information, it is hard to develop a common methodology for all purposes. As was alluded to, both

implicitly or explicitly over the two days, the purpose (along with budgetary or data availability constraints) will likely dictate the methodology to be chosen.

Even so, there was support for developing common, or at least comparable, methodologies, if not common principles on which to base these methodologies. Participants also mentioned the desirability, as much as possible, of having comparable methodologies that were relatively easy to use, that they should be as generally applicable as possible, and that they have international credibility or acceptance.

Regardless of the methodology chosen for a particular purpose, government has a crucial role. In particular, for any methodology to obtain acceptability either nationally or trinationally, governments themselves will have to agree on it.

The result of the meeting was a commitment on the part of the three NAFTA governments to work towards common or at least comparable methodologies (or possibly principles) for the calculation of displaced emissions from renewable energy and energy efficiency. As well, they agreed to have the CEC convene a trinational technical group that will work towards the goal of achieving a common or comparable calculation methodology.

9:30 Welcoming Session

The attendees were welcomed by Chantal Line Carpentier of the CEC, Tom Kerr of the US EPA, Nick Macaluso of Environment Canada and Ubaldo Inclán of Conae.

9:45 Government Overview of Experience with Displacement Calculations in the Three Countries

Presentation by Leslie Welsh, Environment Canada

Leslie Welsh represented the government of Canada. He briefly introduced the environmental impacts of the electricity sector, discussed issues that complicate the analysis of these impacts, and gave a history of how the analysis of these relations has changed with the move toward more competitive electricity markets in Canada.

He then continued by emphasizing the importance of displaced emissions calculations for policy making (e.g., when considering the development of renewable portfolio standards [RPSs] for emissions trading or fiscal incentives), as well as to enable market decisions (e.g., for green power marketing). When considering how to go about calculating displaced emissions he highlighted three important decisions to be made when deciding on the type of methodology to be used: whether to use marginal versus system average emission rates; whether to concentrate on the short term or long term; and what spatial scale should be used, recognizing that analyzing for different air contaminants can present different data requirements. After explaining Canada's approach to full environmental cost accounting in green power, he briefly summarized different examples of displaced emissions calculations in Canada and gave some of their main characteristics. In particular, he referred to the calculations done using the Energy 2020 model; calculations for the Federal Green Power Procurement Program, including of Registered Emissions Reductions under the Canadian Greenhouse Gas Emissions Reduction Trading (GERT) Pilot program; the Pilot Emissions Removals, Reductions and Learnings Initiative (PERRL); Ontario's NO_x and SO_2 Emissions Trading Code; and calculations for the Kyoto Clean Development Mechanism/Joint Implementation.

To conclude, he provided some lessons learned from Canada's work on calculating displaced emissions from renewable energy. The first was that the purpose for which the benefits calculations are used is important in determining the methodology. Second, care must be taken to ensure that calculations do not result in double counting, overlaps or data leakage. Third, simple is better (recognizing that this can imply a trade-off in accuracy), and an overarching solution is better (recognizing that this also can cause a trade-off in accuracy).

Presentation by Ubaldo Inclán, *Comisión Nacional para el Ahorro de Energía*

Ubaldo Inclán represented the government of Mexico. He began by outlining a two-step process for estimating the environmental benefits of renewable energy and energy efficiency used in Mexico. The first step involves estimating energy savings and/or total generation from a renewable source of energy (either from integrated programs or from individual projects). This follows the process known as MERVC (monitoring, evaluation, reporting, verification and certification). The second step involves calculating the environmental benefits generated and, in particular, local and regional pollutant and greenhouse gas (GHGs) concentrations. He explained that the control of the national electricity network by two companies (*Comisión Federal de Electricidad*—CFE, and Luz y Fuerza—LyF) facilitates the calculation of emissions savings. Information needed for calculations of emissions savings for regional and local pollutants could be obtained from operating reports of the CFE and LyF, as well as from Mexico's pollutant release and transfer register (*Registro de Emisiones y Transferencia de Contaminantes*—RETC). For GHGs, GHG emission factors by type of plant can be obtained from the same information sources.

Inclán emphasized that Mexico is endeavoring to actively participate in GHG markets and particularly in the Clean Development Mechanism (CDM), for which the Mexican Office of Climate Change has been created. After a description of what the Mexican government believes is essential for strengthening 'green' markets (certification, validation and registration), and the necessary policies for developing GHG reduction markets from CDM, he explained the different programs for GHG markets in Mexico, as well as the institutions that have been created to govern the development of these markets and the process by which GHG will be registered. In addition, he mentioned that Mexico is designing an SO_2 trading system. Both of these initiatives could benefit from reliable estimations of the environmental benefits of renewable energy and energy efficiency—these estimates are thereby considered to be very important by Mexico.

Presentation by Rick Morgan, US EPA

Rick Morgan represented the US government. He described four different types of methodologies for displaced emissions calculations that have been used in the United States and some of their advantages and disadvantages.

The first was the use of average system mix as a proxy for displaced emissions. While this has the advantage of drawing on readily available data, it poorly represents displaced emissions. The second methodology was the use of dispatch models. Such models are considered the preferred method for analyzing a regional electric system, and are very accurate for short-term analysis, but they have the drawback of being expensive and labor-intensive. He described three examples of dispatch models that have been used in the United States (ISO-NE's Marginal Emissions Analysis, OTC Emission Reduction Workbook and the Stappa/ICLEI planning tool). The third type of methodology was the planning model, which is considered to be well suited for a national-level perspective and can be used to examine multiple time frames. The example given of such a planning model was the EPA ADER (Average Displaced Emission Rate) Project. The final

category described was the spreadsheet methodology. Spreadsheets have the advantage of being flexible, transparent and inexpensive. Morgan described the Environmental Resources Trust spreadsheet methodology, called the Dispatch Ranking Protocol and alluded to two other spreadsheet methodologies (the EPA Texas Methodology and the MIT Photovoltaic Methodology).

After these descriptions, he highlighted the main challenges facing modelers of displaced emissions. With respect to methodological trade-offs, modelers have to decide between regional and national scales, as well as between short- and long-term levels of analysis. It is also important to realize that the results are very sensitive to assumptions about the future (i.e., demand and economic growth, relative fuel prices and the cost and performance of new units). Another important issue to consider is the trade off between the resolution and robustness of models. Finally, he described the challenge of modeling capped emissions, which if displaced would likely be traded away to other emitters so that overall emissions are unlikely to decrease in the area over which there is a cap. Thus, models should incorporate emissions trading and banking into their models.

Morgan concluded, after having reviewing the different methodologies and challenges facing the calculations of displaced emissions, that there is no "silver bullet": the methodology chosen should be dependent upon the purpose for which the displaced emissions are being calculated and the resources available to undertake the calculations.

Discussion relating to this session followed two main themes:

Technical questions regarding displaced emissions methodologies

Three main questions were posed on technical issues regarding displaced emission methodologies. The first, from Ted Ferguson (BC Hydro), dealt with whether transmission constraints are generally included in the calculation of displaced emissions. A second, from Praveen Amar (NESCAUM), regarded the important role that siting plays in the calculation of displaced emissions and, in particular, how displaced emissions could be used as offsets and whether these calculations could be used to satisfy stringent regulatory requirements, such as the so-called "PERS" requirements. A third question, from Martin Tampier (EnviroChem Inc.), concerned the calculation of emissions coefficients in Canada for Environment Canada's Pilot Emission Removals, Reductions and Learnings Initiative. Rick Morgan responded to the first question, saying that indeed models generally include transmission constraints and to the second, saying that the PERS criteria are indeed quite stringent and that they cannot necessarily be satisfied currently with the methodologies used, but that that is the next big issue in this field. Leslie Welsh also responded to Tampier's query, saying that the information he requested is to be made publicly available this fall when the PERRL program issues its request for proposal.

Uses of displaced emissions calculations

Meredith Wingate (CRS) asked the panelists what they believed the most important uses for displaced emissions calculations were. Welsh responded that the two obvious uses were for policy making (e.g., the setting of renewable portfolio standards [RPSs] or emissions caps), as well as for information to allow green markets to function (e.g., for green power markets). Rick Morgan agreed with Welsh and also added that they could prove useful for regulatory requirements. Ubaldo Inclán agreed with the other panelists.

11:35 Presentation of Background Paper

Presentation by Bruce Biewald, Synapse Energy Economics, Inc.

Bruce Biewald, co-author of the background paper produced for this meeting, provided his insights based on the research that went into the background paper and after having reviewed the different methodologies applied across North America. He highlighted five main themes from this research and then his conclusions on working towards a comparable methodology, as follow:

Energy is at issue when talking about renewable energy, energy efficiency and policy in this area. For the most part, there are good data on projects that have been measured and measuring their impact on emissions is the least controversial of the themes to be raised. More difficult is measuring what did not happen—e.g., emissions displaced/saved because of the use of renewal energy or from energy efficiency projects. Here there are big differences in the details of the different methodologies.

Time—as mentioned in the presentations of Rick Morgan and Les Welsh, the time frame for analysis is an important factor and a challenge in displaced emissions calculations. In the 'short term,' the effects of renewable energy and energy efficiency can be relatively easily and confidently known, although assumptions about load profile need to made. In the longer term, matters become more complicated, in part because of issues like those brought up by Rick Morgan (assumptions about economic growth, fuel prices, etc.), but also because the evolution of the resource mix has to be estimated. Sometimes displaced emissions calculations are done for the past. This is relatively straightforward since actual data can be input into the models and renewable scenarios can be compared with actual reference cases.

Space/Geography—The question/challenge with respect to space/geography is to decide how far to extend a displacement analysis since the effects of renewable energy additions or energy efficiency improvements can be felt far from the location of the project. Synapse has found regions such as the northeastern US to be a manageable unit of analysis that can produce reliable results.

Causation—What effect does the project in question have in the future? This ultimately depends upon the assumptions that are made about the future and about the expected resource mix. While the future resource mix can be estimated by computer programs,

there are limits to such programs and they can be very expensive to operate. To consider the effect of a given project in the future, it is necessary either to simplify models a great deal, or for modelers to add future capacity changes exogenously.

Information and Cooperation—In writing the background document, it became clear that there is a great deal of information (methodologies or programs or data) that could be used for the calculation of displaced emissions but which is not readily available or not available at all. While it is understandable, because there are good business reasons for safeguarding proprietary information, it also can make the calculation of displaced emissions prohibitively expensive.

With respect to the development of a comparable methodology, Biewald reported that he thought it a tall order to be able to find such a methodology and that there is a limit to the amount that methodologies for such different purposes could be standardized.

Analysis versus policy

A number of questions were raised concerning the ability for particular situations or issues to be analyzed. Nick Macaluso asked to whom credit for displaced emissions should go in the case that renewable electricity was exported out of the jurisdiction in which the generation occurs. Elisabeth De Marco (MaCleod Dixon LLP) asked how one might analyze a 'hybrid' system with Canada as a Party to the Kyoto protocol and the United States as a non-Party, in the case of electricity generation. Praveen Amar asked about predicting the retirement of coal plants. In all of these cases, Bruce Biewald responded that there are analytical methods to try to approach each of these types of problems but that, in the end, the outcomes would be related to policy and the political process. In the case of Macaluso's question, Biewald elaborated by saying that the methods for analyzing the situation were relatively straightforward and that once any "unintended consequences" of the new generation had been established, then it would have to be decided whether these consequences were large enough to warrant policy action. If so, he thought that two possibilities to deal with this situation might be a tradable credit system, or a broader policy such as a North American Renewable Portfolio Standard (RPS).

Groundtruthing model predictions

Tom Kerr and Adam Chambers (NREL) both asked questions related to whether or not models and model estimates or predictions had been compared with realized outcomes, *ex post*. Kerr's question was focused more on model predictions of plant retirements, and whether such 'backcasting' was a good idea, and Chambers' question was aimed particularly at the IPM® model. Biewald replied that backcasting is generally a useful exercise, but that in the case of trying to understand policy effects, it is often difficult to determine for example whether a particular policy caused certain plants to be retired. The reason for this is that decisions about plant retirements are very complicated and also because one has only one case (actual history) on which to base the analysis. With respect to whether or not such backcasts had ever been done, Biewald referred to two such

exercises: one which is undertaken annually by ISO New England, and one by Synapse, sponsored by the Commision for Environmental Cooperation. Juanita Haydel (ICF Consulting) said there had been some internal exercises like this on the IPM® model, but that they had not been extensive.

Technical issues

Fred Mayes (DOE) asked about how to calculate offsets from combined heat and power (CHP) plants. Biewald said that this was analytically very similar to other electricity generators, but that information on the production of steam would have to be incorporated.

13:30 Specific Examples of Displaced Emissions Calculations

Presentation by Geoff Keith, Synapse Energy Economics Inc.

Geoff Keith described the OTC (Ozone Transportation Commission) Emission Reduction Workbook that Synapse Energy Economics, Inc., has developed for the OTC. The goals of the OTC project for which the workbook was developed were to advance the understanding of emission reductions from energy efficiency and renewable energy in quantitative terms and to move toward a methodology sufficiently robust to stand behind state implementation plan credit. There were two main steps in this process. The first was to collect data on the type of energy saved or the clean energy generated. The second was to develop assumptions about how the regional energy system would react. Keith explained and demonstrated how the spreadsheet could be used. The spreadsheet itself contains default information on the load profile of different generating technologies as well as emission rates for different times of day and different times of year. Information on emission rates were developed using a system dispatch model. In addition to default data, it is possible for the user to enter his own input assumptions. The spreadsheet itself can be downloaded from the CEC web site associated with this meeting[1] or from the OTC web site.[2]

Presentation by Juanita Haydel, ICF Consulting

Juanita Haydel presented the Average Displaced Emissions Rate (ADER) approach to estimating displaced emissions from clean energy technologies. The methodology employed by ICF to develop the ADER approach begins with parameterizing ICF's Integrated Planning Model (IPM®). The parameterized IPM is used to identify the impacts on the power system resulting from changes in load for series of unique "hour blocks."[3] The model is a national model with regional detail (five regions modeled) that

[1] <http://www.cec.org/calendar/details/index.cfm?varlan=english&ID=1854>
[2] <http://www.sso.org/otc/Publications/pub2.htm>
[3] Hour blocks are periods of time that are grouped because their power system characteristics are similar and/or they are similarly affected by energy efficiency programs.

explicitly captures inter-regional interactions. It is also a dynamic long-term planning model and explicitly handles environmental/emissions and fuel markets (cap and trade and other constraints and feedbacks are modeled). Although any number of hour blocks could have been modeled, eleven unique hour blocks were modeled (with different hour blocks for summer and winter). Renewable energy and CHP plants were modeled directly. ADER emission factors were paired with climate zone load shapes from the DOE2 model to produce two part impacts: impacts in the region of penetration of the technology, as well as all other regions. The sum of these two yields the national impacts. Hour block impacts were examined in isolation, one region at a time, resulting in 55 runs of the model. When the model was run for each hour block, the entire dispatch is adjusted, including infra-marginal units, inter-regional interactions are captured, and emission market considerations are factored in. The system response also reflects longer-term considerations. An ADER spreadsheet is being developed and will eventually be made publicly available.

Presentation by Ted Ferguson, BC Hydro

Ted Ferguson presented on displaced emissions calculations that were done for BC Hydro for its Green Power Program. Ferguson explained that the question of avoided emissions is particularly pertinent for a company (like BC Hydro) that has an existing low emissions profile, combined with a number of programs that have been initiated to keep their profile low.

He explained how BC Hydro adjusts green power and customer-based generation contract bids to reflect their GHG emissions intensity. Prices are reduced by C$3/MWh if they are GHG-free. This is based on displaced emissions of 0.36 tonnes/MWh of GHGs, which is based on a build margin for combined cycle gas turbine technology (reflecting avoided natural gas generation in the BC Hydro system) and an estimated price for carbon of C$10 per tonne. In some cases, a GHG intensity calculation is performed to address the fact that the project emits some GHGs. At the time the program was created, it was assumed that BC Hydro would receive some kind of baseline protection—that credit for early action might exist and that GHG targets for thermal generation would be stricter. It was also expected that green power would create an emissions credit. The C$3/MWh is still used, but may be affected by Kyoto policies as they come into play. Ferguson also explained BC Hydro's process for the Green Power Certificate program, which includes the emission reductions at 0.36 tonnes per certificate. BC Hydro's Power Smart energy efficiency program also assumes emissions reductions of 0.36 tonnes/MWh.

Ferguson discussed proposed Canadian regulations for implementing Kyoto, highlighting that the result of current policy recommendations is that BC Hydro will likely only purchase carbon offsets instead of reducing GHG intensity. Moreover, renewable energy and energy efficiency GHG credits are not currently allowed. He ended by suggesting possible policies for coping with these issues, namely establishing RPSs and TRECs (tradable renewable energy certificate), creating energy efficiency (EE) goals with tradable EE certificates with no GHG value; or establishing an emissions-intensity proxy

for the grid and awarding GHG credits to renewable energy and energy efficiency output; and the provision of set-asides. He also asked the audience for any suggestions they had.

Presentation by William Golove, Lawrence Berkeley National Laboratory

Bill Golove presented on ProForm, a tool for pre-feasibility analysis of renewable energy and energy efficiency projects developed by the Lawrence Berkeley National Laboratory (LBNL). ProForm quantifies emission reductions and calculates the financial impact of the sale of carbon credits on projects.

LBNL developed ProForm because there was a perceived need for a common framework to conduct the assessment of clean energy projects (i.e., with GHG reduction benefits); a lack of familiarity among small entrepreneurs in developing countries with financial analysis/proformas; a lack of access among local developers to expensive project analysis software; and a requirement for evaluation of the potential revenue from carbon credits. ProForm was thus developed for small entrepreneurs in developing countries, national climate/energy and regulatory agencies, individual/multilateral investors and financial institutions and consultants. ProForm is designed to evaluate renewable energy, fuel switching, cogeneration, landfill methane gas and energy efficiency projects. It is distributed free of charge, and training to use ProForm will be offered is there is sufficient interest and funding.

The package allows the user to evaluate either user-defined scenarios, as well as three default scenarios with variation being introduced in terms of the value of carbon credits and discount rates. It also incorporates other financial information like loan-terms, electricity prices, capacity factors, etc. ProForm produces financial results (e.g., NPV—net present value, internal rate of return, cash flow and debt service coverage ratio) as well as emission reductions (C, NO_x, SO_x, PM). Golove presented an example of the results of the displaced carbon emissions of a small hydro project in Central America. The example provided three different scenarios for the calculations: the carbon intensity of current marginally dispatched power, that a retired diesel generator were brought out of mothballs and that there was development of a Central American grid.

Presentation by Ing. Rogelio Covarrubias, *Fideicomiso para el ahorro de Energía Eléctrica*

Rogelio Covarrubias presented on the avoided emissions from the energy efficiency programs in Mexico. Covarrubias introduced *Fideicomiso para el ahorro de Energía Eléctrica* (Fide) and gave a short history of the development and use of the methodology used to calculate avoided emissions from EE programs. He then outlined the general methodology used. First, annual emissions are calculated as the product of the annual volume of fuel consumed and an emissions factor by fuel derived from information from the CFE, the Ministry of Energy and EPA's AP-42.

Emissions by GWh sold are then calculated and avoided emissions are the product of GWh sold and the amount of energy saved through the EE project. After a brief

description of utility energy balance and projected future fuel use in the electricity sector for Mexico, Covarrubias provided a demonstration of the program developed to calculate displaced emissions from daylight savings using this methodology.

Discussion relating to this session followed two main themes:

Questions relating to Synapse OTC Spreadsheet

Tom Kerr asked who seemed to be using the OTC spreadsheet, for what purpose, and whether or not it was being used to get credit for State Implementation Plans (SIPs). Keith responded that it is thought to be mostly regulators who are using it. With respect to whether it was being used to get credit for SIPs, he emphasized the distinction between getting earned reduction credits and getting credit as part of a state implementation plan. That said, he did not know whether anyone was using the OTC spreadsheet to get renewables included in SIPs, but that they had received one query from a group that was considering using it to try to get wind generation into a SIP.

Anna Garcia (Global Environment and Technology Foundation) asked how Synapse had worked causality (effect of policy and regulations on generator mix) into their model when developing the OTC spreadsheet. Keith explained that estimates came from dispatch models, and thus there was no need to incorporate causality. In the long term, generator mix changes were added exogenously so that causality was not incorporated implictly into the model.

Availability of Information and Moving Forward

Chantal Line Carpentier referred to what Bruce Biewald had said in his presentation about problems relating to the availability of information on displaced emissions calculations. She recognized the fact that the OTC spreadsheet and ProForm were available on the Web, and asked whether the other methodologies were also available, as well as what would be a good method of working towards comparable methodologies when the methodologies used are not always easily available. Juanita Haydel said that an ADER spreadsheet would eventually be public and Covarrubias said that Fide was developing a worksheet that would be made more widely available and for end electricity users. Ted Ferguson reported that the models that BC Hydro uses were mostly internal and that there are competitive reasons for which models and methodologies might not be shared more widely. He also added that not even the independent market operators of Alberta or Ontario make such information widely available. With respect to how to move forward, Geoff Keith suggested that more meetings of this sort between practitioners would be helpful, as well as further analyses of the different methodologies used, to the extent that information is available about them. Ubaldo Inclán emphasized the need for such information to be made more freely available and methodologies more transparent.

15:00 Demand for Displaced Emissions Calculations

Presentation by Oscar Vázquez, Government of Mexico City

Oscar Vázquez presented on Mexico City's strategy on climate change. Vázquez began with a description of the main physical and demographic characteristics of the Mexico City region (ZMVM) and then described the methodology Mexico City had used for its inventory on GHGs. The work on energy was based on work by the International Energy Agency, the emissions work on studies by the Intergovernmental Panel on Climate Change, and based on a bottom-up approach. Vázquez continued with a breakdown and explanation of the CO_2 emissions and total and sectoral energy and electricity use. The conclusion of this work has been to identify the largest seven sectors in Mexico City that could yield environmental (reductions in CO_2) and economic benefits.

Those sectors are: transportation, residential, industrial, commercial, electricity generation, public sector and other large consumers like the metro system. He then continued to explain the potential problems caused by climate change in the ZMVM (e.g., changes in rain patterns, etc.), as well as several different population scenarios of the ZMVM, coupled with what the ZMVM is planning on doing to cope with and remedy the issues associated with climate change and population growth.

Vázquez also added comments regarding methodologies for displaced emissions and for inventories. In particular, he wanted to emphasize ways in which Mexico was different. First of all, he mentioned that while Mexico has methodologies for developing larger-scale inventories, they are lacking for application to individual projects. Moreover, in order to develop these methodologies there needs to be better access to information in the three countries. In addition to problems of access to information, there are other important differences that need to be considered when calculating displaced or potentially displaced emissions in Mexico. For example, whereas in the rest of North America it is common to use 30 percent capacity factors for wind generators, in Mexico the capacity factors are more likely to be around 80 percent. There is a lack of resources for adapting methodologies to the Mexican context.

Presentation by Matt Williamson, Natsource

Matt Wilson spoke on behalf of Natsource, an energy and environmental commodity broker (among the largest and most highly rated SO_2 and NO_x brokerages). Wilson that Natsource uses various EPA products such as the NO_x/SO_2 allowance tracking system and E-Grid to help it identify potential buyers, as well as for performing emissions displacement calculations (primarily for renewable energy certificates (RECs) and GHG markets). He then continued his discussion on RECs by defining them (i.e., they are the environmental benefits of a specific quantity of renewable generation, or the displaced emissions from conventional electricity generation) and describing why REC marketers use data of the type provided by EPA (the data provide purchase rationale and guide customer purchase volumes). After having outlined the many benefits of renewable energy, he outlined his concerns about the displaced emissions concept.

In particular, he said that he thought the benefits themselves may be important, but they are vague and limited, and attributing ownership is difficult; they create multiple sub-commodities because they are dependent upon the technology used, the location, and the time and day. Moreover, he expressed concerns over the term "renewable" and whether it actually means clean energy, for which it is often used synonymously.

As a result, he proposed an alternate definition for RECs. According to him, an REC would simply be a unique and exclusive proof that a specified unit of energy was generated from a renewable source; the inclusion of environmental benefits is not necessary and avoids concerns. His overall conclusion was that the calculation of environmental benefits from renewables is helpful for sophisticated planners, but not helpful for RECs. Thus, he thought displacement calculations should be used for planning RPSs, set-asides, SIPs, etc., but he cautioned against their use in green marketing.

Presentation by Jeff Burks, Utah Energy Office

Jeff Burks discussed using renewable energy and energy efficiency to reduce regional haze in the West. In 1999, the regional haze rule was issued by the Western Regional Air Partnership. The rule targets 156 Class I air sheds, applies to all states, and requires that SIPs must demonstrate "reasonable progress" in improving haze. The basis of the requirements of the regional haze rule (set out in the Grand Canyon Visibility Transport Commission report "Recommendations for Improving Western Views") is contained in section 309 of the rule, One of the findings of this report was that RE and EE can be effective tools to reduce haze and can result in emissions reductions. Subsection 309(d)(8) on Pollution Prevention requires states to identify RE and EE programs, cite progress in meeting renewable energy goals as well as provide projections for the short and long term of emissions reductions and secondary benefits, among other things. Modeling was undertaken in order to be able provide projections. The results of this modeling have been that 21,500 GW of renewable energy are needed to meet the "10/20" renewable goal; wind is the big winner in displacing gas and "new" coal generation, with projected annual costs of electricity production increasing by two to five percent. Modeling of EE produced equally interesting results, namely: EE best practices would reduce power demand in the western states by one percent in 2005 and eight percent in 2018, representing 16,000 MW of capacity, resulting in net savings in electricity production costs of between US$150 million in 2005 to US$1 billion in 2018.

Burks concluded by citing those areas where displaced emissions modeling was needed. Institutional needs included utility resource planning, policy planning and analysis, environmental compliance verification, emissions and "green energy" market transactions and uniform acknowledgement by EPA and state regulators. Characteristics needed in modeling tools include that they be regional in scope, that they respect geography and markets, and finally, that they be linked to verifiable generation data.

Presentation by George Durazzo, Community Energy, Inc.

George Durazzo began his talk by providing an introduction to Community Energy, Inc. The company is the nation's leading marketer of wind power: by 2004 it will have brought 250 MW of new wind generation online and currently has 280,000 MWh of wind under contract to a cross section of the public sector, universities and large private corporations. According to Durazzo, there are many factors driving wind energy demand, including the sense that it's the "right thing to do," that it shows environmental leadership, and provides favorable public relations, energy independence, stakeholder development and economic development benefits. On the other hand, obstacles to further wind use are its cost, the need to educate the public about their electricity choices, and the routine of "business as usual."

Durazzo showed what is provided to customers as the sample environmental benefits to be derived from switching to wind power. The information has a very clear disclaimer detailing where the information on benefits has come from and how it was derived. He said that the company never guarantees the displaced emission "numbers," although he said that they were very important—suggesting a use for credible methods of calculating the benefits of wind production and renewables more generally. He concluded by outlining the key positive features of new wind energy, in particular, that it is emissions free, locally generated, provides real environmental benefits and has huge PR advantages.

Presentation by Theresa Howland, Vision Quest

Theresa Howland began by providing background on Vision Quest an independent subsidiary of TransAlta, Canada's largest unregulated independent power provider. Vision Quest prospects for, develops and produces wind electricity with 183 turbines totaling 120.7 MW of capacity. It markets this electricity as Green Energy® and Green Energy® Tags. After outlining the benefits of wind electricity (positive environmental and economic impact, incremental supply growth and competitive pricing), she continued by explaining about Green Power Marketing.

Green Power Marketing encompasses green pricing (the provision of green electricity for price premium), green power marketing (competitive offers in deregulated markets) and green tags (discussed several times in previous presentations—see e.g., Williamson's presentation). Howland continued by outlining residential and commercial customer motivations for buying Green Energy® and Green Energy® Tags. For commercial customers, these motivations included environmental sensitivity, corporate stewardship, regulatory or voluntary requirements, employee morale, public relations and marketing benefits. For both residential and commercial customers, having the benefits of Green Power be tangible is important so Vision Quest works hard on that. This is done by, among other things, signage, emission reductions, third-party certification, and public relations.

Howland concluded by saying that Green Power marketing results in increased renewable energy development, that program design and promotion is crucial to success, and that product development and tangibility (including emission reductions) are what the

customer is purchasing. As such, policy support for calculation methodologies will assist with market development.

Discussion relating to this session followed two main themes:

Liability for Displaced Emission Credits

Nick Macaluso asked who would be liable if an offset credit of some sort was given to a wind generator but the actual wind generated electricity did not materialize. In a similar vein, Les Welsh asked Theresa Howland on whom the liability would fall if a green power seller sold the environmental benefits of electricity that was not generated. Lisa DeMarco also highlighted the important issue of double counting with RECs. Williamson responded to Macaluso's question saying that it is precisely this type of issue in which governments should consider participating, namely the enforcement and verification of displaced emissions. Howland responded to Welsh saying that so far they had not experienced any difficulties of the sort he had described and had relied on green certificates as the method of assigning displaced emissions.

The Health Benefits of Displaced Emissions

Lisa DeMarco felt that an area of great importance related to the quantification of the health benefits of displaced emissions and that it represented a possible area of future research on renewables. Julia Martínez (INE) responded that, indeed, the Mexican government, the City of Mexico and the Mexican National Institute of Ecology, together with MIT, have been working on this very issue. Praveen Amar said that the methods to perform this type of work exist and are well known, but that they need to be applied to the situation of RE directly. Leslie Welsh added that the environmental and health benefits of displacing emissions with green power had been estimated by Environment Canada and others as part of federal environmental cost accounting, and these valuations were being used in green power purchasing decisions.

17:15 Close of Day One

Day Two

9:00 Setting the Stage for a Comparable Methodology

Presentation by Craig Hanson, World Resources Institute (WRI)

Craig Hanson spoke about why estimating the environmental benefits of renewable energy matters to corporate energy end users, and what are the important next steps in this domain. He began by introducing the World Resources Institute as well as the Green Power Market Development Group (GPMDG), a group of 12 large US and multinational

companies committed to developing corporate markets for 1,000 MW of new, cost competitive green power by 2010. The GPMDG is endeavoring to create this market through on-site development, the purchasing of green power from power producers, and acquiring the environmental attributes of green power through the purchase of green tags. There are many reasons for which these companies participate in this group: to strengthen stakeholder relations, to achieve cost improvements (e.g., through "peak shaving," cost stabilization or cost improvements), as well as due to corporate desire to reduce GHGs, either for internal targets or for voluntary or mandatory programs and requirements.

Hanson then turned more directly toward green tags. In particular, he showed how nine different green tag providers calculated their displaced emissions and that this variation in methodologies could provide quite different estimates. He used the example of one Oregon wind farm and showed the calculated displaced CO_2 emissions from four different green tag suppliers. Whereas one supplier estimated displaced emissions to be 329 lbs/MWh, another calculated displaced emissions as 1403 lbs/MWh. This difference can matter, since it will affect the cost of the amount of the displaced emission. For example, if a green tag costs $5/MWh, this would imply paying either $33.56 or $7.86/tonne of CO_2. Thus, establishing a common displaced emissions accounting protocol is important. It would build the business case for buying green tags by removing uncertainty about what is being bought and paid for, strengthening environmental integrity, helping to circumvent gaming, establishing a foundation for playing a role in emissions markets and facilitating fungibility between schemes.

Hanson then turned to the important next steps in establishing a displaced emissions accounting protocol. First, he suggested, clarify the purpose such a protocol would serve (trading off accuracy with practicality). Second, engage other related initiatives already in progress (e.g., the GHG Protocol Initiative). Third, engage the business sector (e.g., energy suppliers, energy end uers). Fourth, develop policy perspectives/messages, and finally develop a work plan for tackling technical issues.

Presentation by Beatriz del Valle, *Asociación de Técnicos y Profesionistas en Aplicación Energética, A.C.* (ATPAE)

Beatriz del Valle discussed laying the groundwork for a comparable displaced emissions methodology, based on the work that she had undertaken with ATPAE (the Association of Experts and Professionals in Energy Applications). The purpose of this work was to develop an analysis of methodologies for the calculation of GHG emission coefficients for projects related to electrical energy and then to recommend how these methodologies could be adapted for use in Mexico. After having explained the different reasons for this undertaking as well as the barriers faced during this work, she described the steps through which this analysis was done.

The analysis began with revision of methodologies that had been used already in the international arena, as well the development of relevant questions for understanding displaced emissions from the electricity sector (e.g., is the location of plants important, is time of day important, how is the electrical system dispatched, what kinds of plants are

displaced?). Three different methodologies were selected for evaluation: system average, operating margin and build margin. Mexico was then divided into four regions based on characteristics of the electrical systems in those areas. The different methodologies were then compared quantitatively. (What was the system average versus the operating margin coefficient in a particular region? What was the system average versus the operating margin coefficient for particular blocks of time?) A qualitative analysis was also performed evaluating the availability of information, the degree of accuracy required, cost, transparency and consistency with international methods. In the end, ATPAE's recommended emission coefficient was a hybrid comprising a regional average emission coefficient for fossil fuel burning generators and an emission coefficient for the five most recent generators added to the system. The two parts of the hybrid coefficient are equally weighted. Values for the hybrid coefficient were calculated for the four regions as well as for three-hour blocks.

Del Valle concluded by saying that ATPAE chose a conservative methodology in order to facilitate its approval, and also so that it would be easy for project developers or others who might wish to use it. The next step in the process is to submit a follow-up project to the ATPAE board of directors and to follow the evolution of discussions internationally.

Presentation by Meredith Wingate, Center for Resource Solutions (CRS)

Meredith Wingate divided her presentation into three parts: observations, recommendations for the process and suggestions for critical next steps. Beginning with five observations, she said that there are a variety of reasons for people, governments, institutions and businesses wanting to calculate displaced emissions (policy making, regulatory compliance, "early action" and public relations benefits). Second, many displacement methodologies exist and choosing between them requires accepting trade-offs: between accuracy (how much is needed? how much is acceptable?) and complexity of the methodologies (what are the costs? is the methodology practical and feasible enough for widespread adoption?). From this, she suggested that before one asks "how?" you need to understand for what purpose the methodology is being used, or "why?" More to the point is whether there is a common purpose among the three countries?

Building on these observations, she provided five recommendations. First of all, she recommended narrowing the scope of the effort by more clearly defining why the three countries want a standard methodology, recognizing that it may not be practical or desirable to develop one methodology for all applications. Moving forward on this requires agreement on the common purpose and goal behind creating such a methodology. Second, she suggested that the application for which a methodology is used should dictate the methodology chosen. Third, while currently the choice of methodology used to calculate displaced emissions is an economic decision balancing cost with precision of estimatation, not all applications require absolute precision. Fourth, while there are trinational applications that will benefit from a standard methodology (e.g., voluntary pollutant markets), not all problems can be solved with one tool, so there is a need to separate the issues should be approached by the federal governments.

Wingate then outlined what she felt to be critical next steps in this process: defining and narrowing the scope of the effort, better understanding the costs of the various displacement methodologies, assessing the capacity of the three governments to assist with developing (a) displacement calculation tool(s) that can be deployed in all three countries at a low cost to participants, continuing to coordinate with GHG registries and other groups, and finally developing a trinational tracking system to track and verify RE generation and certificate transactions.

Presentation by Martin Tampier, EnviroChem Services, Inc.

Martin Tampier also provided a wrap-up presentation focusing mainly on methodological issues concerning the calculation of displaced emissions and then suggested a plan of moving towards a comparable and credible methodology.

Tampier reflected that while marginal dispatch combined with future projections of changes in generating capacity seems to be the preferred methodology, there are still many other methodologies used. He then reflected on some of the barriers to, and limitations of, dispatch modeling, using the example of Alberta, where dispatch data are simply not available. Moreover, he questioned whether dispatch modeling is really more accurate than other approaches, given there are many factors that either are not (or cannot) be built into dispatch models (such as differing emissions factors for different loads of thermal units). Tampier also suggested that perhaps such models are simply too complicated to be useful in green power marketing or for application by companies undertaking green power marketing. While highlighting problems with dispatch modeling, Tampier asked the audience not to disregard average displaced emission rates partly because they are so accessible, partly because often they are not *that* different from marginal emission rates, but also for policy reasons. He argued that if the purpose of developing displaced emission rates is to encourage the development of renewable energy, then precise marginal rates would encourage the development of renewables in areas of North America which have the most emission intense electricity production, and would disadvantage development of renewable energy in relatively clean areas (e.g., Virginia versus Quebec). Thus he suggested that if the goal is renewable energy development throughout North America, then perhaps an average North American emission factor might be suitable.

Tampier concluded that evaluating the "damage" that would be caused by the use of average emission factors versus the need for dispatch modeling necessitated the involvement of the relevant players, and that it would eventually be the governments that would need to decide what is the most appropriate methodology. Moreover, he added that a pragmatic methodology could be acceptable if it were to receive official support.

Discussion relating to this session followed the following themes:

Requirements/Objectives of a Common Methodology

Several people mentioned what they thought to be important requirements for a common methodology. Oscar Vázquez believed that a single methodology was desirable and that in order to be useful to Mexico City, and Mexico more broadly, it needed to be internationally credible, relatively easy to calculate (a methodology with various emission coefficients, like those produced by ATPAE, would be good) and ideally would have several possible purposes, in terms of what it was intended to accomplish. Lisa DeMarco, in a similar vein, thought that for business it would be ideal if there could be a North American methodology that could be used for multiple purposes, including regulatory compliance, and it would be even better if such a methodology would be able to serve for regulatory compliance at multiple levels of government. Beatriz del Valle added that in addition to the desirability of such a methodology being internationally credible and easy to use, it should be transparent.

Process for Arriving at a Methodology

There was a great deal of discussion about how to arrive at a comparable methodology. Fred Mayes and Bill Golove, recognizing that it might be difficult to find one methodology for all purposes, thought that the best approach was to begin by defining the purpose (whether for determining financial incentives, calculating health benefits, REC or SO_2 trading, etc.) and then proceeding with the methodology development from there. In a similar vein, Oscar Vázquez (after an extensive discussion on what the objective of the methodologies should be) thought that the purpose or objective should simply be to reduce emissions and then the appropriate methodology should be developed, taking into account constraints such as data and budgetary availability. Agreeing with Vázquez, Ubaldo Inclán added that the best approach would be to first develop methodologies at the national level and then work at the trinational level. Adam Chambers added that if a suitable trinational methodology could be developed, it might put North America in an international leadership role in this area.

Suzie Greenhalgh (WRI) reflected that often methodologies are data-driven, in the sense that they are limited by the availability of data, so that might be a good starting point. Greenhalgh also thought that considering who might be the end user would also be a good place to start. Finally, Beatriz del Valle explained that she thought the best approach was to begin with an evaluation of methods being currently used and choose or, if necessary, adapt a methodology from among those. Art Diem also felt that it was important to be aware of the many different methodologies used and thought that a good approach would be to try to assign as many purposes to a particular methodology that made sense.

Ted Ferguson commented that ultimately the goal of developing a comparable methodology is to meet emission reduction targets and to get more green market transactions to occur, but that often government (as in his analysis of the Canadian government's proposed policies on Kyoto as they pertain to the electricity sector—please refer to the summary of his presentation, above) seems to have many different goals

working at cross purposes and that governments need to agree on their common objectives first. Les Welsh, while agreeing that policy coordination is important, disagreed with the Ferguson's suggestion that policy needs have only one objective and that governments often need to, and do routinely, accommodate a multiplicity of objectives.

The Relationship between Policy and Methodology

Praveen Amar sparked a line of discussion when he observed that often he found that analysis and policy were far apart, but that in the case of displaced emissions methodologies, the two needed to be put together. Meredith Wingate presented views similar to this, although Art Diem thought that while policy is very important that policy issues should be kept separate for issues surrounding methodology. Nick Macaluso felt that it is hard to separate policy from methodologies because ultimately, any decision on the comparability of methodologies would become a political decision, although Oscar Vázquez disagreed.

11:50 Where to Go from Here

In this session representatives from the governments and the CEC presented ideas about work on displaced emission calculations, what constitute steps forward and how they would be able to contribute to such work.

Presentation by Art Diem, US EPA

Art Diem believed that there is a need to continue this work and that the best way to do so would be to convene a working group to explore further details of it. He suggested that a good approach would be identify the key programs for which displaced emissions calculations could be useful. He also thought that a useful analytical approach would be similar to that undertaken by ATPAE: finding where the different methodologies 'intersect,' and leading ideally to an agreed upon methodology that was relatively affordable, simple for users to gather the necessary information and that would also include EE or other negative loads. In the US, such a methodology could be used for voluntary programs, state initiatives or green markets. If it were impossible to arrive at such a methodology, then the work could focus on common principles.

Presentation by Ubaldo Inclán, Conae

Ubaldo Inclán reported that this work tied in with what Mexico has been doing for the past two years and is indeed similar to the USAID ATPAE work described by Beatriz del Valle. In Mexico, Conae is in charge of coordinating the development of a national methodology. He suggested that this could be the role of the CEC in North America. The output of this work could be to develop principles of methodologies for valuing benefits in the three countries for all sectors and which would include other indicators, such as water use. The process would involve the private sector as well as ENGOs. Finally, and

with respect to the background paper, after comments have been received and incorporated into the document, it should be considered a common document among the three governments.

Presentation by Nick Macaluso, Environment Canada

Nick Macaluso highlighted four issues that the government will need to address: the purpose of the methodology (e.g., regulatory compliance), the development of a comparable/common methodology, who owns displaced emissions, and the policy environment in each of the countries. With respect to next steps, Macaluso said Environment Canada would like to have the CEC feed into the policy development process and suggested convening a technical group. He also agreed with Inclán about the need of a methodology for evaluating renewable benefits. The group itself should to take into consideration different policy drivers that would affect the direction of the work, stating for example that it would likely go in different directions, depending upon whether it was aimed at RECs or for regulatory purposes.

Presentation by Chantal Line Carpentier

Chantal Line Carpentier described how the CEC would follow up on this meeting. First, she agreed to convening a technical group, run through the CEC, to examine more closely the idea of a common methodology or principles for one, to be made up of representatives of the three countries. Second, she asked for comments on the background paper within two weeks, and whether the government agencies present would like to have their logos on the paper.

12:45 Close of Meeting

Suggested Next Steps for the CEC

1. Set up a technical group on the calculation of displaced emissions from renewable energy and energy efficiency. The group will consist of technical representatives from governments, NGOs and the industry and its proposed objectives will be to:

   A. Analyze existing methodologies and flesh out their strengths and weaknesses (as done by ATPAE);

   B. Identify policy environment in the three countries and its impact on methodology;

   C. Define salient details of a common methodology, such as:

      i. What major goals would these calculations serve.
      ii. What pollutants would be covered.
      iii. What would be the right coefficients for each country.

Other suggestions

1. In cooperation with the WRI/WCSBD, coordinate and facilitate the development of a North American emission displacement from Renewable Energy Protocol that:

      i. Consists of a single tracking and accounting system that will provide a credible, verifiable basis for any future work on establishing a single North American protocol to establish standards for emission displacement of GHG and green power certificates;
      ii. Identifies environmental benefits of renewable energies for markets as well as regulatory compliance, based on an estimation of nonrenewable energy that would otherwise be consumed;
      iii. Allows flexibility for state, provincial and federal governments to reflect local and regional energy grid and consumption conditions;
      iv. Is consistent within a jurisdiction such that emission displacement calculations in a particular area are entirely replicable;
      v. Is harmonized and reflects the methodology/(ies) adopted by the CDM Methodology Panel. In this manner, a single, consistent, North American Protocol may be established that incorporates energy region-specific displacement calculations that Canada or Mexico can use for CDM and Kyoto purposes and the United States can use for voluntary and state purposes;
      vi. Determines who owns displacement;
      vii. Includes all clean energy sources, not just renewables;
      viii. Is transparent;
      ix. Is inexpensive.

2. Become involved with the California Energy Commission's Western Governor's Association project.

3. Establish power plant databases for each country, based on a support by an appropriate domestic energy statistics agency.

4. Develop a glossary that would define words/concepts that are specific to the emission displacement "world" in North America.