STATE OF VERMONT
PUBLIC SERVICE BOARD

Docket No. 7250

Amended Petition of Deerfield Wind, LLC for a certificate	)
of public good authorizing it to construct and operate 17 turbine,	)
34 to 35.7 MW wind generation facility, and associated transmission	)
and interconnection facilities, on approximately 80 acres in the	)
Green Mountain National Forest, located in Searsburg and	)
Readsboro, Vermont, with 7 turbines to be placed on the east side	)
of Route 8 on the same ridgeline as the existing GMP Searsburg	)
wind facility (Eastern Project Area), and 10 turbines along the	)
ridgeline to the west of Route 8 in the northwesterly orientation	)
(Western Project Area)	)

PREFILED REBUTTAL TESTIMONY OF EZRA D. HAUSMAN, Ph.D.

ON BEHALF OF DEERFIELD WIND, LLC

July 3, 2008

Summary:

Dr. Hausman responds to the concerns raised by other parties regarding the need for the Deerfield project and its economic benefits, and regarding his testimony on the quantity and value of displaced emissions associated with the project.

Q. Please state your name and occupation.

Response: My name is Ezra D. Hausman, Ph.D., and I am a Senior Associate with Synapse Energy Economics in Cambridge, Massachusetts.

Q. Have you previously filed testimony in this proceeding?

Response: Yes.

Q. What is the purpose of your testimony?

Response: The purpose of my testimony is to respond to certain statements and assertions in the prefiled direct testimony of Mr. Thomas A. Hewson, Jr. for Save Vermont Ridgelines (SVR), Dr. Robert J. Michaels for SVR, Ms. Lisa Linowes for IWAG, and Mr. Douglas Thomas for the Department of Public Service (DPS). In addition, I revise my previous estimate of the displaced emissions likely to be associated with Deerfield Wind, LLC's proposed project ("Deerfield Wind"), based upon updated project information I have received from the project developer.

Q. What is the updated Deerfield Wind project information to which you refer?

Response: I have been informed that the proposed project size has been changed to 30 MW total nameplate capacity. In addition, the project developers now project an average annual capacity factor of 36.4%.

Q. How do these changes affect the displaced emissions associated with the Project?

Response: All other things being equal, the displaced emissions are directly proportional to the amount of power produced, which is in turn directly proportional to both the capacity and the capacity factor of the Project. My revised estimates of the displaced emissions benefit, based on 30 MW total nameplate capacity and a 36.4% capacity factor, are shown in the following Table 1.

Table 1
Displaced Emissions
(tons/yr)

Years 1 through 4	
NOx	95
SO_2	260
CO_2	67,667
Years 5 through 7	
NOx	65
SO_2	142
CO_2	58,705
Year 8 and beyond	
NOx	33
SO_2	24
CO_2	49,742

Q. Mr. Thomas and Mr. Hewson contend that one cannot attribute avoided emissions to the Project due to the operations of RGGI (Thomas pft at 3-4, Hewson pft at 17). Please first respond by providing some context. In your prior testimony and report, you have referred to both "avoided" emissions and "displaced" emissions. Please explain the difference between these two concepts.

Response: "Avoided" emissions are emissions that would occur, but that do not occur due to some change in the system such as energy production from a non-polluting source. The more general term "displaced" emissions is used in recognition that real-world electricity markets and pollution regulations are more complicated

than this. Under cap-and-trade regulations, for example, some or all of the emissions that are displaced from one source may end up being emitted by another source somewhere else, because it is the *total* emissions that are regulated.

Q. If the emissions are only "displaced" and not avoided, is there still an emissions benefit associated with this Project?

Response: Absolutely. It is only because of low- or zero-emissions resources, such as Deerfield Wind, that cap-and-trade regulations can work as an economically efficient, effective means of reducing pollution. These resources are the means by which such regulations have their effect, and they make it possible for regulators to set aggressive pollution reduction goals that can be met at a reasonable cost. Therefore, although the immediate direct effect of the Project may be to "displace" pollution under cap-and-trade, it will play a vital role in the process of reducing pollution overall throughout its service life.

Q. In light of the above answers, how would you respond to Mr. Thomas' and Mr. Hewson's contention that avoided emissions cannot be attributed to the Project due to the operation of RGGI?

Response: The flawed logic on which Mr. Thomas and Mr. Hewson are relying for this somewhat paradoxical argument is that because a specific, numerical emissions limit will be in place, there is no benefit to building resources which actually help to achieve the goals of the RGGI policy. It is as if it is the policy *per se*, and not the resources that the policy is intended to support, which somehow magically reduces

GHG emissions to the atmosphere. The solution to this paradox lies in the political and economic environment in which RGGI has been proposed and will be implemented.

RGGI should be understood as a first toe in the waters of CO_2 regulation in the United States. Like a swimmer gingerly testing the water, the RGGI initiative is both bold, in that no other region or state has yet implemented a limit on CO_2 emissions, and timid, in that the limits are relatively mild and there are mechanisms in place to ensure that the impact is not economically onerous. What this means in practice is that policymakers--in the region, in other regions, and on a national level--will be watching closely to see how RGGI plays out. The more carbon-free resources such as Deerfield that are built, the lower will be the cost of compliance and the more successful the test will have been. If such resources are not built, the cost of compliance will be high and it will be a setback for carbon regulation in the United States.

It is true that we cannot count one-for-one the emissions displaced by Deerfield with emissions avoided altogether. However, it would be wrong to discount these benefits for these reasons. In fact, as a pioneering project participating in a pioneering program, it may be more appropriate to assume that each ton displaced by Deerfield will lead to many, perhaps hundreds of tons eventually avoided through successful carbon regulation. Obviously I cannot account for this precisely, and I have not assumed this effect in calculating project benefits in my report. But it is important to understand that the emissions benefits of Deerfield will

be significant, real, and important, as they will contribute to low cost, successful carbon regulation in the RGGI region.

Q. Dr. Michaels contends that your testimony "appears to be an attempt to perform [GMP's] research" "to show that DW and its proposed contract are part of its [Integrated Resource] Plan." (Michaels pft at 8). Do you agree with this characterization?

Response: I do not. There is nothing in my testimony or report that responds specifically to GMP's Resource Plan in any way, nor was it my intention to do so.

Q. Ms. Linowes argues that the intermittent nature of the wind resource means that building the Project "will not eliminate the need to build more reliable forms of generation in the region." (Linowes pft at 10). Do you agree?

Response: I do not. Wind, like any other electric generating resource, carries risk that it will not be available at certain times. This is true of hydropower, coal, gas, nuclear, or any other technology. Power pools and system operators maintain reserve margins over and above expected peak load, in part because no one can know for certain which resources may be unavailable during each peak load hour of the year. Wind generators carry a higher likelihood that they will be unavailable than many other resource types, because their output depends on the availability of wind. Thus they are properly assigned a relatively low "capacity value," accurately reflecting their risk of unavailability during peak hours. This calculation reasonably reflects the capacity value of the project or of any other resource. Utilities routinely accommodate this

unavoidable risk in their resource plans, as do system operators in their operational planning.

Deerfield Wind will provide capacity value to New England as part of a diverse portfolio that includes conventional resources, demand resources, and renewable energy resources. Like any other resource, it will diminish the need for alternatives in proportion to its capacity credit, following the rules of the ISO.

Q. Dr. Michaels contends that the Project could not substitute for power produced under current fixed-price contracts with Vermont Yankee and Hydro-Quebec because these are contracts for "base load" power, whereas the Project will produce power intermittently. How do you respond?

Response: Vermont is part of the integrated New England Power Pool, and is physically served with electricity from a broad portfolio of resources including base load, intermediate, and peaking resources. I certainly agree that Deerfield does not have the same base load characteristics as Vermont Yankee and Hydro Quebec. However, given the right contractual terms, Deerfield would serve as a stably-priced source of power because it will not be subject to fuel or emissions price volatility in the way that fossil-fuel resources are. This is also a characteristic of the contracts with Vermont Yankee and Hydro Quebec, although there is no guarantee that they will provide this benefit in the future when the current power purchase contracts expire. Another characteristic that a contract with Deerfield Wind would share with Vermont Yankee and Hydro Quebec PPAs is that, subject to variations in transmission losses, each kWh of power delivered from any of these resources is one

kWh that does not need to be purchased elsewhere. It makes no sense to discount the value of delivered kWh just because they come from a resource with a lower capacity factor.

Q. Regarding demand-side alternatives to the Project, Dr. Michaels argues that the PSB Order noting room for more spending on Efficiency Vermont and on Green Mountain Power's investment in efficiency programs shows that "Dr. Hausman has not made a case for his claim of diminishing opportunities." (Michaels pft at 13-14). How do you respond?

Response: I certainly never claimed that Vermont cannot do more in the area of efficiency programs, nor would I. I merely noted in deposition that because Vermont is on the cutting edge in this area, there is no basis by which to judge the cost of the next increments of energy efficiency. In any event, the state's load-serving entities will still need to purchase electricity to serve their remaining load, and all of the benefits of obtaining a portion of this power from a wind resource such as Deerfield Wind would still pertain.

Q. Dr. Michaels testifies that although fixed-price contracts protect Deerfield's revenue stream, "fixed-price contracts do not remove risk. Instead, they conceal it." (Michaels pft at 15). How do you respond to this claim?

Response: I disagree with this assertion. While it is true that fixed-price contracts may end up being more or less expensive than spot market purchases, the entire reason for their existence is to remove risk on both sides of the transaction.

Q. Dr. Michaels also implies that a fixed-price contract for Deerfield's output is unlikely to benefit consumers, because wind generation often produces greater output at times when demand is less, such as at night or during the winter, and lower output at times of peak demand, such as daytime or during the summer (Michaels pft at 15-16). How do you respond to this claim?

Response: To the extent that such a differential exists, the expected seasonal and diurnal pattern of production from Deerfield should be taken into consideration when negotiating price terms for the output of the Project. There is nothing "concealed" about this characteristic, and it certainly does not mean that a negotiated power purchase price is inherently advantageous to either party to the arrangement; nor does it negate the risk-reduction benefits for ratepayers.

Q. Dr. Michaels states that the sale of RECs benefits the Project's owners but not the citizens of Vermont (Michaels pft at 17). How do you respond to this claim?

Response: RECs are financial instruments that represent the environmental attributes of power generated by certain kinds of resources, such as wind resources. Because many states have recognized the societal benefits of reliance on renewable energy for a fraction of their energy needs, these RECs have value that accrues to the entity that creates them, or to some other entity that has a contract for them.

The benefits that accrue to Vermont consumers from Deerfield's production of RECs will be twofold. First, they will help Vermont load serving entities, such as GMP, to meet any future RPS program in Vermont at lower cost. Second, they will provide an additional revenue stream for Deerfield and other renewable projects, so

that it is economically feasible for these projects to provide the renewable energy demanded by Vermont's legislature on behalf of its citizens.

Q. In discussing global climate change, Dr. Michaels states that the complexity of the global climate system and uncertainty about human activity, climate change, and the efficacy of carbon control programs result in an extremely large amount of uncertainty in estimates of the marginal damage costs of carbon emissions (Michaels pft at 23-24). How do you respond to these claims?

Response: As a climate scientist, I certainly appreciate the complexity of the global climate system and the difficulty inherent in making precise predictions of the future impacts of climate change. Unfortunately, however, there is no doubt that the net effect of these impacts will be substantial and detrimental in terms of health, welfare, and the environment. There is also ample evidence from numerous scientific studies that reducing emissions of CO_2 and other greenhouse gases (GHGs) today will significantly reduce the ultimate costs of adapting to the climate of the future, by an amount far in excess of the current costs of emissions mitigation. For example, a recent study sponsored by the Union of Concerned Scientists entitled "Confronting Climate Change in U.S. Northeast: Science, Impacts, and Solutions"[1] details both the likely impacts of climate change in the region, and the benefits of reducing emissions in the near term.

[1] available at http://www.climatechoices.org/ne/resources_ne/nereport.html

It is indeed difficult to estimate the marginal benefits of any particular action we take on the climate, whether it be altering our driving habits, changing light bulbs, regulating CO_2 emissions in New England, or replacing GHG-emitting electricity generators with clean ones. It is the combined effect of all of these actions and many others that will determine the ultimate social and economic impacts of climate change.

Dr. James Hansen, director of the NASA Goddard Institute for Space Studies, recently explained it before the Iowa Utilities Board (Docket #GCU-07-01) as follows: human-induced climate change is likely to lead to the extinction of a large fraction of the millions of species on Earth today. Although we will never be able to assign the loss of any particular species to any particular action, it will be fair to assign a handful of those species to every fossil-fired resource that we allow to continue contributing to the problem. Thus the benefits of Deerfield's proposed project, and other projects like it, could one day be counted in the number of species it preserves for future centuries and future generations on the planet by contributing to the mitigation of climate change.

Q. Dr. Michaels predicates his discussion of the impact of Deerfield on global warming as follows: "Assume that warming will only be slowed down if some threshold of abatement is crossed, after which additional emissions reductions will further decrease temperatures." Do you believe this is a reasonable assumption?

Response: No, it is not. In fact, the opposite is true—the damage function for global warming increases with increasing atmospheric concentration of CO_2, and the only

"thresholds" are atmospheric concentrations of CO_2 that produce catastrophic and irreversible results—loss of major polar glaciers, say, or extinction of species, or devastating storms, floods, or droughts. Unfortunately, we do not know exactly what those thresholds are. Thus there is a benefit to all abatement efforts today, both in terms of reducing "smooth" damages (those which worsen gradually with increasing atmospheric CO_2) and in terms of reducing the risk of catastrophic ones. Dr. Michaels' assumption has no basis in any science of which I am aware.

Q. Dr. Michaels questions the methodology you used to determine the value of displaced emissions, arguing that you applied dated standards that have arbitrary adders and multipliers and fail to account for increases in cost of fuel or capital costs of wind projects (Michaels pft at 21-26). How do you respond to this claim?

Response: I agree that the standards I have used, based on the application of PSB rulings in dockets 5270 (1990) and 5980 (1999) are somewhat out of date, somewhat arbitrary in their numerical value, and not directly applicable to this project. I discussed this at some length in my report, and explained my view that they merely provide guidance for the monetization of certain benefits based on the Board's previous rulings.

In my opinion, the methodology I used is an extremely conservative approach that clearly understates the value of reducing emissions and fuel cost risk to Vermont. If the value were not at least this high and almost certainly higher, it would be hard to explain the Legislature's actions in promoting energy efficiency and the development of renewable energy sources in the State.

Q. Mr. Hewson argues that the Project would not directly compete with fossil-fuel projects, because it "is being built to meet a special set-aside demand created by state renewable portfolio standards and incentive policies." Thus he concludes that it will compete only with other qualifying renewable projects, and therefore will not displace emissions (Hewson pft at 16-17). How do you respond?

Response: As I noted earlier, the encouragement and facilitation of projects such as Deerfield Wind is the precise purpose of the policies to which Mr. Hewson refers, and projects such as Deerfield Wind are the mechanisms by which these policies can achieve their goals. Mr. Hewson seems to be arguing, paradoxically, that because the State has expressed a need and a preference for renewable energy, no such need exists. He seems to imply further that an overabundance of renewable projects are competing for a limited opportunity to sell emissions-free energy in Vermont. Unfortunately, this does not describe the prevailing situation in the State, in New England, or in the nation as a whole.

Q. Both Mr. Hewson and Ms. Linowes state that the model of system electricity employed by Synapse in its analysis is too simple and does not account for changing grid operating conditions or detailed power output profile (Hewson pft at 18, Linowes pft at 10). How do you respond?

Response: It is true that predicting exactly which *resources* will be displaced by any new source of low-cost energy, such as wind, is an extremely complex and perhaps unsolvable problem. This would be so even were we to use the most sophisticated model available, because we cannot know future market and grid conditions with any

precision. However, it is relatively simple to predict displaced CO_2 *emissions* with a reasonable degree of accuracy. This is because there is only a narrow range of possible values of carbon emission rates for any of the generators that are likely to be displaced. For the most efficient gas generation, this value is about 0.6 tons of CO_2 per MWh; for coal, it can be around 1.2 tons per MWh. Because gas is more likely to be displaced than coal in New England, the rate will generally be on the lower side of this range.

For other pollutants such as NOx and SO_2, the problem is not quite as constrained. This is because different resources can have substantially different and varying emission rates, depending on their pollution controls and on ambient conditions. Nonetheless, the method I have relied upon produces as reasonable an estimate of the displaced emissions to be expected over the course of a year as can be achieved by any predictive model, and it may reasonably be relied upon for this sort of analysis.

Q. Mr. Hewson claims that "given renewable power's significantly higher cost, it is unlikely that Deerfield Wind could displace any fossil fired power even if it could compete in the open power market." (Hewson pft at 19). Can you respond to his claim?

Response: This statement is based on a fundamentally flawed understanding of power system economics. Wind power (or other renewables) are "high cost" resources only in that their capital costs are high relative to certain other generating technologies. Once they are in place, they are extremely low-cost resources to run

and will compete successfully with any resources that consume fossil fuels. It is possible for a wind developer to make a poor investment in a new resource and to lose money on the deal, never recovering the initial capital outlay. Even in such a case, once the project is built it will have economic value and will continue to operate and to displace existing fossil resources. Deerfield Wind's investors are being asked to take on this risk; Vermont's ratepayers are not.

Q. Does this complete your testimony?

Response: Yes.