From: francoise fetchko
To: Beyer, Stacie R
Subject: Re: Milton Substantive Review
Date: Monday, May 30, 2016 2:46:23 PM

On May 30, 2016, at 1:18 PM, francoise fetchko <standstillfarm@gmail.com> wrote:

> Dear Ms Beyer; My name is Peter Fetchko I live in Bryant Pond (Woodstock Maine) and have served for many years on the conservation commission of Woodstock. As a Com. we worked closely with Patriot Renewables on the Woodstock 10 turbine project. In spite of all our efforts many citizens found themselves negatively affected.. We now have a wind ordinance in spite of which woodstock will once again be negatively affected by at least two turbines on Mt Chamberlane (2000 plus ft). The boundary between woodstock and Milton goes right over the top . .Much worse , however, is the top has two parcels with conservation easements placed on them by the Nature Conservancy ,on the Milton side.. In spite of this, two other parcels ,sandwiched between and flanking, are scheduled to have turbines. One locally important Mt. almost saved! Does this not represent excessive burden on the town of Woodstock? I am supporting the over 60 signatures wishing to be removed from Expedited Permitting but I must say Criterion A and Criterion B provide a real challenge to our citizens. I know you did not write these but how do I advise people to express their views ,their right to know how they will be affected by a wind project that no one knows anything about and which no proposal has yet been submitted? Can I advise people to call you to express their views??? I will be submitting a more extensive pre-hearing submission but please enter this request as well.

Monday, June 6, 2016

From the desk of: Robert D. McQueeney Jr.
350 Cushman Rd.
Bryant Pond, Maine 04219
1-207-409-1630
uphillklimber@yahoo.com

RECEIVED
JUN 08 2016
LUPC - AUGUSTA

To:

Department of Agriculture, Conservation and Forestry
22 State House Station
18 Elkins Lane
Augusta, ME 04333

To the Maine LURC,

I am writing to you in regard to the proposed Wind generating project for Milton TWP. I live, literally, walking distance from the wind turbines in Woodstock, having hiked up to them several times. The power lines from these turbines pass by my house, and I am tied into them. I am a proponent of green living, my own house being a geothermal heated and cooled house.

I'll not discuss the relative benefits and costs of renewable and green energy sources, but rather the impact wind turbines have upon neighbors. The Wind turbines in Woodstock were placed "too close" to residential homes, causing many a distinct change in lifestyle. They caused a near permanent change in the local environment, the peace and quiet folks had enjoyed was now gone, and some have been forced to move.

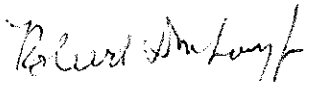
The town of Woodstock, recognizing that there has, in deed, been a negative impact on some of its citizens, formed a commission to investigate and draw up a new town ordinance. This ordinance has required a set back of one mile from any residential property, more restrictive than Maine's expedited requirements. This set back limit was a direct result of the impact of the wind turbines recently erected.

There are very real impacts from these wind turbines. As I have stated, I live very close to a wind turbine farm. Fortunately, the wind typically blows from me to them, so the impact on me is minimal. But occasionally, the wind blows from the turbines to me, at speeds enough to cause a negative impact, from the sound vortex similar to any bladed fan you may turn on high speed. This typically will last all day, and it very clearly is not pleasant. Were this to last all day, every day, it would simply be unacceptable.

I am asking you to please consider the very real impact wind turbines have on people who live nearby. Please do not overlook Maine's citizens who live nearby while processing applications from wind energy generators who do not have to live next to one.

Sincerely,

Robert D. McQueeney Jr.



From: grfraser @megalink.net
To: Beyer, Stacie R
Subject: Milton Twp fast track
Date: Wednesday, June 08, 2016 12:29:27 PM

To Stacie R. Beyer

I am writing to say I want to see Milton Twp removed from the fast track process for wind development. In fact, I want to see all unorganized towns removed from the fast track. Everyone concerned or affected has a right to review the project proposed. Mainers have a right to know when their way of life and neighborhood will be affected. I feel adversely affected in the belief that big money is willing to see wind towers on every mountain in Maine. That is not how life should be. The scenic beauty attracts tourism which helps the economy and Maine. I am also concerned how adversely it will affect the wild life in the area. I believe that there is a bat cave in the proposed Milton Twp development area.

I am not against wind power. However, I feel that the Maine citizens should be informed of the project and notified of the proceedings along the way. Starting from a proposal, the test area and results, the site, findings, and visual affects to the area. I would request that a simulation be provided of what the towers would look like from all view points. Plus a sound analysis. What are the sound levels proposed?

Thank you for your consideration.

Rose Fraser
Route 232 Woodstock Citizen

From:	Sara Wright
To:	Beyer, Stacie R
Cc:	Rose Frazer
Subject:	Milton Plantation -Fast Track
Date:	Thursday, June 09, 2016 11:33:45 AM

Stacie,

I am writing to request that Milton plantation (and any similar future proposals for unorganized territories) be removed from the fast track for wind development.

We already know how wind power has adversely effected people around the towers that already exist in this area.

Those towers make NOISE that disrupts people's lives, creating all sorts of undesirable physical symptoms like headaches, inability to concentrate, an internal buzzing sound to mention a few.

As a result people's homes and cottages around the existing towers have been impacted on a negative level economically.

We know little about how wind power effects wildlife beyond that these towers kill song birds and may negatively impact migratory routes of other birds in ways that we do not understand (because so little research has been done).

I believe that there is a bat cave in the proposed development area.

Our bat population has crashed. With such sophisticated sonar there is no way the few bats that may be surviving can't be negatively impacted by the erection of these wind towers.

I am not against wind power. I am against any "improvements" made at individuals' (human or non human) expense.

Respectfully,

Sara Wright

Sara Wright
Jungian Therapist
Ph.D

From: Scott Hynek
To: Beyer, Stacie R
Subject: Milton Township
Date: Thursday, June 09, 2016 5:27:13 PM

Any proposal as contentious as the Milton Township wind farm has no business being fast tracked.

Sent from my iPhone

From: Mary Wilson
To: Beyer, Stacie R
Subject: Fast Track
Date: Wednesday, June 15, 2016 7:42:36 PM

Stacie,

I'm e-mailing you concerning the wind farm probability in Milton Plantation. It will have a big impact on my husband and myself as well as his family. The family homestead has been in existence since roughly 60 yrs ago.

If it goes through we would most likely have lower property value. Who in their right mind would purchase property looking at that every day? Not to mention our beautiful view of the mountains will be destroyed. We've enjoyed many sunrises, also watching the snow, rain, fog coming our way before it reaches us. So we're praying that it never happens.

How by the way would it be a benefit ??What exactly becomes of the power that's make?? Who is on the receiving end?? Certainly not us in any way.

Thank you for your time.

Mary + Todd Wilson

From:	Charlie Nielsen
To:	Beyer, Stacie R
Subject:	Milton Wind Project
Date:	Thursday, June 16, 2016 2:11:17 PM

Stacie, Although my house is in Woodstock, a part of my property is in Milton, close to Chamberlain Mt. I'd like to attend the August 10th public hearing. Where will it be held and at what time?
Thanks, Charlie

From: Cathy Newell
To: Beyer, Stacie R
Subject: Milton Twp
Date: Friday, June 17, 2016 9:14:22 PM

Dear Ms. Beyer,

We are concerned about the effort to retain expedited status for wind power projects in Milton Twp. While Milton is certainly unorganized, it is surrounded by residents of Woodstock and Bethel, and in our case Greenwood. The project in Milton Twp. would impact residents of these towns and a complete review project is definitely in order. The issue has apparently been going on for months, yet locals only learned of it in the past 2 weeks.

In our case we live in Greenwood on North Pond and look directly up the pond to the area of Bryant and Chamberlain Mtns. The view, enjoyed by those travelling on Route 26 as well as residents, would be significantly changed should this project happen. North Pond is a much used recreational asset to the entire Bethel area, and the spectacular view in question is cherished by locals and visitors, and has been photographed regularly for such publications as Down East and the LL Bean catalog, as well as more local publications. There is a year round population of eagles, and I believe peregrine falcons are also on the cliffs above the pond. The recreational assets of the Pond are marketed by the local Chamber for pursuits such as canoeing, kayaking, swimming, fishing, and paddleboarding.

It is vital that the Lakes Association, the local Land Trusts, and the residents of the greater area have a voice in this process. The population of Milton Twp itself is small, just over 100 people, but the development of the land in question for wind power will impact many more individuals and visitors to this tourism-dependent area.

Clearly this project would impact more than the residents of Milton, and should not be given "expedited" status, but rather be given thorough review or the type that would happen if the project were located in a municipality.

We will be planning to attend the August 10 hearing.

Cathy and Charlie Newell
PO Box 187
Johnnys Bridge Road
Greenwood 04255

From:	Jane Chandler
To:	Beyer, Stacie R
Subject:	Expedited wind project in Milton Township
Date:	Sunday, June 19, 2016 6:55:01 PM
Attachments:	Milton expedited wind.doc

Stacie,

I would like to lift the expedited status for the wind development project in Milton Township.

I am attaching my letter with a list of concerns.

Jane Chandler, Woodstock resident
357-3524

TO: State of Maine Department of Agriculture, Conservation and Forestry
Land Use Planning Commission
16 Hogan Road, Suite 8
Bangor, ME 04401

FROM: Jane Chandler, Woodstock resident

RE: Removal of Expedited Status for Wind Projects in Milton

Date: June 19, 2016

I am asking you to remove the expedited permitting area for Wind Development for Milton Plantation (Township).

1) I believe the greater Milton community has a right to be better informed about a proposed wind farm of eight to twelve turbines. Thus far the community has been kept in the dark with little communication from Ever Power Wind Holdings. The greater Bethel region, including Milton, prides itself on its dedication to outdoor recreational activities and it is crucial that economic impact on the region be carefully evaluated.

2) There is a bat hibernaculum site only 3 miles from the proposed towers. And as you know, many species of bats are seriously threatened as a result of white nose syndrome. This proposed wind farm can only increase pressure on these critical species.

3) Only with a full evaluation of the turbine locations, plans for decommissioning, maintenance requirements, guidelines for sound (decibel levels) for the proposed towers can the LUPC make reasonable judgements regarding the proposal. With the expedited process in place, there is no opportunity to evaluate the proposal on its merits.

4) I am also on the Board of Directors of the Mahoosuc Land Trust in Bethel. The MLT holds an easement on abutting land to the proposed wind towers. As an abutter, the land trust would like to be party to hearings regarding the proposal as it affects the abutting conserved land. There is also abutting State Park at Little Concord Pond. I care for the quality of life, the scenic views and our lakes and rivers. And I would appreciate time to evaluate this particular proposal from Ever Power Wind Holdings.

From: leslie baumgartel
To: Beyer, Stacie R
Subject: Milton Township Fast track
Date: Sunday, June 19, 2016 5:42:59 AM

Greetings,

I would like to go on record that I would like to see Milton remove from the fast track process so that we can learn more about the proposal and to be able to fully review and comment.

Thank you for your time on this matter.

Leslie Baumgartel
(living at the base of Bryant Mountain)

From: Marissa
To: Beyer, Stacie R
Subject: Woodstock Wind Project Concern
Date: Sunday, June 19, 2016 1:13:20 PM

Stacie;
I currently own property at the base of Bryant Pond Mountain on rt 232 and was just informed about the wind project. I am highly concerned with not only my property values (as my address falls in the Bethel Township) but even more so about noise pollution. I am highly concerned that I will fall into the trap of needing to move because of noise/ not being able to resell my home for the same reason. I enjoy the peaceful atmosphere of Western Maine. Environmental impacts that could result are also a concern, wind farms have a reputation for negatively impacting bird populations. I do not want to see harm come to the many Bald Eagles and other birds of prey that nest in the area. Please let me know what I can do as a concerned citizen.
Thank you for your time
Marissa Hughes

From:	Thea Dunn
To:	Beaucage, Timothy
Cc:	Beyer, Stacie R
Subject:	Milton Township
Date:	Sunday, June 19, 2016 7:28:03 AM

Hi. Can you tell me whether there is a person who is assigned to development activities in unorganized territories? As you know there is a proposed wind tower project in Milton Township and we would like to know who the State's contact person is. Thank you for your consideration.

Thea Dunn
Pianoexp@gmail.com

Sent from my iPhone

From:	Perry Risley
To:	Beyer, Stacie R
Subject:	Woodstock Wind Project
Date:	Tuesday, June 21, 2016 12:37:18 PM

Stacie,

I am sending to tell you I do NOT support fast tracking this project. I see no urgent need for it. Please stop the fast track process.

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Slaínte Mhath!
Perry, Sharon, & Phantom
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From: zoosie @oxfordnetworks.net
To: Beyer, Stacie R
Subject: Fast track
Date: Tuesday, June 21, 2016 9:14:41 AM

To whom it may concern,

I am writing to respond to the "fast tract" proposal for wind power for Milton.
I hope that as a landowner we will be able to be heard and our rights will be considered.
Chamberlin Mt is in my area.
sincerely,
Sue Ellis

GREENWOOD
BICENTENNIAL
1816-2016
Birthplace of LL Bean
Town of Greenwood 593 Gore Road Greenwood, Maine 04255 • (207) 875-2773

June 22, 2016

Stacie R. Beyer
Maine Land Use Planning Commission
106 Hogan Road, Suite 8
Bangor, ME 04401

Dear Ms. Beyer,

The Greenwood Board of Selectmen respectfully request to remove Milton Township from the Expedited Permitting Area for Wind Energy Development. There are several properties in Greenwood that would be visually impacted by this proposal and the Board of Selectmen would welcome a substantive review and public hearing on said proposal.

Thank you for your consideration of our request.

Sincerely,

Greenwood Board of Selectmen

Fred Henderson, Chair

Arnold Jordan

Amy Chapman

From:	Valerie Billings
To:	Beyer, Stacie R
Subject:	MiltonTownship wind towers
Date:	Thursday, June 23, 2016 4:34:53 PM

We do not want them in Milton twp We would like to have Milton Twp. removed from the fast track process of wind development. Thank you. Reginald and Valerie Billings 555 Milton Road Milton Twp. 04219 email valleymain@yahoo.com

Sent from Yahoo Mail on Android

Andrew Benson
25 Dore Hill Rd.
Athens, ME 04912

June 24, 2016

Stacie R. Beyer
Maine Land Use Planning Commission
106 Hogan Road, Suite 8
Bangor, ME 04401

Re: Milton Wind Power Project/Bryant Mountain

Dear Ms. Beyer,

It is my understanding that LUPC has requested that interested persons submit comments in connection with this matter by 5:00 P.M. on June 29, 2016. As one of the landowners involved, I believe that I would qualify as an interested person.

My stepmother, sister, and I own a large tract of land on Bryant Mountain in Milton Twp. as tenants in common. That tract would be at least a sizeable portion of the proposed project.

Based on research I have done, it is my understanding that many towns in the immediate area have large-scale developments that are consistent with wind power and that there is existing transmission infrastructure available. Further, I would argue that creation of a wind power project would not negatively affect hunting. In fact, because of the road that would have to be built, there would be a reliable way to get to the top of the mountain for hunting for older hunters or those who might be otherwise disabled.

There is also nothing about the project that is inconsistent with other traditional rural uses. The project would not negatively affect either snowmobiling or the use of all terrain vehicles. I would also point out that both of those groups have generally been vocal in their support of such projects.

While our property was fairly recently subjected to a timber harvesting operation, there is nothing about a wind power project that would be incompatible with ongoing timber harvesting or other traditional rural uses.

Although I don't live in Milton Twp., I do live in another rural Maine community and I clearly understand that there is an important need for economic development

throughout rural Maine, including in Milton Twp. This project would be a boon for the community in a number of ways. If the state were to change the current zoning, that sort of change will only serve to suggest that it is not just indifferent to the need for such development, but positively hostile to it.

Further, on a personal level, if the zoning is changed, the state will be depriving my family of an important economic opportunity, and we can ill afford such a deprivation. For all intents and purposes we will be losing value in our land that we would otherwise have.

Finally, I would note that wind power, by its nature, is a resource based form of development, and, that as such, it is consistent with the state's energy goals.

Thank you for the opportunity to address the issues.

Sincerely,

Andrew Benson

From: Connie Haas
To: Beyer, Stacie R
Subject: Proposed Bryant Mount Wind Project
Date: Friday, June 24, 2016 7:53:18 PM

Dear Stacie:

In reference to the proposed Bryant Mountain Wind Project in Milton Township, we would like to submit our comments in support of this project.

We believe the project will benefit the town of Milton economically by providing funds for road improvements and possibly cable and internet availability. It will also provide jobs during the construction process.

There is also an existing transmission station located on Route 232, and in keeping consistent with local development, there is also another wind project existing on Spruce Mountain.

Please add our comments for support of this project.

Sincerely,

Llewellyn E. Buck
Constance D. Haas
7 Buck Road, Milton Twp., ME 04219

June 17, 2016

Stacie R. Beyer
Maine Land Use Planning Commission
106 Hogan Road, Suite 8
Bangor, Maine 04401

Dear Commissioners,

I own 100 acres of timberland in Milton Township through my family corporation, Chamberlain Mountain LLC., plus adjoining land and a home in Woodstock where I plan to retire in two years. The wind turbine project proposed by Everpower impacts my family and I in a variety of ways both favorable and unfavorable but (after considerable research) I am strongly in favor of this development.

When I was first approached about this project my initial reaction was the typical, "not in my back yard" but I realized over time that this was selfish and short sighted. Not only does America need this alternative energy but the project will help the State achieve it's energy goals while bringing much needed economic development to Milton and Western Maine. Thanks to Patriot Winds existing wind farm on nearby Spruce Mountain transmission lines and other infrastructure are already in place nearby.

This development would also be thoroughly compatible with existing land uses in the area as activities such as hunting, logging, snowmobiling and hiking trails would be substantially enhanced by improved land access.

Milton, Maine and America need this kind of compatible alternative energy project to assure our future.

Sincerely,

E. Stanley Dodge
Milton land owner

From:	Kathryn Hurd
To:	Beyer, Stacie R
Subject:	Milton Wind Towers
Date:	Monday, June 27, 2016 10:46:58 PM

We would like to vote NO on the Milton Township Wind Farm Fast Track Project.

There should be no "fast tracks"

Chris & Kathy Hurd

From: Connie Haas
To: Beyer, Stacie R
Subject: Milton Twp.Wind Project
Date: Monday, June 27, 2016 1:42:37 PM

In reference to the proposed Bryant Mountain Wind Project in Milton Township, I would like to submit my comments in support of this project.

I fully support the wind project. Local schools will receive funding for different programs and equipment, which in turn, will benefit the parents. Also the town will receive tax revenue which will help fund improvements, such as roads and services.

Wind power is a clean, renewable energy source and will not cause any environmental pollution.

Lastly, I myself find the wind turbines fascinating and do not see them as an eyesore.

Please add my comments as support for this project.

Sincerely,

Llewellyn Buck 04219
7 Buck Road, Milton Twp., Inc.

From:	Lesley Herschlag
To:	Beyer, Stacie R
Subject:	Proposed wind project in Milton township
Date:	Monday, June 27, 2016 11:35:11 PM

M.L.U.P.C.

106 Hogan Road,

Bangor, Me 04401

6/27/16

Dear Stacie Beyer,

We have recently learned of a proposed wind farm in Milton township. We are very much in favor of renewable energy and as local residents would like to have some time to learn more about this project. As lifetime outdoor enthusiasts in the Bethel area and outdoor instructors for many years, we care a great deal about land use issues. We are quite surprised that a project of this magnitude could be happening in our backyard and that we only learned about it by happenstance after speaking with some of our neighbors.

It seems as though this project is being rushed and as local residents we would greatly appreciate it if this process were to slow down to allow for adequate review and participation.

Thank you for your consideration in this matter,

Lesley and Harold Herschlag

288, Route 232,

Bryant Pond.

Me, 04219

Lesley Herschlag
Academic Coach
ELL District Coordinator

From:	francoise fetchko
To:	Beyer, Stacie R
Subject:	Milton"s request to exit the expedited wind permitting area
Date:	Tuesday, June 28, 2016 12:17:13 PM
Attachments:	substantive.pdf

Thank you for your consideration. Peter Fetchko

Dear Ms Beyer: The following are my comments on the Ever Power Wind project proposed for Milton Township and the Substantive Review. Peter Fetchko, Woodstock

CriterionA:

1: A petition to remove Milton from the Expedited Permitting Area and the substantive review of the petition, in themselves do not effect the ability of the state to meet its goals. The purpose of the petition was to allow for more time to provide greater participation by not only Milton residents but also residents in surrounding communities who had no knowledge of a proposed wind farm . Ever Power has done a deplorable job in being open,honest, forthright and communicative. Selectmen in Woodstock, Bethel, Greenwood and Peru and perhaps Rumford have only recently learned of a wind farm of 10 to 12 turbines that has been in planning for over two years. The Mahoosuc Land Trust which holds conservation easements on adjoining properties to at least two proposed turbines also only recently learned of the wind farm. The citizens wish for greater transparency and information should not have an unreasonable adverse effect on the states goals.

2: There are 20 million acres in Maine, surely enough for the state to meet its goals and provide adequate protections for it's citizens . I cannot believe that our legislators intended that an unorganized territory like Milton surrounded by organized towns with wind ordinances would have their rights abrogated without due process.

Any land close to a town border is not subject to the ordinance of the town that it is in, but rather is subject to the standards of the state or the adjoining town, meaning any future development by a property owner may be impossible. This amounts to the taking of private property without due process.

I hear often how Maine must keep its young people for our economy to grow,yet my young neighbor who just invested in a Civil War period hill farm and intended to restore it, now must have second thoughts. This property,less than a mile from the turbines will certainly be effected with the consequence of him loosing equity. Hardly encouragement to the young. Hardly an encouragement to the retired ,like myself who has a great deal of equity in my home and land whose value is now greatly diminished.

3: Woodstock already has 10 turbines and whatever sacrifices have been made will be increased unfairly because of 10 to 12 additional turbines. This proposed density in such a populated area is far too great.

Criterion B:

1: The Bethel region prides itself for its dedication to outdoor recreational activities. Canoeiing, kayaking in our lakes and rivers support a broad and diverse group of guide services and rentals. North Pond, South Pond , Round Pond and Lake Christofer are all a critical ,mostly interconnected water recreational area that have spectacular views of of Bryant Mt. and Mt. Chamberlain. These lakes also are important for fishing activities in all seasons. The Androscoggin River likewise is a major thoroughfare for boaters,canoers and kayakers. A wind farm is not compatible with the economic interests of these spectacular resources.

Sunday River, the Mahoosuc Mts. the Appalachian trail all are a regional resources of outdoor economic activity that support outfitters and other local businesses.

2: Saddest of all is the loss of Mt Chamberlain (2081 ft.) whose summit is shared by Milton and Woodstock. The Woodstock side is preserved by a wind ordinance and on the Milton side there are two land parcels with conservation easements held by the Mahoosuc Land Trust and implemented by the Nature Conservancy. In spite of this there are two turbines planned for this summit!

3: We do not know where the transmission lines are going to be. Like so much of this project, secrecy and obfuscation have been the rule. It is likely , however that they will travel along route 232 toward the existing electrical station. They will then pass the Whale Back Cemetery and climb up on to the Whales Back, a classical geological esker and then pass through the center of Pin Hook (North Woodstock) and then by the Cole Cemetery before reaching there destination. They will have significant negative impacts on not only an important geological feature but also the character of our community.

4: The Bats: The average mortality of bats from wind turbines in the eastern U.S. is 37 bats per year. That is 444 bats each year if as proposed there are 12 turbines. However,because only one of three major bat hibernaculums in Maine is only a little more than three miles away the mortality could be much greater.

5: Cultural and Historic Resources: I have two neighbors one who over many decades has been restoring a classical hill farm dating to the civil war which exists on the slopes of Mt Chamberlain. My other neighbor mentioned above under criterion A and living on Billings Hill rd. will also be adversely affected. His farm the Russ farm was occupied until 1938, when Mr. Russ a civil war veteran, surviving on a civil war penssion died. These resources so closely linked to our cultural identity will have negative investment pressure and could be lost.

From: Allison Ross
To: Beyer, Stacie R
Subject: Support leaving Milton Township in expedited permitting
Date: Monday, June 27, 2016 10:47:21 AM

Hi I'm Susan Hooper and I support leaving Milton Twp. in expedited permitting. I look forward to seeing this project completed. I understand there is a neighborhood agreement that will benefit our area which is much needed. Thank you for your time. Susan
Sent from my iPhone

June 27, 2016

Stacie R. Beyer
Maine Land Use Planning Commission
106 Hogan Road, Suite 8
Bangor, ME 04401
Stacie.R.Beyer@maine.gov

My name is Steve Perry from Lincoln, Maine and I am writing to you in support of the Wind Project proposed for Milton Township in Oxford County, Maine. Wind development in Maine is important to our local economy and to families here in Maine

I have the privilege of living on one of the 13 lakes in Lincoln and can see 9 turbines from the Rollins Wind Project. I am always amazed at their ability to be making power at the same time that I am kayaking on a lake as smooth as glass.

Renewable energy projects has brought over $1 billion in private investment into Maine over the last decade, creating thousands of good paying construction jobs, and increasing rural property tax coffers, while generating inexhaustible, clean, safe, and reliable electricity.

As a tax payer in Lincoln, I was relieve to learn that when the paper mill was closed the bad news would have been even more devastating if it hadn't been for the Rollins wind project. The same project that gave some folks concern at first is now very pleased with the fact that the Rollins Wind project contributes $1.3 million to the town in tax revenue every year.

Along with the 13 lakes that bring tourist to Lincoln every year the turbines are also visited by hundreds folks on ATVs in the summer and snowmobilers in the winter.

The land that the project will be constructed is and will continue to be a working forest with landowners that share the forest to thousands of sportsmen to hunt and fish and in return only want the benefit of working the land through logging and forestry. Since 2005 when Mars Hill Wind project was constructed, Wind projects have proven to be an additional financial resource for the land owners who have witness one mill after another closing and no longer have demand for wood produces.

Harvesting Maine's natural resources is not new to Maine's economy. Our success has always been exporting our renewable resources like wood, blueberries, lobster and potato…Wind is one of our many natural resources that we have the good fortune to be able to process and export to the open market…

This is Maine people building Maine projects that produce Maine-made energy. Wind power in our state has proven good for our economy and good for the environment. It is a shining example of a billion dollar industry that allows Mainers to continue to enjoy the quality of life we have become accustomed to and that keeps our economy moving forward.

Respectfully,

Steve Perry
207-944-0368
sperry54@roadrunner.com

From: Tracy King
To: Beyer, Stacie R
Subject: Milton Township expedited fast track
Date: Monday, June 27, 2016 7:48:17 PM

Dear Stacie, My husband and I are Milton Township residents. I'd like to take the opportunity to register our opposition to the LUPC's decision to allow EverPower to move forward with a wind farm via the expedited fast track mode. As long time residents, we feel that a wind farm will have a negative impact on the environment, our property value and our general quality of life. Please give us and all Milton residents the same opportunity to publicly review and comment on EverPower's plans that surrounding towns have had. Sincerely, Tracy King tracyking387@gmail.com

From: Jerry Bernier
To: Beyer, Stacie R
Subject: Milton Windmill Project
Date: Tuesday, June 28, 2016 8:57:48 PM

Dear Ms. Beyer,
We am writing to you about the concerns we have with the Milton Township windmill project. The biggest being that the project seems to be very unforthcoming. We have two houses within 1 mile of two potential windmill locations, and only know about the project because of a neighbor whose land may be used as a site. None of the town managers of the three abutting towns have been officially told about the project. A person from New York has been buying land in Woodstock to gain access to the Milton property line. This man obviously knew long ago about the potential windmills, all the while posing to be a conservationist to the town.
The issue of fast track is also very concerning to us. The concept of fast track in unorganized territory with no residents may makes sense. However, in a township like Milton there are an immense number of residents that will be effected. Many people from Woodstock, Bethel, and Rumford will also be directly inconvenience by these windmills. Because of this, we do not understand how no public hearings, voting, or even public announcement is required.
We would like to know, as many other people do, what the plans are. Where and how many windmills are being proposed? Where are the power lines being routed? And where is the access road going to be?
This project could cause major disruption to many peoples' lives depending on the answers to these questions. This project being in unorganized territory is at the mercy of Maine government officials. We hope that the health and wellbeing of it residents is Maine's number one priority, since much of the economics of this project will not be kept in state, or even in the country.
Thank you for hearing our concerns and please feel free to follow up with us via email. We look forward to hearing from you.

Thank you,
Jerry and Nicole Bernier
224 Billings Hill Road
Woodstock, ME 04219

June 28, 2016

Stacie R. Beyer
Maine Land Use Planning Commission
106 Hogan Road, Suite 8
Bangor, ME 04401
Stacie.R.Beyer@maine.gov

RE: Bryant Mountain Wind Project, Milton Township, Oxford County, Maine

Dear Ms. Beyer:

Please consider this a letter in support of the Bryant Mountain Wind Power Project.

I firmly believe this Project is consistent with the principal values and goals of the comprehensive land use plan. Specifically, other than people from away that oppose wind projects and a few abutting neighbors, wind energy is widely supported by the residents of the State of Maine. Even though the energy is shipped to southern New England it effectively displaces fossil fuel generating facilities which we as a country drastically need to do in order to slow global warming.

I believe wind power is an allowed use consistent with the uses, activities, and objectives for the area.

- Surrounding towns all have forms of large scale development that are consistent with wind power.
- There is existing transmission infrastructure available.
- This wind project will not have an adverse impact on outdoor recreational us. It has been demonstrated wind projects do not impact hunting, fishing, snowmobiling, or ATV activities. In fact, as users, many of these outdoor enthusiasts support wind power.
- This Wind project will allow landowners to continue logging & harvesting but will minimize negative impacts of a struggling wood products industry. Wind projects allow major land owners to continue to own and preform typical land use activities while maintaining a policy that is unique in Maine wherein major landowners allow the public to access their land for recreational purposes.
- There is a critical need for economic development in Milton Twp. This is an economically challenged region that could really benefit by the jobs created by this Project.
- Changing the zoning will send a negative message that makes future economic development more difficult.
- Bryant Mountain Wind is a resource based form of development consistent with State's energy goals.

I look forward to further supporting the permit application process for this exciting project in the coming months.

Best regards,

John Cooney

12 Baxter Lane
Brunswick, ME 04579
T 207-721-8606

Marcel Polak
168 Cushman Hill Rd.
Woodstock, Maine 04219
207 665-2577
sprucemt@megalink.net

June 28, 2016

Ms. Stacie Beyer
Maine Land Use Planning Commission
Chief Planner, Acting Capacity
106 Hogan Rd., Suite 8
Bangor, Maine 04401

Dear Ms. Beyer,

I am writing in strong support of removing Milton Township in Oxford County from the Expedited Permitting Area for Wind Energy Development.

I live in the town of Woodstock and supported the Spruce Mountain Wind project that currently has ten turbines. Patriot Renewables LLC, the developer, was open and transparent about their project and worked slowly and methodically with the Woodstock planning board, selectmen, and town manager to permit the project. The outcomes were overall strong community support, a contribution to the State's energy needs, and multiple benefits to the Town of Woodstock.

In contrast, Everpower, the developer of the Milton Wind Project has had the opposite strategy. They've been secretive and opaque. Town selectmen and managers in the neighboring towns, most likely impacted, were not contacted and hardly knew anything about the proposed project. To this day, there is scant information about the project. Everpower's process has resulted in an atmosphere of self-created mistrust.

While Milton is in the expedited zone, the project will be literally on Woodstock's border and extremely close to Bethel. The neighboring town of Greenwood will also be impacted. All of these incorporated towns are out of the expedited zone. There is a strong disconnect here in terms of regulatory oversight of towns – one unorganized in the expedited zone and the other organized towns in the unexpedited zone.

The proposed project in Milton, as we know it, will add 12 turbines to the 10 existing turbines. There is no doubt that every wind project in Maine has winners and some losers.

Those “losers” are often wildlife such as birds and bats. Homeowners whose proximity to wind towers typically sustains a decrease in property values will likely face a very challenging selling market.

If anything, there should be additional review because of the proposal for a total of 22 turbines. This increased total density in a relatively small area that is highly dependent on tourism, and has many neighboring residents, is beyond the sacrifices this community should sustain without rigorous review.

There is no apparent decrease of the two criteria upon which to judge whether or not Milton should be kept in the expedited zone.

> *Criterion A.* The proposed removal will not have an unreasonable adverse effect on the State’s ability to meet the state goals for wind energy development in [Title 35-A] section 3404, subsection 2, paragraph C.
>
> *Criterion B.* The proposed removal is consistent with the principal values and the goals in the comprehensive land use plan adopted by the Maine Land Use Planning Commission pursuant to Title 12, section 685-C.

Local residents in Woodstock, Bethel and Greenwood or Milton, whether or not they are in the expedited zone, should be protected by a full range of available state and local review for industrial scale development in their communities. This development has the potential to be transformative.

Therefore, I strongly request that Milton be removed from the Expedited Permitting Area for Wind Energy Development.

Sincerely,

Marcel Polak

cc: Senator John Patrick, Maine Legislature

From:	paulo@copiz.net
To:	Beyer, Stacie R
Subject:	In the Matter of the Substantive Review of the Petition to Remove Milton Township from the Expedited Permitting Area for Wind Energy Development
Date:	Tuesday, June 28, 2016 9:34:26 PM

As the owner of property in the Town of Woodstock, Maine, I am writing to request that the State of Maine, pursuant to Title 35-A, Section 3453-A of the Maine Revised Statutes, remove Milton Township from the Expedited Area. Doing so a) would not have an unreasonable adverse effect on the State's ability to meet its goals for wind energy development as specified in Title 35-A, Section 3404, of the Maine Revised Statutes and b) is consistent with the principal values and goals in the Comprehensive Land Use Plan adopted by the Maine Land Use Planning Commission (2010).

Any action taken in Milton Township with respect to wind energy will have significant impact on the use and enjoyment of my land in the Town of Woodstock, not to mention the potential reduction in property value. I have been an owner of the land for over 40 years and my family has plans to continue enjoyment of the property, including the possibility of placing a cabin on the property; any wind farms could have notable, adverse, auditory and visual impairment of enjoyment of the property.

Failure to remove Milton Township from the Expedited Area would deprive the residents and property owners in Milton Township and surrounding communities of their due process rights. Removal of Milton Township from the Expedited Area, however, would allow for due process while meeting the statutory criteria under Title 35-A, Section 3453-A of the Maine Revised Statutes.

First, by allowing for full due process of all interested parties there would be no adverse effect on the policy goals under Title 35-A, Section 3404, of the Maine Revised Statutes and the target wind generation goals. In fact, removal from the Expedited Area would further meet one of the goals of ensuring "appropriately sited development". Appropriately sited means not only how much energy will be generated and at what cost, but also consideration of the public interest, including, but not limited to, environmental consequences, economic impact on the local communities, and the effect on individual residents and property owners.

Second, removal from the Expedited Area is consistent with the principal values and goals in the Comprehensive Land Use Plan adopted by the Maine Land Use Planning Commission. For example, under Section 5.5 of the Comprehensive Land Use Plan, Expedited Areas are intended to reward "well-sited projects"; however, it is not clear this project is well-sited as currently conceived, with such determination being best ascertained through the full review process, requiring removal from the Expedited Area. Additionally, under Section 5.5 of the Comprehensive Land Use Plan, consideration is to be given to impact on birds and bats, noise levels, public safety-related setbacks, and scenic impacts, amongst others, all of which can be better addressed through removal from the Expedited Area. Under a full review process, the objectives under the Comprehensive Land Use Plan can and will be met.

While the State of Maine is taking positive steps in harnessing clean,

renewable, energy sources, which is to be applauded, it should be done so with a full analysis of the impacts on the environment, communities, and individuals. Your consideration of the reasons why Milton Township should be removed from the Expedited Area is much appreciated.

Paul Copiz

From:	Alice Barnett
To:	Beyer, Stacie R
Subject:	Substantive Review of the Petition to Remove Milton Township from the Expedited Permitting Area for Wind Energy Development
Date:	Wednesday, June 29, 2016 1:06:11 PM

I live in Peru, Maine and I have adverse affects from Spruce Mountain Wind Project, three miles away. Milton Township is less than a mille from my property. I will experience accumulative adverse affects if Milton Township is not removed from the Expedited Permitting Area for Wind Energy Development.

Alice Barnett
1068 Dickvale Road
Peru, Maine 04290
207-562-8384

From: Choi, April
To: Beyer, Stacie R
Subject: Aug 10 hearing on wind power in Milton Township
Date: Wednesday, June 29, 2016 2:36:00 PM

Stacie R. Beyer
Maine Land Use Planning Commission
106 Hogan Road, Suite 8
Bangor, ME 04401

Dear Ms. Beyer,

Re: upcoming hearing on Aug 10.

After listening to very personal arguments from both sides of this issue, I am still in favor of the wind turbines and believe that keeping wind power as an allowed use is consistent with the current uses, activities and objectives for Milton Township. While I am not a full-time resident, I believe that we need to invest in renewable, clean energy and feel that the benefits outweigh the costs in this case. I am completely sympathetic to all sides in this matter, but would like to see the proposal move forward in the most thoughtful and responsible way possible.

Thank you for your consideration.

Sincerely,
April Dodge Choi

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Date: June 29, 2016

To: Commissioners, Land Use Planning Commission

Cc: Nick Livesay, Executive Director, Land Use Planning Commission

From: Scott Lever, Chief Legal Officer, Associated General Contractors of Maine

Re: Substantive Review; Milton Township Petition

On behalf of the Associated General Contractors of Maine and our nearly 200 statewide members, thank you for the opportunity to submit comments on the proposed removal of Milton Township from the expedited wind permitting area.

As Maine's largest construction trade association, AGC Maine is proud to represent the men and women charged with building and maintaining our state's infrastructure. It is a job that is critical to our state and regional economies and one that our companies and their employees take very seriously. Aside from the two statutory questions that you are required to answer through this substantive review process of the Township's Petition for Removal from the EPA, AGC Maine urges you to seriously and thoughtfully consider the economic impacts that your decision may yield.

With regard to the statutory questions at hand, AGC Maine strongly believes that 1) wind power as an allowed use is consistent with the uses, activities, and objectives for the area and therefore removal is inconsistent with the Comprehensive Land Use Plan and 2) removing Milton Township from the EPA will have an unreasonable adverse effect on the state's ability to meet its wind power goals.

Oxford County currently hosts three wind farms totaling 93 MW of generation and the towns surrounding Milton Township all have forms of large scale development that are consistent with wind power. AGC Maine understands that the 40 MW project will not negatively impact the existing land usage and activities in the Township, such as hunting, timber harvesting, and recreational ATV and snowmobile access. Therefore, wind power generation is consistent with the uses, activities, and objectives for the area and removal would be inconsistent with the Comprehensive Land Use Plan.

Maine's current 710 MW of wind power generation is falling well short of its statutory goal of hosting 2,000 MW of wind power by 2020. Removing Milton Township from the EPA, effectively delaying or destroying the opportunity for a new 40 MW project to be sited in Oxford County, will not only set bad precedent for Maine and the region but will also help ensure the state does not meet the above mentioned statutory goals.

Beyond the statutory questions, there is a human-interest piece to this equation that warrants your consideration. What impact will this decision have on the hard working men and women of Maine's construction industry who rely on wind development for their paychecks? Investment in wind development statewide is estimated to create or sustain nearly 1,600 jobs annually. To put those jobs in perspective, Maine's construction industry lost 10,000 workers during the Great Recession. According to AGC America's Chief Economist Ken Simonson, Maine lost 800 jobs from May 2015 to May 2016. That ranks us 44th in the country when that number is calculated as a 12-month percentage change and as you can see in the chart below it places us dead last in New England.

New England Ranking

Rank	State	May '15	May '16	12-mo. gain/loss	12-mo. % change
1	Massachusetts	140,800	150,800	10,000	7%
2	New Hampshire	24,500	25,400	900	4%
3	Rhode Island	17,300	17,800	500	3%
4	Connecticut	59,200	60,100	900	2%
5	Vermont	15,600	15,700	100	1%
6	Maine	27,000	26,200	-800	-3%

Mr. Simonson further estimates that in 2014 the annual pay of all construction workers in Maine averaged $45,000. That is 12% more than all private sector employees in the state. These are good paying jobs held by your friends and neighbors. With our employment numbers still falling drastically and increased competition between states for investment and development of this magnitude, Maine simply cannot afford to drive it away.

The economic impact of this decision cannot be understated and it goes beyond employment numbers. During construction of a project, our companies and their employees pump money into the local economies that are often times in need of a boost. Also, wind farms make great neighbors. The Bangor Daily News published a story about the benefits received by the Oakfield community from the 49 MW project completed in Aroostook County last year and the numbers may surprise you. According to the article, Oakfield's 800 or so residents will receive $14.7 million in tax revenues over 20 years, and an additional $12 million in community benefit payments during that time span. That's not bad for one good neighbor that is helping Maine meet its wind power goals, creating jobs, and producing clean renewable energy, all while allowing existing land uses to continue.

In conclusion, AGC Maine urges the Commission to deny the petition proposing removal of Milton Township from the EPA and will be happy to answer any questions or provide any further data required. Thank you for your time and consideration of this critically important issue. Best regards.

AGC of America
THE ASSOCIATED GENERAL CONTRACTORS OF AMERICA
Quality People. Quality Projects.

The Economic Impact of Construction in the United States and Maine

Economic Impact of Construction:

- In 2014, U.S. gross domestic product (GDP)—the value of all goods and services produced in the country—totaled $17.3 trillion; construction contributed $653 billion (3.8%).
- In Maine, construction contributed $2 billion (4.1%) of the state's GDP of $56 billion. Thus, construction's contribution to GDP in the state was more than the industry's 3.8% share of U.S. GDP.
- Construction wages and salaries in 2014 totaled $353 billion in the United States, including $1.2 billion in Maine.

Nonresidential Construction Spending:

- Nonresidential spending in the U.S. in 2014 totaled $618 billion ($348 billion private, $271 billion public).
- Private nonresidential spending in Maine totaled $581 million in 2014. (Public spending is not available by state.)
- Nonresidential starts in Maine totaled $1.2 billion in 2014 and $1.0 billion in 2013, according to CMD.

Construction Employment (Seasonally Adjusted):

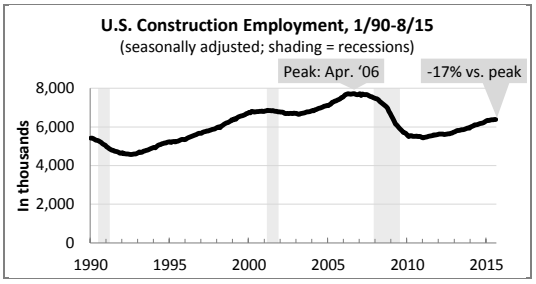
- Construction (residential + nonresidential) employed 6.4 million workers in August 2015, an increase of 219,000 (3.6%) from August 2014 and a decrease of 1.3 million (17%) from April 2006, when U.S. construction employment peaked.
- Construction employment in Maine in August 2015 totaled 25,400, a decrease of 1.9% from August 2014 and a 20% decrease from the state's peak in April 2006.

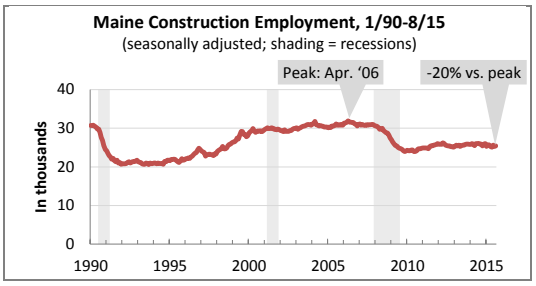
Construction Industry Pay:

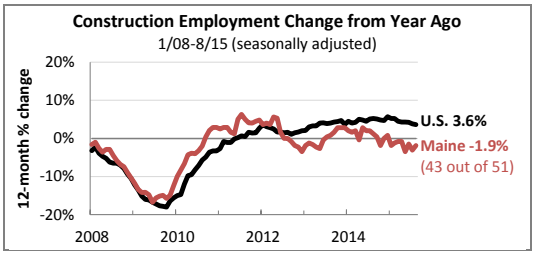
- In 2014, annual pay of all construction workers in the United States averaged $55,000, 7% more than the average for all private sector employees.
- Construction workers' pay in Maine averaged $45,000, 12% more than all private sector employees in the state.

Small Business:

- The United States had 658,500 construction firms in 2013, of which 92% employed fewer than 20 workers.
- Maine had 4,700 construction firms in 2013, of which 96% were small (<20 employees).







Empl. Change by Metro (not seasonally adjusted)		Rank
Metro area or division	8/14-8/15	(out of 358)
Statewide (construction)	-2%	
Statewide (Const/mining/logging)*	-2%	
Bangor, ME NECTA	-3%	245
Lewiston-Auburn, ME NECTA	0%	164
Portland-South Portland, ME NECTA	2%	128
Dover-Durham, NH-ME NECTA	*7%*	*51*
Portsmouth, NH-ME NECTA	*10%*	*26*

NECTA: New England City and Town Area (equivalent of metropolitan statistical area)

**The Bureau of Labor Statistics reports employment for construction, mining and logging combined for metro areas in which mining and logging have few employers. To allow comparisons between states and their metros, the table shows combined employment change for these metros. Not seasonally adjusted statewide data is shown for both construction-only and combined employment change.*

Source: Ken Simonson, Chief Economist, AGC of America, simonsonk@agc.org, from Bureau of Economic Analysis (GDP); Census Bureau (spending, small business); CMD (formerly Reed Construction Data) (starts); Bureau of Labor Statistics (jobs, pay)

September 22, 2015

State List of Construction Employment by Metropolitan Area or Division, May 2015-May 2016
(not seasonally adjusted)

Area[1]	Industry[2]	May '15	May '16	12-mo. % change	12-mo. gain/loss	Rank[3]
Elizabethtown-Fort Knox, KY	Const, mining, logging	2,000	2,100	5%	100	93
Lexington-Fayette, KY	Const, mining, logging	12,500	13,200	6%	700	74
Louisville/Jefferson County, KY-IN	Const, mining, logging	28,600	29,200	2%	600	187
Owensboro, KY	Const, mining, logging	2,900	3,000	3%	100	148
Clarksville, TN-KY	*Const, mining, logging*	*3,200*	*3,300*	*3%*	*100*	*148*
Cincinnati, OH-KY-IN	*Const, mining, logging*	*43,300*	*44,700*	*3%*	*1,400*	*148*
Evansville, IN-KY	*Const, mining, logging*	*11,300*	*11,200*	*-1%*	*-100*	*279*
Huntington-Ashland, WV-KY-OH	*Const, mining, logging*	*8,700*	*8,200*	*-6%*	*-500*	*331*
Louisiana						
Statewide	Construction	138,100	141,900	3%	3,800	
Statewide	Const, mining, logging	186,800	182,000	-3%	-4,800	
Baton Rouge, LA	Construction	48,500	53,000	9%	4,500	35
Houma-Thibodaux, LA	Construction	5,200	5,000	-4%	-200	319
Lafayette, LA	Construction	11,200	12,200	9%	1,000	35
Lake Charles, LA	Construction	14,100	15,700	11%	1,600	16
New Orleans-Metairie, LA	Construction	32,300	31,200	-3%	-1,100	305
Shreveport-Bossier City, LA	Construction	8,600	8,600	0%	0	228
Maine						
Statewide	Construction	27,000	26,200	-3%	-800	
Statewide	Const, mining, logging	28,800	27,900	-3%	-900	
Bangor, ME NECTA	Construction	2,900	3,000	3%	100	148
Lewiston-Auburn, ME NECTA	Const, mining, logging	2,500	2,500	0%	0	228
Portland-South Portland, ME NECTA	Const, mining, logging	9,000	8,800	-2%	-200	289
Dover-Durham, NH-ME NECTA	*Const, mining, logging*	*1,500*	*1,600*	*7%*	*100*	*61*
Portsmouth, NH-ME NECTA	*Const, mining, logging*	*2,300*	*2,400*	*4%*	*100*	*119*
Maryland						
Statewide	Construction	153,600	161,100	5%	7,500	
Statewide	Const, mining, logging	155,100	162,600	5%	7,500	
Baltimore-Columbia-Towson, MD	Const, mining, logging	74,600	77,900	4%	3,300	119
Calvert-Charles-Prince George's, MD	Const, mining, logging	32,100	33,700	5%	1,600	93
Hagerstown-Martinsburg, MD-WV	Const, mining, logging	4,100	4,000	-2%	-100	289
Salisbury, MD-DE	Const, mining, logging	7,900	8,400	6%	500	74
Silver Spring-Frederick-Rockville, MD Div.	Const, mining, logging	33,200	36,100	9%	2,900	35
Wilmington, DE-MD-NJ Div.	*Const, mining, logging*	*16,500*	*16,100*	*-2%*	*-400*	*289*
Massachusetts						
Statewide	Construction	140,800	150,800	7%	10,000	
Statewide	Const, mining, logging	141,900	151,900	7%	10,000	
Barnstable Town, MA NECTA	Const, mining, logging	5,900	6,100	3%	200	148
Boston-Cambridge-Newton, MA NECTA Div.	Const, mining, logging	63,500	68,600	8%	5,100	49
Brockton-Bridgewater-Easton, MA NECTA Div.	Const, mining, logging	4,700	5,200	11%	500	16
Framingham, MA NECTA Div.	Const, mining, logging	8,700	9,700	11%	1,000	16
Haverhill-Newburyport-Amesbury Town, MA-NH NECTA Di	Const, mining, logging	4,500	5,100	13%	600	9
Lawrence-Methuen Town-Salem, MA-NH NECTA Div.	Const, mining, logging	2,400	2,600	8%	200	49
Leominster-Gardner, MA NECTA	Const, mining, logging	2,000	2,000	0%	0	228
Lowell-Billerica-Chelmsford, MA-NH NECTA Div.	Const, mining, logging	7,900	8,300	5%	400	93
Lynn-Saugus-Marblehead, MA NECTA Div.	Const, mining, logging	1,500	1,500	0%	0	228
New Bedford, MA NECTA	Const, mining, logging	2,400	2,600	8%	200	49
Peabody-Salem-Beverly, MA NECTA Div.	Const, mining, logging	3,000	3,100	3%	100	148
Pittsfield, MA NECTA	Const, mining, logging	2,000	2,100	5%	100	93
Springfield, MA-CT NECTA	Const, mining, logging	11,500	11,300	-2%	-200	289
Taunton-Middleborough-Norton, MA NECTA Div.	Const, mining, logging	3,000	3,300	10%	300	25
Worcester, MA-CT NECTA	Const, mining, logging	10,100	11,300	12%	1,200	13
Nashua, NH-MA NECTA Div.	*Const, mining, logging*	*4,900*	*5,200*	*6%*	*300*	*74*
Providence-Warwick, RI-MA NECTA	*Construction*	*22,000*	*22,500*	*2%*	*500*	*187*
Michigan						
Statewide	Construction	151,700	156,600	3%	4,900	
Statewide	Const, mining, logging	159,600	163,700	3%	4,100	
Ann Arbor, MI	Const, mining, logging	3,900	4,000	3%	100	148
Battle Creek, MI	Const, mining, logging	1,800	1,800	0%	0	228
Bay City, MI	Const, mining, logging	1,100	1,100	0%	0	228
Detroit-Dearborn-Livonia, MI Div.	Const, mining, logging	20,500	21,700	6%	1,200	74
Flint, MI	Const, mining, logging	4,500	4,800	7%	300	61
Grand Rapids-Wyoming, MI	Const, mining, logging	21,100	22,200	5%	1,100	93
Jackson, MI	Const, mining, logging	1,900	1,900	0%	0	228
Kalamazoo-Portage, MI	Const, mining, logging	5,600	6,000	7%	400	61
Lansing-East Lansing, MI	Const, mining, logging	7,100	7,200	1%	100	211

188 Whitten Road | PO Box 5519 | Augusta, Maine 04332-5519 | t: 207-622-4741 | f: 207-622-1625 | info@agcmaine.org

From:	Jessica Tilton
To:	Beyer, Stacie R
Subject:	FW: Public Comments from Milton Township Landowners
Date:	Wednesday, June 29, 2016 3:11:32 PM
Attachments:	Climate Change GMRI.pdf Berkley Lab - Hedge Value of Wind.pdf Renew - Benefits.pdf Wind Power Economic Report.pdf Milton Township Public Comments Letter.docx

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This letter in response to the request for public comments in regards to Milton Township comprehensive land use plan.

Cianbro is typically cautious about weighing in on issues regarding local control. However we do feel that we have a role in providing objective information with which we are familiar to be a part of the discussion. We off the following in support for keeping wind power as an allowed use in the region.

Jessica Tilton
Admin Specialist
Power & Energy

CIANBRO

CIANBRO CORPORATION
7 Ocean Street
2nd Floor
South Portland, ME 04106

Direct (207) 741-0815

www.cianbro.com

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CIANBRO

Cianbro Corporation

June 29, 2016

Stacie R. Beyer
Maine Land Use Planning Commission
106 Hogan Road, Suite 8
Bangor, ME 04401

RE: Public Comments
Milton Township

Dear Ms. Beyer:

On behalf of Cianbro, a local business, which will directly benefit from the development of the Wind Farm Industry, we want to share why we feel it is important to demonstrate our support for these projects.

First, Cianbro became a wind contractor not just as a business venture, but because we felt it is important to advance the state of the art of renewable energy to mitigate climate change and the well-studied and reported negative effects of this phenomenon. For evidence that demonstrates the global effect on issues important to Maine that are occurring here and now, we offer attachment 1, Effects of Climate Change on the Gulf of Maine prepared by the Gulf of Maine Research Institute and published in Science Magazine.

Second, many of our industrial customers, our team members, and our own company are subjected to the costs of energy in New England. Although we support the business opportunities that wind energy provides, it should not be at a cost that is to the detriment of others relying on that product to earn a living. Contrary to popular belief, long term wind energy contracts provide LOWER electricity rates due to the hedge it provides against other more volatile energy sources. We offer Attachment 2, The Hedge Value of Wind Power in a Time of Historically Low Natural Gas Prices by the Berkeley National Laboratory, and Attachment 3, Benefits of Long Term Wind Contracts in New England by RENEW.

Third, the significant economic benefit to the State of Maine provided by wind energy development is clearly articulated in Attachment 4, Economic Impacts of Wind Power Construction prepared by Charles Colgan, Maine Center for Business & Economic Research, University of Southern Maine. In addition, all wind projects have significantly expanded the tax base and many have provided other local benefits, lessening the tax burden on the local citizens.

We hope this illustrates the importance of keeping wind power as an allowed use for the State of Maine, its businesses, and citizens.

Very truly yours,

7 Ocean Street, 2nd Floor, South Portland, ME 04106 | (207) 518-9388 | (207) 518-9395 (FAX) | www.cianbro.com

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Equal Opportunity Employer

Parker Hadlock
General Manager Wind Energy Services
Power & Energy

CIANBRO CORP

Mobile (207) 838-8162
www.cianbro.com

LBNL-6103E

ERNEST ORLANDO LAWRENCE
BERKELEY NATIONAL LABORATORY

Revisiting the Long-Term Hedge Value of Wind Power in an Era of Low Natural Gas Prices

Mark Bolinger
Lawrence Berkeley National Laboratory

Environmental Energy Technologies Division

March 2013

This is a pre-print of an article submitted to Energy Policy.

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Executive Summary

Expanding production of the United States' vast shale gas reserves in recent years has put the country on a path towards greater energy independence, enhanced economic prosperity, and (potentially) reduced emissions of greenhouse gases and other pollutants. The corresponding expansion of gas-fired generation in the power sector – driven primarily by lower natural gas prices – has also made it easier and cheaper to integrate large amounts of variable renewable generation, such as wind power, into the grid.

At the same time, however, low natural gas prices have suppressed wholesale power prices across the nation, making it harder for wind and other renewable power technologies to compete on cost alone – even despite their recent cost and performance improvements. A near-term softening in policy-driven demand from state-level renewable energy mandates, coupled with a possible phase-out of a key federal tax incentive over time, may exacerbate wind's challenge in the coming years.

As wind power finds it more difficult to compete with gas-fired generation on the basis of near-term cost, it will increasingly need to rely on other attributes, such as its "portfolio" or "hedge" value, as justification for inclusion in the power mix. This article investigates the degree to which wind power can still serve as a cost-effective hedge against rising natural gas prices, given the significant reduction in gas prices in recent years, coupled with expectations that prices will remain low for many years to come. It does so by drawing upon a rich sample of long-term power purchase agreements ("PPAs") between existing wind generators and electric utilities in the U.S., and comparing the contracted prices at which utilities will be buying wind power from these existing projects for decades to come to a variety of long-term projections of the fuel costs of gas-fired generation modeled by the Energy Information Administration ("EIA").

The wind PPA sample – consisting of 287 contracts totaling more than 23.5 GW of operating wind capacity in the U.S. – exhibits a high degree of long-term price stability. On average and in real dollar terms, the buyers of the wind energy in the PPA sample will pay no more per MWh twenty years from now as they do today. In contrast, natural gas prices are difficult to lock in for any significant duration, making it hard to capitalize on today's low prices. Although short-term gas price risk can be effectively hedged using conventional hedging instruments (like futures, options, and bilateral physical supply contracts), these instruments come up short when one tries to lock in prices over longer terms – e.g., greater than five or ten years. It is over these longer durations where inherently stable-priced generation sources like wind power hold a rather unique competitive advantage.

Comparing the wind PPA sample to the range of long-term gas price projections reveals that even in today's low gas price environment, and with the promise of shale gas having driven down future gas price expectations, wind power can still provide long-term protection against many of the higher-priced natural gas scenarios contemplated by the EIA. This is particularly true among the most recent wind PPAs in the sample, which likely better represent current wind pricing, at least on a national average basis. These newer wind contracts not only provide ample long-term hedge value, but on average are also directly competitive with gas-fired generation in the near term.

1. Introduction

One of the largest energy supply developments of the past decade has been the application of horizontal drilling in combination with hydraulic fracturing to unlock seemingly massive deposits of "shale gas" – natural gas that was previously considered to be trapped in shale rock formations. In the United States, where the enabling technology was developed and first applied on a large scale, the U.S. Energy Information Administration ("EIA") estimates that shale gas accounted for 34% of total domestic natural gas production in 2011, up from 23% in 2010 and just 4% in 2005, and projects that shale gas' share of domestic production will increase to 40% by 2018 and 50% by 2037 (EIA 2012a).

Not only has its proportional contribution increased; shale gas has also played a major role in reversing what had been a declining trend in absolute overall domestic gas production in the U.S. since 2001. After hitting a low of about 18 trillion cubic feet ("Tcf") produced in 2005, domestic gas production increased by nearly 5 Tcf through 2011, led by a more than 7 Tcf increase in shale gas production (i.e., production from non-shale resources continued to decline over this period). Looking ahead, the EIA projects that total domestic gas production will increase by another 3.6 Tcf per year by 2020, 3.2 Tcf of which will be shale gas (EIA 2012a).

One consequence of expanding domestic shale gas production is less need to import natural gas into the U.S., either from Canada or Mexico via pipeline or from other countries in the form of liquefied natural gas ("LNG"). At the same time, with the price of natural gas significantly higher in parts of Asia and Europe (where natural gas prices are more closely linked to oil prices) than it is in the U.S., opportunities to export domestic gas surplus have grown.[1] The EIA reports that in 2011, rising exports and lower imports reduced net gas imports to 1.95 Tcf, the lowest level since 1992 (EIA 2012d), and projects that the U.S. will be a net exporter of LNG by 2016, and a net exporter of natural gas overall by 2020 (EIA 2012a).

This "gas revolution" in the U.S. is having, and should continue to have, a profound effect on the electric power sector. With ample supply pushing natural gas prices down to historic lows – spot gas prices fell below $2/MMBtu in April 2012 – aggressive fuel switching from coal to natural gas has been occurring in the power sector. Coal-fired generation fell from 49.6% of all U.S. power generation in 2005 to 42.2% in 2011, while natural gas-fired generation grew from 18.8% to 24.8% (EIA 2012a). Additional fuel-switching occurred in 2012, with coal expected to have dropped to 38% of all electricity generation while natural gas rose to 30% (EIA 2012a). Looking ahead, the implementation of air quality regulations from the Environmental Protection Agency – principally the Mercury and Air Toxics Standards ("MATS") and the Clean Air Interstate Rule ("CAIR") or its successor – is likely to further benefit gas relative to coal.

[1] As of January 30, 2013, twenty-three entities had applied to the U.S. Department of Energy for licenses to export LNG totaling 29.41 Bcf/day (see http://www.fossil.energy.gov/programs/gasregulation). Only one of these applications – for 2.2 Bcf/day from Sabine Pass Liquefaction, LLC – had so far been approved (for export to countries with which the U.S. does not have a free trade agreement) and was under construction. How many of these facilities are ultimately approved and built remains to be seen, as the global diffusion of horizontal drilling and hydraulic fracturing technology may ultimately reduce the need for LNG exports (Krauss 2013).

The ongoing switch from coal-fired to gas-fired generation in the U.S. is, arguably, a positive development within the power sector, on several fronts. Natural gas is cleaner-burning than coal, and therefore emits fewer criteria pollutants (NOx, SOx, particulates) and greenhouse gases when combusted to generate electricity.[2] Gas-fired generation is also more flexible than coal-fired generation (in terms of its ability to ramp output up and down), which provides a number of system benefits, including greater ease in integrating variable renewable generation sources like wind and solar into the nation's power grids.[3] These renewable power technologies generate electricity without direct emissions and with very little water use, and help to diversify the nation's power mix, thereby protecting against future adverse impacts (be they environmental, cost-related, and/or security-related) from any single technology or fuel.

On the other hand, the impact of shale gas development on natural gas and wholesale power prices has also made it harder for wind and solar to compete with gas-fired generation. Fuel costs make up the vast majority of the operating cost of gas-fired generation, so when fuel costs are low, so is the cost of gas-fired generation. And with gas-fired generation commonly serving as the marginal supply resource that sets the market clearing price in wholesale power markets in many parts of the country, there is a strong correlation between natural gas fuel costs and wholesale power prices in most parts of the U.S.

As an example of the impact of low natural gas prices on the relative economics of renewable energy, at a delivered gas price of $4/MMBtu, fuel costs account for roughly 85% of the total operating cost – of around $30/MWh – of an efficient combined-cycle gas turbine (EIA 2010).[4] While some wind power projects in the U.S. that are sited in excellent wind resource areas are already selling power to utilities at prices in the neighborhood of $30/MWh (a "post-incentive" price that reflects federal and state government incentives received), in general, $30/MWh is difficult for any type of non-gas generator to compete with.

As such, there is a risk that an acute focus on cheap natural gas in the near-term could slow or delay the transition to cleaner, more-sustainable forms of power generation, such as wind and solar, over longer terms, and that the U.S. could, as a result, end up heavily dependent on gas-fired generation (Jacoby et al. 2012). This may be of particular concern at present, given that state renewables portfolio standards ("RPS") are unlikely to drive as much demand for wind power over the next few years as they have in recent years (BNEF 2012), and as the federal production tax credit ("PTC") for wind – which helps to make the cost of wind generation more

[2] Though gas-fired generation produces less CO_2 per MWh than coal-fired generation during combustion, there is nevertheless the potential for methane (CH_4) – which has a higher global warming potential than carbon dioxide – to leak into the atmosphere at various stages of natural gas production and transportation. Some studies contend that these "fugitive" emissions can be significant, particularly with shale gas development, thereby greatly impacting the life-cycle greenhouse gas emissions of gas-fired generation (Howarth et al. 2011, 2012), while others present evidence to the contrary (Cathless et al. 2012, JISEA 2012).

[3] Furthermore, with natural gas prices at historically low levels, the cost of integrating these variable resources has declined. For example, as part of its integrated resource planning process, PacifiCorp recently released a draft study that estimates the cost of integrating wind power on PacifiCorp's system to be $1.89/MWh, down sharply from $9.70/MWh when the study was last conducted in 2010 (PacifiCorp 2012). This 80% reduction in wind integration cost is driven primarily by lower natural gas prices.

[4] Not surprisingly, then, average wholesale power prices across the United States in 2012 ranged from roughly $20/MWh to $40/MWh, reflecting the influence of low natural gas prices.

competitive with other forms of power generation – faces serious risk of being phased out in the coming years (AWEA 2012c).

At this time when wind, solar, and other renewable generating technologies are facing reduced policy support and are having difficulty competing with gas-fired generation in the near-term on cost alone, it is useful to keep in mind other "non-cost" attributes that may help to justify the continued addition of fuel-free renewables to the power mix. In addition to the environmental benefits mentioned above, another important attribute – and the focus of this article – is the ability of wind and other fuel-free renewables to deliver a stable-priced product over very long time frames. In other words, adding wind power to a portfolio of generating assets will partially hedge or insulate that portfolio against the risk of rising fuel costs over the long term.

This "hedge value" that wind and other fuel-free renewables provide has been studied in the past – though primarily during periods of high gas prices and high gas price volatility – using a variety of methods (Awerbuch 1993, 1994, 2003; Bachrach et al. 2003; Bolinger et al. 2006; Bolinger and Wiser 2008; Huber 2012; Humphreys and McClain 1998; Kahn and Stoft 1993; Wiser and Bolinger 2007). This article builds on the existing literature by taking a comparatively simple and empirically grounded approach to demonstrating the long-term hedge value of wind power. Specifically, it draws upon a rich sample of long-term power purchase agreements between existing wind generators and electric utilities in the United States, and compares the contracted prices at which utilities will be buying wind power from these existing projects for decades to come to a variety of long-term projections of the fuel costs of gas-fired generation. This comparison reveals that recognizing the long-term hedge value of wind power is just as relevant today, at a time of historically low natural gas prices, as it has been in the past when gas prices have been higher.

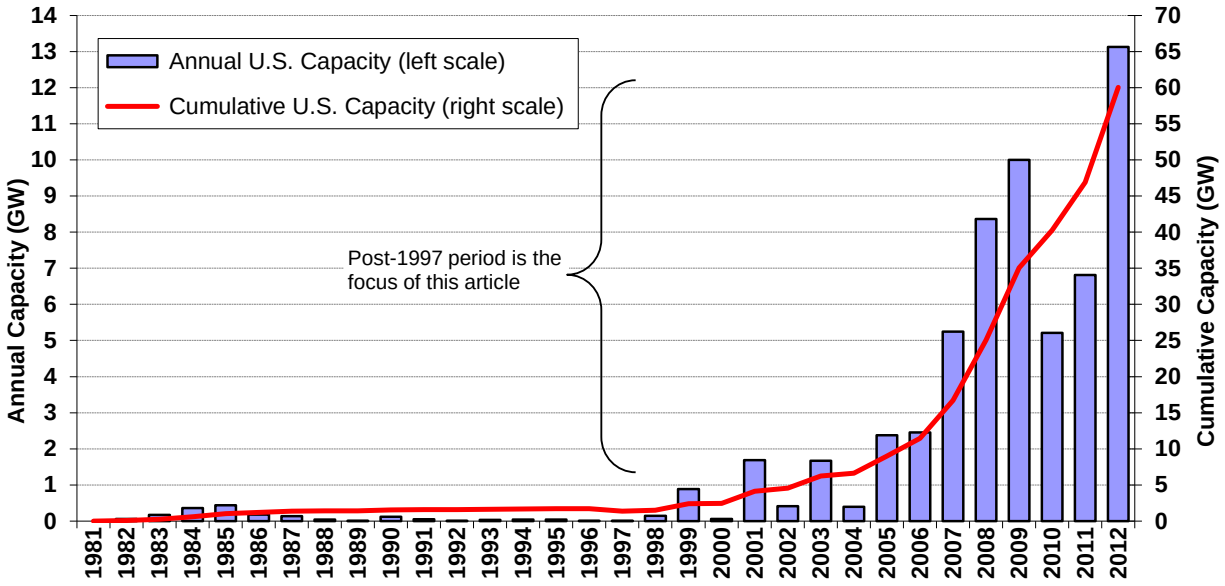
This article proceeds as follows. Section 2 makes the case for valuing wind power as a long-term natural gas price hedge by contrasting the characteristics of a large sample of wind power purchase agreements ("PPAs") to the shortcomings of conventional gas price hedging instruments like futures and options contracts. Although these conventional hedging instruments can be used effectively to hedge gas price risk in the near-term, they come up short when one tries to use them to lock in prices over longer terms – e.g., over the average 20-year duration of a wind PPA. Section 3 sets up an empirical comparison between wind power prices from this PPA sample and long-term natural gas price projections, in order to explore whether wind power can provide this long-term hedge in a cost-effective manner. Section 4 presents the comparison graphically and discusses results, and Section 5 draws conclusions.

2. The Case for Wind as a Long-Term Natural Gas Price Hedge

This section makes the case that considering wind power as a long-term natural gas price hedge is just as relevant today – in an environment of low gas prices – as it has been in the past when gas prices have been higher and more volatile. It does so by first describing the characteristics of a sample of long-term PPAs through which wind power projects in the U.S. sell their power to utilities and other power purchasers, highlighting the inherent price stability of such contracts. Then it proceeds with an overview of current natural gas prices in the U.S., highlighting the difficulties of locking in today's low prices – at least for any length of time – using conventional hedging instruments.

2.1 Wind PPA Sample Exhibits Long-Term Price Stability

At the end of 2012, there were more than 60,000 MW (60 GW) of installed wind power capacity in the U.S. (AWEA 2012b), some of it dating back to the early 1980s. As shown in Figure 1, however, roughly 58.8 GW of this amount, or 98% of the cumulative total, have been built since 1997. Given the overwhelmingly disproportionate weighting of this more-recent period, the remainder of this article focuses on just this post-1997 period in the history of wind power in the U.S.



Source: AWEA 2012b

Figure 1. Annual and Cumulative Growth in U.S. Wind Power Capacity

After subtracting out 13.75 GW of post-1997 wind power capacity that operate on a "merchant" basis (i.e., selling power into local spot markets, rather than bilaterally to a dedicated power purchaser through a long-term PPA), another 9.1 GW of capacity that are owned by electric utilities (and therefore do not involve a sale of wholesale power), 0.3 GW that are interconnected

and operate "behind the meter" (i.e., offsetting retail power purchases, rather than selling wholesale power), and 0.4 GW built in Alaska, Hawaii, and Puerto Rico (presumed to be outliers due to their remote locations and/or challenging construction environments), the total possible universe of post-1997 wind power capacity selling power through long-term PPAs comes to 35.4 GW. Out of this possible universe, Lawrence Berkeley National Laboratory has collected pricing terms from a sample ("the LBNL sample") of 287 separate wind power PPAs totaling 23.5 GW, and therefore representing 67% of the total possible universe of wind projects (in capacity terms).[5]

As shown in Table 1, the wind projects whose PPAs are captured within the LBNL sample are distributed throughout the US, with at least one project in all nine U.S. census divisions, resulting in fairly broad sample representation (in total, 29 states are represented in the sample). In percentage terms, the LBNL sample is most under-represented in the New England census division (where 86% of the post-1997 installed wind capacity selling energy through a PPA is not represented), followed by the East North Central division (54% missing) and West South Central division (50% missing). In MW terms, the LBNL sample is missing the most capacity in the West South Central division (3,971 MW missing),[6] followed by the East North Central division (2,313 MW missing) and the Pacific division (2,105 MW missing).

Table 1. LBNL PPA Sample Overview by U.S. Census Division

Census Division	Possible PPA Universe (MW)	LBNL PPA Sample (MW)	Capacity Missing (%)	Capacity Missing (MW)
New England	417	59	86%	358
Middle Atlantic	908	769	15%	139
East North Central	4,309	1,996	54%	2,313
West North Central	8,244	6,820	17%	1,424
South Atlantic	342	241	30%	101
East South Central	27	27	0%	0
West South Central	8,012	4,041	50%	3,971
Mountain	5,777	4,347	25%	1,430
Pacific	7,334	5,229	29%	2,105
Total U.S.	**35,370**	**23,529**	**33%**	**11,841**

The degree to which underrepresentation in these regions results in overall sample bias is hard to assess, as the West South Central division – which includes Oklahoma and Texas – is generally a low-cost wind region, while the East North Central and Pacific divisions tend to be high-cost regions (the New England PPA total is small enough in MW terms to ignore for this purpose). For example, Figure 2, which shows the levelized PPA price of each contract within the LBNL sample,[7] reveals that contracts in the East North Central region, and particularly in the Pacific

[5] The LBNL wind PPA price sample is compiled from a variety of sources, including regulatory filings with the Energy Information Administration ("EIA"), the Federal Energy Regulatory Commission ("FERC"), and state public utilities commissions.

[6] Underrepresentation in the West South Central division is largely attributable to Texas, where projects located within the footprint of the Electric Reliability Council of Texas ("ERCOT") – i.e., the grid operator for most of the state – are not subject to Federal Energy Regulatory Commission ("FERC") reporting requirements (filings with FERC are a principal source of PPA price data).

[7] Each circle in Figure 2 represents the levelized PPA price (y-axis) of a single wind contract, plotted along the x-axis by the date on which that PPA was signed. PPA prices are levelized over the full duration of each contract using a 7% real discount rate. The area of each circle represents the size (in MW) of the contract; several

region, tend to be above the dashed polynomial trend line for the full sample, while contracts from the West North Central region tend to fall below this overall trend line. From a national perspective, it is possible that underrepresentation within these three regions is offsetting to some extent.

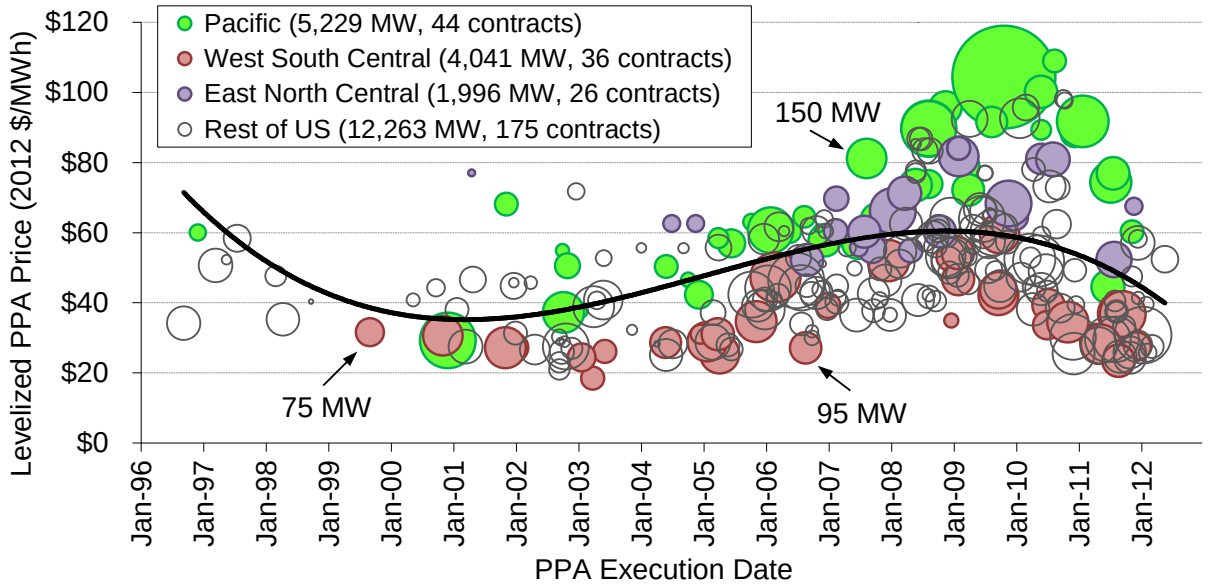


Figure 2. Levelized Wind Power PPA Prices by PPA Execution Date

The mean PPA contract duration in the LBNL sample is 20.2 years (20.7 years on a capacity-weighted average basis), while the median is 20 years. Twenty-year contracts make up 58% of all PPAs (and 53% of all capacity) in the LBNL sample, followed by twenty-five-year contracts at 19% (26% of capacity), and then 15-year contracts at 9% (8% of capacity). In total, more than three quarters of all wind power capacity in the LBNL sample is selling power through PPAs that are twenty years or longer in duration.

In all cases, PPAs within the LBNL sample convey all energy, capacity, and renewable energy credits ("RECs") generated by the project (or at least that portion of the project represented by the PPA) to the buyer.[8] As such, these PPA prices represent the entire revenue stream earned by the project on a post-government-incentive basis. In instances where government incentives – such as, but not limited to, the 10-year PTC or the Section 1603 Treasury grant – have been awarded to the project, the PPA price is presumed to reflect the receipt of any such incentives.

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benchmarks are provided for reference. The dashed 2nd-order polynomial line represents the best fit time trend for the full LBNL PPA price sample, and reflects that wind PPA prices have fallen since 2009, after having previously risen from 2002 through 2009.

[8] Energy refers to the electricity generated by the project, capacity refers to the project's contribution towards meeting peak demand (which is explicitly valued in some markets), and renewable energy credits, or RECs, represent the environmental attributes of wind power. RECs can be stripped out and sold separately from a wind project's energy and/or capacity. By design, however, all of the projects within the LBNL PPA sample sell RECs on a "bundled" basis along with energy and capacity, such that the PPA price reflects the full post-government-incentive amount of revenue received by the project.

In other words, the amount of revenue required by the project (through the PPA price) is assumed to have been reduced due to the government incentives provided.

By definition, all of the PPAs in the LBNL sample feature prices that are contractually locked in and that were known in advance (i.e., fixed) at the time each contract was signed. In 44% of the LBNL sample (48% in capacity terms), these prices remain constant in nominal dollar terms over the life of the contract (i.e., each MWh of wind generation is sold for exactly the same price over the entire contract term). Another 11% (of capacity) features pricing terms that do not escalate from year to year, but that do vary diurnally (e.g., depending on whether electricity is generated during on-peak or off-peak hours) and/or seasonally within each year. In total, then, 59% of the LBNL contract sample features prices that do not escalate in nominal dollars over time (which means that they actually *decline* in real dollar terms over time).

Another 38% (in capacity terms) of the LBNL sample is sold under PPA prices that do escalate (in nominal dollar terms) on an annual basis.[9] Escalation rates vary from contract to contract, and are not always uniform from year to year over the contract term, but in general average around 2.4% going forward. In other words, in most cases, nominal escalation rates are intended primarily to keep pace with anticipated inflation, which means that prices do not change by much in real dollar terms. Unlike gas-fired generation, wind power can offer this type of PPA price stability because much of the cost in a wind power project is up-front capital cost; operating costs are relatively low, because the fuel itself is free.

Figure 3 shows the generation-weighted average wind PPA price (expressed in both nominal and real 2012 $/MWh) from the entire LBNL sample, extending both back in time and into the future.[10] These average prices are overlaid on top of an area graph showing the combined capacity of the PPA sample at any given point in time. The maximum contract sample is naturally achieved in 2012, and then declines in the future as contracts expire, causing projects to drop out of the sample, at first gradually and then more rapidly as the years progress. As this happens, the average wind price becomes more volatile in later years, as the small remaining contract sample becomes increasingly dominated by a number of large projects. For example, the sharp drop in average PPA pricing in 2036 is caused by more than 1 GW of relatively high-priced wind power in California dropping out of the sample at that time.

[9] The remaining 3% (in capacity terms) of the LBNL sample features PPA prices that both escalate and de-escalate (or vice versa) annually over time.

[10] Generation-weighted average prices are calculated based on actual generation historically (where available) and assuming that historical capacity factors hold into the future. For those wind projects that lack sufficient operating history to enable the calculation of an empirical capacity factor, generation-based weightings were derived from some combination of generation estimates from either within the PPA itself or externally, along with use of the author's judgment where necessary. Although capacity-weighted average prices are more straightforward to calculate (given that the rated capacity of each project is known with certainty), generation-weighted averages provide a truer measure of the average cost of wind energy across the LBNL sample.

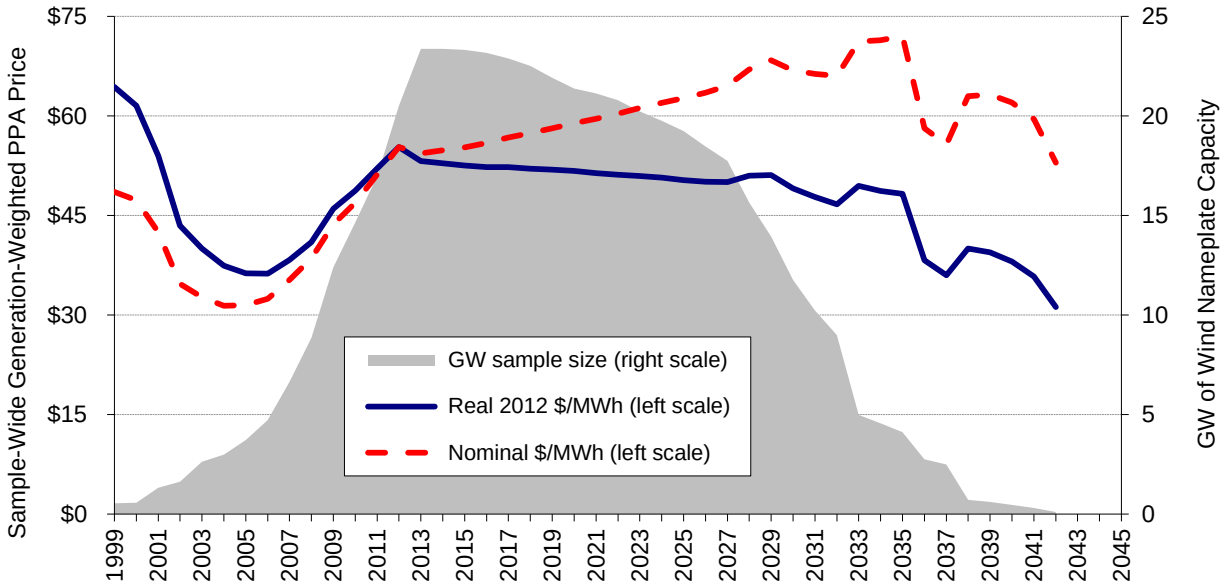


Figure 3. Generation-Weighted Average Wind PPA Price Over Time vs. Sample Size

Focusing on just the future period through 2031, during which sample size remains relatively robust above 10 GW, reveals that average wind power pricing holds relatively steady during this period. In nominal dollar terms, the average price for the full LBNL sample escalates by just 1.1%/year on average. In real 2012 dollar terms, the average price actually *declines* slightly by 0.6%/year on average,[11] hovering right around $50/MWh. In other words, buyers of the wind power in the LBNL sample can rest assured that, on average and in real dollar terms, wind power will cost them no more (and even slightly less) in 2031 than it does today.

2.2 Natural Gas Prices Are Historically Low, But Difficult to Lock In

Though they have historically been quite volatile, natural gas prices are currently close to 10-year lows, and are expected by many to remain relatively low in the years ahead as continued shale gas development provides ample domestic supply. In contrast to wind power prices, however – which, as demonstrated in the previous section, can be locked in for long periods of time with relative stability – natural gas prices are difficult to lock in for any significant duration. In large part for this reason, gas-fired generation is rarely sold on a fixed-price basis, particularly over longer terms. Instead, gas-fired generation – whether owned by a utility or purchased through a PPA – is most often variable-priced in nature, thereby requiring the utility to hedge fuel prices in order to replicate any degree of price stability. Though short-term gas price risk can be effectively hedged using conventional instruments like futures, options, and bilateral physical supply contracts, this section demonstrates that these instruments come up short when one tries to lock in prices over longer terms – e.g., greater than five or ten years. It is over these longer-term periods where inherently stable-priced generation options like wind power hold a rather unique competitive advantage.

[11] Conversions between nominal and real dollars are made using the actual historical GDP deflator (for historical conversions) or the EIA's latest projection (in EIA 2012a) of the GDP deflator going forward (for future conversions).

The solid blue line in Figure 4 shows monthly spot gas prices at the Henry Hub in Louisiana (i.e., the delivery point for NYMEX natural gas futures contracts) going back to January 2002. After experiencing unprecedented volatility – marked by two extreme price spikes to more than $12/MMBtu – natural gas prices fell sharply during the recession of 2008 and 2009, and in early 2012 broke through 10-year lows below $2/MMBtu. Though prices have since recovered somewhat, the decade-low gas prices seen during much of 2011 and 2012 are behind much of the fuel-switching currently happening in the power sector.

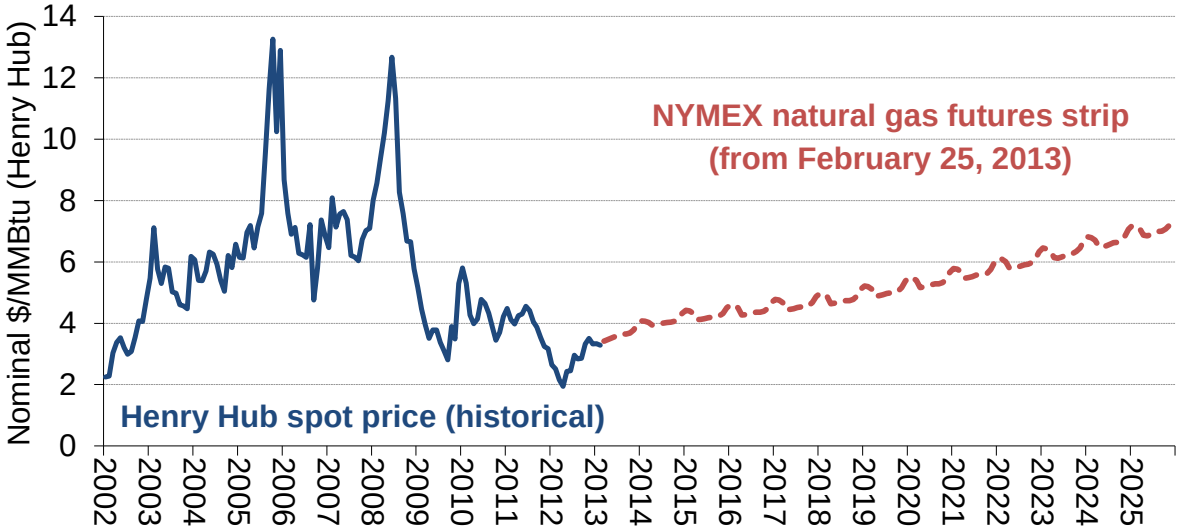


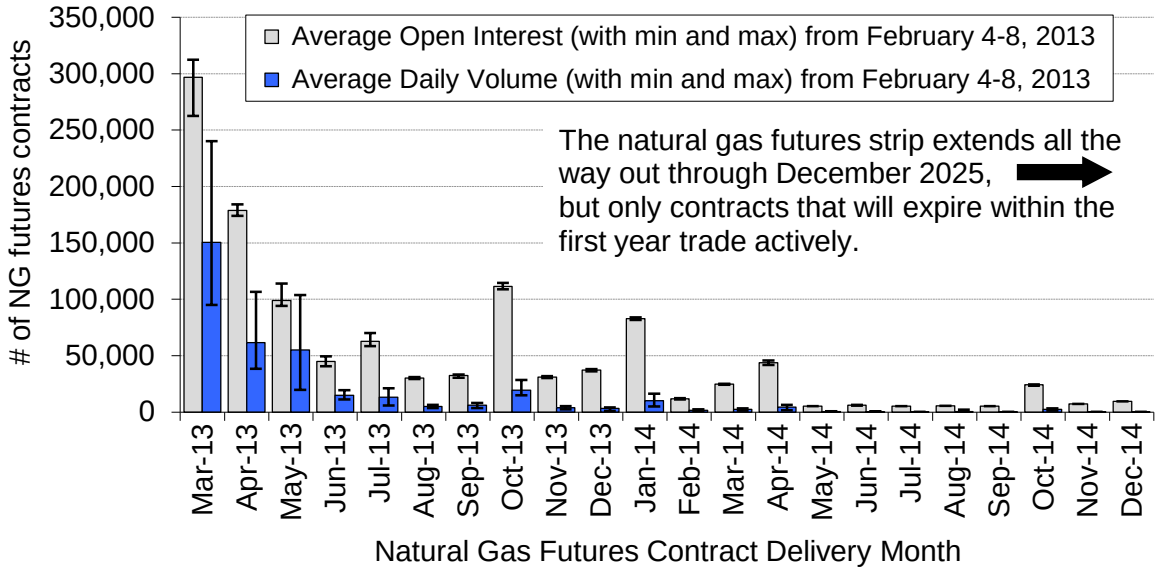
Figure 4. Historical Henry Hub Natural Gas Prices and NYMEX Gas Futures Strip

It's not possible to lock in these historic low prices out into the future, however. The red dashed line in Figure 4 shows the price of the NYMEX natural gas "futures strip" or "forward curve" from February 25, 2013. This futures strip represents the natural gas prices that, as of February 25, could be locked in for delivery in each future month through December 2025, simply by buying futures contracts. While current spot prices are just above $3/MMBtu, the fact that the futures strip is upward-sloping means that this low price cannot be locked in for any length of time. In other words, participants in the futures market expect (on average) spot gas prices to rise from current levels in the coming years – e.g., to $4/MMBtu by mid-2014, $5/MMBtu by 2019, and $6/MMBtu by 2022 – and are therefore unwilling to sell futures contracts at today's low spot prices.[12]

Even if today's low price levels were reflected in the futures strip and therefore available for purchase, it could still be difficult to lock them in over long terms (particularly for large volumes), because the futures market – though very liquid for the first few months of listed contracts– is relatively illiquid over longer terms. Figure 5 shows the average daily trading volume and open interest for the first 22 months of the NYMEX gas futures strip (i.e., shown

[12] One could buy a series of "in the money" call options on gas futures contracts with strike prices set to equal today's spot price (i.e., below the futures strip). Such a string of options would, in fact, grant the right to buy gas in the future at today's spot price. But the "intrinsic value" (i.e., the difference between the futures contract price and the options strike price) embedded in the options premiums would negate the below-market strike price, leaving the buyer no better off than the prices reflected in the upward-sloping futures strip.

only through the December 2014 contract, not all the way out to December 2025) over a representative 1-week period in February 2013.[13] Though natural gas contracts are currently listed out through December 2025, both volume and open interest dry up within a year or so. This makes it difficult to trade any sort of volume over any length of time.



Source: CME Group

Figure 5. Average Volume and Open Interest in NYMEX Gas Futures Contracts

The futures market is, of course, not the only game in town. Bilateral contracts for physical gas supply are also available, but have their own set of issues. Physical supply contracts tend to be less-liquid than the futures market over shorter terms, and similarly illiquid, or even less liquid, over longer terms. In general, the market does not have an appetite for fixed-price physical supply contracts that exceed 10 years (and even 10-year deals are rare), due to the inherent risk of locking in a price for a commodity that has historically been quite volatile (PSCo 2011). Counterparty credit or default risk is a major issue – much more so than with an organized exchange like the NYMEX, where the exchange itself, backed by the combined credit of its members, is the counterparty to every trade (PSCo 2011). Finally, pricing of physical supply contracts is unlikely to diverge significantly from the basis-adjusted NYMEX futures strip[14] – i.e., market price expectations do not vary depending on the type of instrument being traded – which, again, means that it will be difficult or impossible to lock in current low prices going forward for any length of time, due to the upward-sloping nature of the forward curve.

[13] Open interest is defined as the number of outstanding futures contracts for any given delivery month that have not yet been closed out by an offsetting transaction or otherwise fulfilled by delivery. As such, open interest represents a measure of potential future volume or liquidity.

[14] For example, in December 2010, the Colorado Public Utilities Commission approved a 10-year, fixed price (with annual escalation) bilateral physical gas supply contract between the Public Service Company of Colorado ("PSCo") and Anadarko, with deliveries to begin in 2012. Not surprisingly, contract pricing closely resembles the basis-adjusted NYMEX futures strip at the time. This contract has received quite a bit of attention in the industry, due to its uncommonly long 10-year duration.

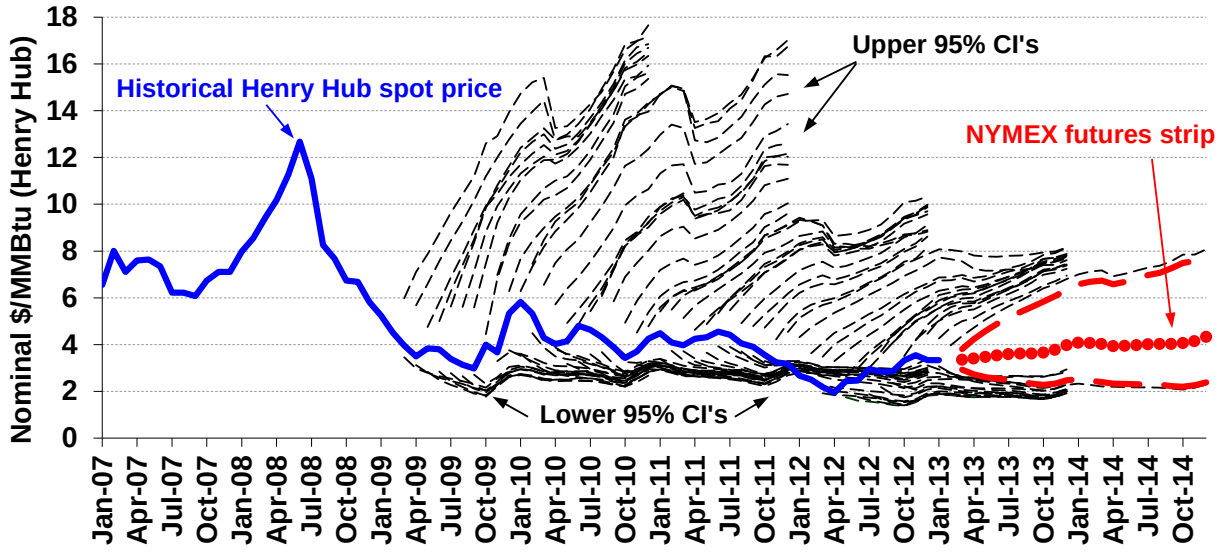
Given the apparent difficulty of locking in today's low prices over longer terms, one might reasonably question the prudence of even trying to do so. If the U.S. shale gas resource proves to be as robust and economically recoverable as is currently believed, then there could be a surplus of supply for many years to come, helping to keep a lid on natural gas prices over longer terms. Indeed, this is seemingly the conclusion reached by utility regulators in some states, who have been tightening restrictions on utility hedging of natural gas prices, based on the belief that the cost of such hedging programs is likely to outweigh any benefit in a low-volatility, low-gas-price environment (Ryan and Lieberman 2012).[15]

Ultimately, only time will tell whether hedging at this particular moment in time would have been a *profitable* decision. This ever-present uncertainty, however, does not mean that hedging is not currently a *prudent* decision. Taking the view that hedging – and in particular long-term hedging – is not as important now, with gas prices just coming off of historical lows, as it may have been in the past when prices were higher, ignores the highly skewed nature of gas price risk at the moment. For example, back in April 2012 when spot gas prices were hovering around $2/MMBtu – i.e., not terribly far from the absolute floor price of zero – the risk that prices would rise by more than $2/MMBtu was almost infinitely greater than the risk that prices would fall by more than $2/MMBtu. Although spot prices have since risen to above $3/MMBtu, price risk remains skewed to the upside.

This skew is evident in Figure 6, which is compiled from the EIA's monthly Short-Term Energy Outlook ("STEO") series (EIA 2009-2013). Each month, in the *Market Prices and Uncertainty Report* that accompanies the STEO, the EIA uses information (mostly about implied volatility) embedded within the market price of options on natural gas futures contracts to calculate the 95% confidence intervals around the price of those future contracts. These confidence intervals bound the range of prices within which the market expects (with 95% confidence) that the futures contract will ultimately expire. When applied to each successive contract month along the futures strip,[16] these 95% confidence intervals form a "cone" around the mean price expectations reflected in the futures strip; this cone tends to widen out over time because price uncertainty increases with the time to contract expiration. Figure 5 simply compiles the 95% confidence interval cones from each monthly edition of the STEO going back to early 2009, and presents them all on a single graph (EIA 2009-2013).

[15] These restrictions seem to pertain mostly to active short-term hedging programs, such as those that use options contracts to create guaranteed price caps or to lock in a range of future gas prices for a few months. Conversely, regulators in several states have taken steps to encourage the use of long-term natural gas contracts as a way to lock in current low gas prices over the long term (for example, see footnote 14 and Costello (2012)).

[16] Although the natural gas futures strip extends out for a maximum of 156 months (i.e., 13 years), the EIA only calculates these confidence intervals for, at most, the first 24 months of the strip.



Source: EIA 2009-2013

Figure 6. History of 95% Confidence Intervals Around Natural Gas Futures Strip

Going back to February 2009, the lower 95% confidence intervals have rarely fallen below $2/MMBtu – despite relatively low spot prices over this entire period – reflecting the physical reality of a floor price.[17] Even in April 2012, when spot gas prices broke below $2/MMBtu, the lower 95% confidence interval never fell below $1.38/MMBtu, and averaged $1.70/MMBtu out through the December 2013 contract. In other words, with spot prices as low as they were at the time, there was recognition that they simply could not fall much further before hitting physical limits, making the gas price bet almost uni-directional. The upper 95% confidence intervals, meanwhile, have varied significantly over time, initially rising above $16/MMBtu (no doubt reflecting the recent memory of the mid-2008 price spike to more than $12/MMBtu), but over time diminishing to the point where the most recent STEO (in February 2013) shows the upper bound for the December 2014 futures contract to be just below $8/MMBtu.

Despite the fact that the upper confidence intervals have narrowed as the market has grown increasingly confident in the promise of shale gas development, the overall range remains skewed to the upside. For example, in February 2013, the market had 95% confidence that the December 2014 NYMEX futures contract would eventually expire somewhere between $3.50/MMBtu above and $1.95/MMBtu below the then-current contract price of $4.32/MMBtu (the red dashed lines on the right side of Figure 6 represent the 95% confidence intervals from the February 2013 STEO, which was the latest edition available at the time of writing). This represents a 1.8:1 skew – i.e., the market believed, with 95% confidence, that prices could potentially rise by 1.8 times as much as they could fall by December 2014.

[17] The absolute floor price is, of course, zero, but in practice there will be some production-cost-related floor price above zero, below which it does not make economic sense to produce and market the gas. Where exactly this floor price lies will vary by shale play, and will also depend on the extent to which the marketed "dry gas" (i.e., methane) is largely a byproduct (with very low marginal cost) of the extraction of either more-valuable "natural gas liquids" (i.e., ethane, propane, and butane) or shale oil.

To summarize, with gas prices as low as they are, and with gas price risk heavily skewed to the upside, it should theoretically be an opportune time to hedge. The directional bet has been almost one-sided, and – to use a well-known analogy – the best time to buy flood insurance is before the water starts rising. The water has already started rising, however, in the sense that the futures strip is upward-sloping. In other words, even though spot gas prices are historically low, one can't lock in these low prices going forward – or at least not without paying a hefty premium in the options market to do so. Even if today's low prices were available through the futures strip, the futures market is just not very liquid beyond a few years out, making it hard to trade any sort of volume over longer terms. Bilateral physical supply contracts are available, but only over the short-to-mid-term (10-year contracts are a rarity), and impose significant counterparty default risk due to the perils inherent in fixing the price of a notoriously volatile commodity. Moreover, the pricing of physical supply contracts will not differ significantly from the upward-sloping futures curve. Finally, even if it were easier to hedge, regulators have been restricting the budgets of utility gas hedging programs, ultimately leaving ratepayers increasingly exposed to unanticipated natural gas price increases.

In light of this current situation, viewing wind power as a long-term fuel price hedge would seem to be as appropriate now as it has ever been, despite prevailing low gas prices. In fact, it may be even *more* appropriate now, given the almost one-sided nature of the gas bet. Whether or not wind can provide this long-term hedge in a cost-effective manner, however, is a separate question altogether – this question is explored in the remainder of this article.

3. Establishing an Appropriate Price Comparison Between Wind and Gas

3.1 Simplifying Assumptions

The rest of this article explores the question of whether wind can provide a cost-effective long-term natural gas price hedge by comparing PPA prices from actual wind projects in the LBNL sample to a range of long-term natural gas fuel cost projections. Implicit in this comparison are a handful of simplifying assumptions, three of which handicap and two of which advantage wind relative to gas.

The first simplifying assumption is that wind serves only as a natural gas "fuel saver" – i.e., wind serves only as an energy resource (and *not* as a capacity resource), and each MWh of wind generation displaces one full MWh of gas-fired generation. [18] This assumption effectively assigns zero value to the capacity portion of the wind PPA price, thereby attributing the full PPA price to the energy and REC components (though, as discussed below, the REC component is also zeroed out in this article to further simplify the analysis). In reality, wind projects do provide some capacity value, though the amount is often relatively small (a general rule of thumb is that a wind project's *capacity credit* – which when multiplied by the cost of capacity yields capacity value – is likely to be less than its capacity factor), will vary from region to region (and even from project to project within a region), will generally decline as wind power penetration increases, and depends on how capacity credit is calculated (Rogers and Porter 2011). As such, treating wind as merely a natural gas fuel saver, and therefore comparing wind PPA prices to only the fuel costs of gas-fired generation, handicaps wind relative to gas to some extent (i.e., by the amount of capacity value that wind does, in fact, provide). That said, there is evidence that some utilities think of wind in exactly this manner – i.e., as a fuel saver, with no credit given to its capacity value[19] – and that is also the conservative approach taken here.

A second simplifying assumption that handicaps wind (and that was alluded to above) is that no credit is given for wind's relative environmental benefits, including the value of avoided criteria pollutant and greenhouse gas emissions. Because these benefits can at least loosely be

[18] Although wind generation displaces primarily gas-fired generation most of the time throughout most of the U.S., there are times (e.g., during off-peak periods most notably) in certain markets when wind generation displaces coal-fired or other forms of generation. As such, the sole focus here on gas-fired generation is a simplification.

[19] For example, a representative of the Public Service Company of Colorado – owned by Xcel Energy, which at the end of 2011 had the most wind power capacity on its system of any utility in the U.S. (AWEA 2012a) – recently testified before the Colorado Public Utilities Commission regarding the utility's 25-year contract with the 200 MW Limon II wind project, noting that "The wind generation is a source of fuel or energy, it's not a source of capacity" (Haeger 2011), and that "since wind is really just an energy resource and not a capacity resource, we treat it like a fuel or fuel substitute" (Haeger 2012). He went on to note that "When Public Service plans its system, we make sure we have adequate generation [i.e., capacity] resources to meet the highest load days. Once we have the capacity resources in place, we then focus on generating energy at the lowest most stable cost….wind energy is a direct substitute for gas-fired generation so one can simply compare the cost of wind to the energy cost component of more traditional generation like gas-fired generation….Since the generators necessary to burn natural gas or other fossil fuels have already or will be acquired to meet reliability needs, the only difference between using wind as a fuel compared to natural gas is the cost of the two fuels or energy sources" (Haeger 2012).

associated with the bundled REC component of the PPA price, the effect of this simplifying assumption is to assign zero value to the REC component, thereby attributing the full wind PPA price to just the energy component (since, as described above, the capacity component is also assumed to hold zero value). In combination, then, these first two simplifying assumptions effectively equate the wind PPA price with just the cost of generating (or purchasing) electricity, which can then be compared to just the variable cost of generating gas-fired electricity.

Equating the variable cost of generating gas-fired electricity with just natural gas fuel costs is a third simplifying assumption. In reality, gas-fired generators must also incur non-fuel operations and maintenance ("O&M") costs in order to generate electricity, and wind – acting as a fuel saver – should receive some credit for offsetting any variable portion of these non-fuel O&M costs. The non-fuel variable O&M costs of gas-fired generation are relatively small, however – e.g., on the order of $3/MWh for an advanced combined-cycle gas turbine (EIA 2010). Furthermore, any wind-enabled reduction in these costs could potentially be offset, to some extent, by correspondingly greater wear and tear on gas-fired power plants from the increased cycling required to balance wind power's natural variability. Lacking clear insight on where the true balance of these opposing influences lies, this analysis simply ignores any non-fuel O&M cost savings provided by wind, and focuses instead on just avoided fuel costs.

The fourth and fifth simplifying assumptions are to ignore integration and transmission costs, both of which would penalize wind relative to gas on average were they included. Integration costs, however, have been shown to be relatively low and area-specific (Wiser and Bolinger 2012), and there is a growing recognition among analysts that they may not even be readily quantifiable or unique to variable renewable generators like wind and solar (Milligan et al. 2011). Transmission costs, meanwhile, will vary considerably from project to project, and in some regions will not be borne by either the wind buyer or seller, depending on how transmission cost allocation is handled.[20] For these reasons, both integration and transmission costs are omitted from this analysis.

In short, this comparison of wind versus gas is not intended to be a full analysis from a societal perspective. It is also not the only, or perhaps even the most appropriate, way to structure such a comparison.[21] Instead, it is a simple comparison between actual wind PPA prices and projected natural gas fuel costs, assuming that wind serves only as a natural gas fuel saver. Though admittedly simplistic, this approach is not entirely an academic exercise, as again there is

[20] For example, within ERCOT, transmission costs are socialized across all electricity ratepayers, rather than being paid by either the seller or buyer of the power itself. Note that this fifth simplifying assumption refers primarily to transmission network upgrades or new construction needed to accommodate wind power *in general*. In contrast, the costs of so-called "gen-tie" lines built by specific wind developers in order to interconnect specific projects to the transmission grid are, in general, borne by the project developer or power seller, and are therefore presumably reflected in the wind PPA price.

[21] For example, rather than taking this article's "bottom up" approach of assuming that wind is merely a natural gas fuel saver (i.e., with no capacity value) and therefore comparing wind PPA prices solely to natural gas fuel costs, one could instead take more of a "top-down" approach by comparing wind PPA prices to the all-in costs of building new gas-fired generation. This latter approach, however, would require just as many simplifying assumptions (e.g., about the capacity value of wind relative to gas, about relative transmission and integration costs, etc.) as have been employed here in order to place wind and gas on a comparable footing. In other words, these two different approaches would eventually arrive at much the same basic comparison, despite starting from opposite ends of the spectrum.

evidence that some utilities think about the comparison between wind and gas in a similar manner (e.g., see footnote 19). Future research might seek to quantify each of the additional cost variables discussed above in order to elucidate further comparisons.

3.2 Fuel Cost Projections

While the wind PPA prices used in the comparison come from the LBNL sample described in Section 2.1, long-term natural gas fuel cost projections are sourced exclusively from the EIA, which is the statistical and analytical agency within the U.S. Department of Energy ("DOE"). Over the past two years, the EIA has published natural gas fuel cost projections associated with at least twenty different future scenarios, both as part of its regular *Annual Energy Outlook* ("AEO") series (EIA 2012a, 2012b, 2011) and also in response to a specific request from the DOE's Office of Fossil Energy, which in August 2011 asked the EIA to look into the impact of future LNG exports on domestic energy markets (EIA 2012c). These twenty different scenarios are categorized in Table 2 and graphed in Figure 7.[22]

Specifically, Table 2 shows that fifteen of the twenty fuel cost projections of interest originate from analysis either within AEO 2011 itself (e.g., the Reference, High EUR, and Low EUR cases) or using the same version of the National Energy Modeling System ("NEMS") as was used for AEO 2011 (e.g., the 12 different LNG export scenarios that were requested by the DOE's Office of Fossil Energy). A gas well's estimated ultimate recovery ("EUR") is defined as its cumulative production over a 30-year life using current technology and without regard to economic considerations; the High and Low EUR scenarios (in both AEO 2011 and AEO 2012) consider 50% greater or lesser EUR per shale well than in the Reference case. Technically recoverable resources ("TRR"), which are unproved shale resources that are estimated to be technically recoverable using current technology and without regard to economic considerations, also correspondingly vary by +/-50% in these scenarios. The lone exception is AEO 2012's High TRR scenario, which assumes that tighter shale well spacing allows for even greater TRR (1,091 Tcf) than would be implied by an EUR that is 50% greater than in the Reference case. Finally, four export scenarios – varying in both the steady-state export volume (either 6 or 12 Bcf/day[23]) as well as the ramp rate to get to steady state (either 1 or 3 Bcf/day/year) – are layered on top of three different underlying scenarios (Reference, High EUR, Low EUR), for a total of 12 export scenarios altogether.

[22] EIA gas price projections are used for this analysis because they are freely available, well-documented, and cover a wide range of future scenarios. The EIA's own comparison of its *AEO 2012* reference case natural gas price projection (for gas delivered to electricity generators) to two different private sector forecasts found that its own projection fell below the two other forecasts in the year 2015, and in between the two other forecasts in the years 2025 and 2035 (EIA 2012b).

[23] In comparison, footnote 1 earlier notes that as of January 30, 2013, twenty-three applications to build LNG export terminals – with a combined export capacity of more than 29 Bcf/day – had been submitted to the U.S. Department of Energy. The likelihood of all of these export facilities, or even a significant subset of them, being approved and built is rather low, however (Krauss 2013).

Table 2. Characterization of Recent EIA Natural Gas Scenarios

NEMS Modeling Platform	Scenario Name	EUR per shale well (% diff from reference)	Unproved Shale TRR (Tcf)	LNG Export Volume (Bcf/day)	LNG Export Phase-In (Bcf/day/year)
AEO 2013	Reference (early release)	N/A	543	N/A	N/A
AEO 2012	Reference	N/A	482	N/A	N/A
AEO 2012	High EUR	+50%	723	N/A	N/A
AEO 2012	Low EUR	-50%	241	N/A	N/A
AEO 2012	High TRR*	+50%	1,091	N/A	N/A
AEO 2011	Reference	N/A	827	N/A	N/A
AEO 2011	Reference, Low/Slow Export	0%	827	6	1
AEO 2011	Reference, Low/Rapid Export	0%	827	6	3
AEO 2011	Reference, High/Slow Export	0%	827	12	1
AEO 2011	Reference, High/Rapid Export	0%	827	12	3
AEO 2011	High EUR	+50%	1,230	N/A	N/A
AEO 2011	High EUR, Low/Slow Export	+50%	1,230	6	1
AEO 2011	High EUR, Low/Rapid Export	+50%	1,230	6	3
AEO 2011	High EUR, High/Slow Export	+50%	1,230	12	1
AEO 2011	High EUR, High/Rapid Export	+50%	1,230	12	3
AEO 2011	Low EUR	-50%	423	N/A	N/A
AEO 2011	Low EUR, Low/Slow Export	-50%	423	6	1
AEO 2011	Low EUR, Low/Rapid Export	-50%	423	6	3
AEO 2011	Low EUR, High/Slow Export	-50%	423	12	1
AEO 2011	Low EUR, High/Rapid Export	-50%	423	12	3

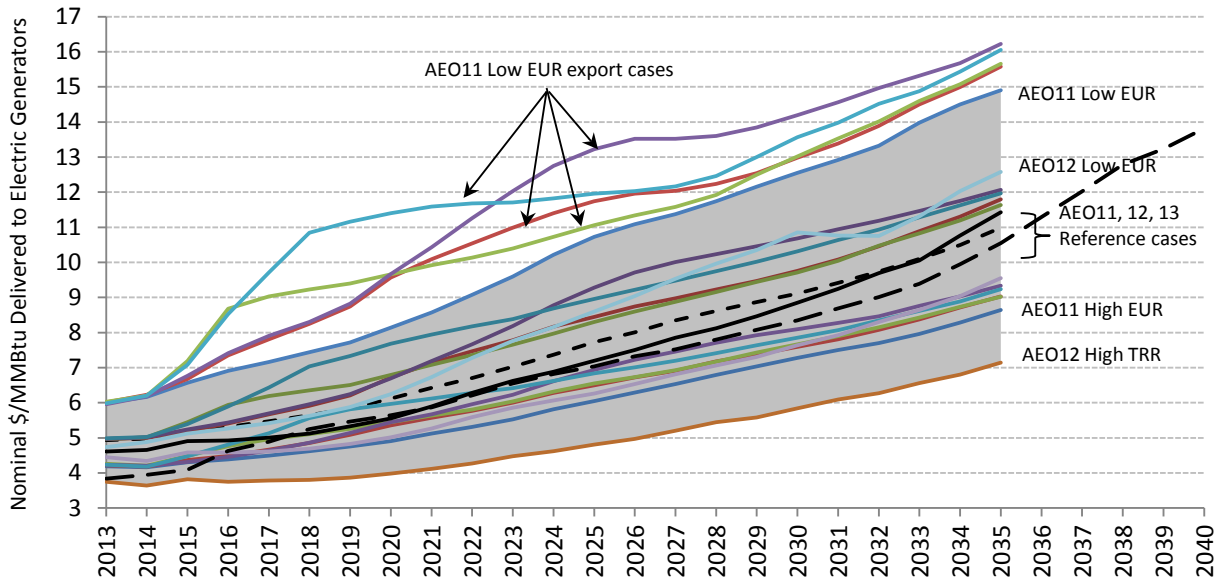
*The High TRR case assumes tighter well spacing than the other AEO12 scenarios, which is why the unproved TRR increases even though the EUR per well remains 50% above the reference case.
Source: EIA 2012a, EIA 2012b, EIA 2012c, EIA 2011

Figure 7 shows the resulting projected fuel costs of natural gas delivered to electricity generators across all twenty of these scenarios for the U.S. as a whole.[24] Due to the sheer volume of overlapping projections, only eleven of the twenty scenarios are labeled in Figure 7. The majority of projections are loosely bound by the AEO11 High EUR scenario on the low end and the AEO12 Low EUR scenario on the high end; the three Reference case scenarios all fall within this range.[25] A bit farther afield are the AEO12 High TRR and AEO11 Low EUR scenarios on the low and high ends, respectively. Finally, the four AEO11 Low EUR export scenarios result in the highest fuel cost projections.

[24] Natural gas prices and price projections can vary substantially by region within the U.S. (as can wind PPA prices – see Figure 2 earlier). In order to simplify the comparison as much as possible, however, this article employs only average gas price projections for the U.S. as a whole (and compares them to average wind PPA prices across the entire LBNL sample).

[25] Though not pictured in Figure 7, it is perhaps worth noting that the AEO13 early release reference case gas price projection for the Henry Hub lies *below* where the NYMEX Henry Hub futures strip was trading at the time the projection was made in late October 2012 (it also lies below where the futures strip has traded ever since, up to the time of writing). In other words, it has not been possible to lock in future natural gas prices at levels projected by the EIA in its AEO13 early release reference case. Past work has highlighted this discrepancy between long-term model-based gas price projections and futures market prices as a source of potential bias against fuel-free renewable generation in favor of gas-fired generation (Bolinger et al. 2006).

These four AEO11 Low EUR export scenarios were subsequently found to be unlikely during the second phase of the DOE Office of Fossil Energy's LNG export study (Montgomery et al. 2012). Specifically, under Low EUR conditions, domestic natural gas prices are projected to be high enough such that LNG export prices are not competitive on the world market (once the costs of liquefaction, transportation, and regasification are added). As such, U.S. LNG exports are unlikely to occur under the Low EUR scenarios, which, in turn means that the domestic fuel cost projections for these four scenarios are spurious. For this reason, these four export scenarios are not considered further in this analysis; this exclusion is symbolized by their omission from the shaded area in Figure 7. Only the fuel cost projections within this shaded area will be compared to wind PPA prices in the next section.



Source: EIA 2012a, EIA 2012b, EIA 2012c, EIA 2011

Figure 7. Projected Natural Gas Prices Delivered to Electricity Generators, Total U.S.

4. Results: Assessing the Cost-Effectiveness of Wind as a Long-Term Price Hedge

Figure 8 presents the comparison between the full LBNL wind PPA price sample described in Section 2.1 and the range of projected natural gas fuel costs described in Section 3.2. To reduce visual clutter, Figure 8 (as well as Figure 9) shows only the *range* of fuel cost projections, as denoted by the shaded area (hereafter referred to as "the cone of uncertainty"). Previously presented in Figure 7 in nominal $/MMBtu terms, this cone of uncertainty has been translated into $/MWh terms in Figure 8, using the average heat rates implied by each individual scenario's NEMS modeling output.[26] Overlaid on top of the cone of uncertainty are the three reference case scenarios from AEO11, AEO12, and AEO13 early release. The red line with circle markers represents actual historical gas prices delivered to generators (on an average nationwide basis), and the solid blue line represents the generation-weighted average wind PPA price from among the entire LBNL sample of more than 23 GW of wind capacity built in the U.S. since 1997.

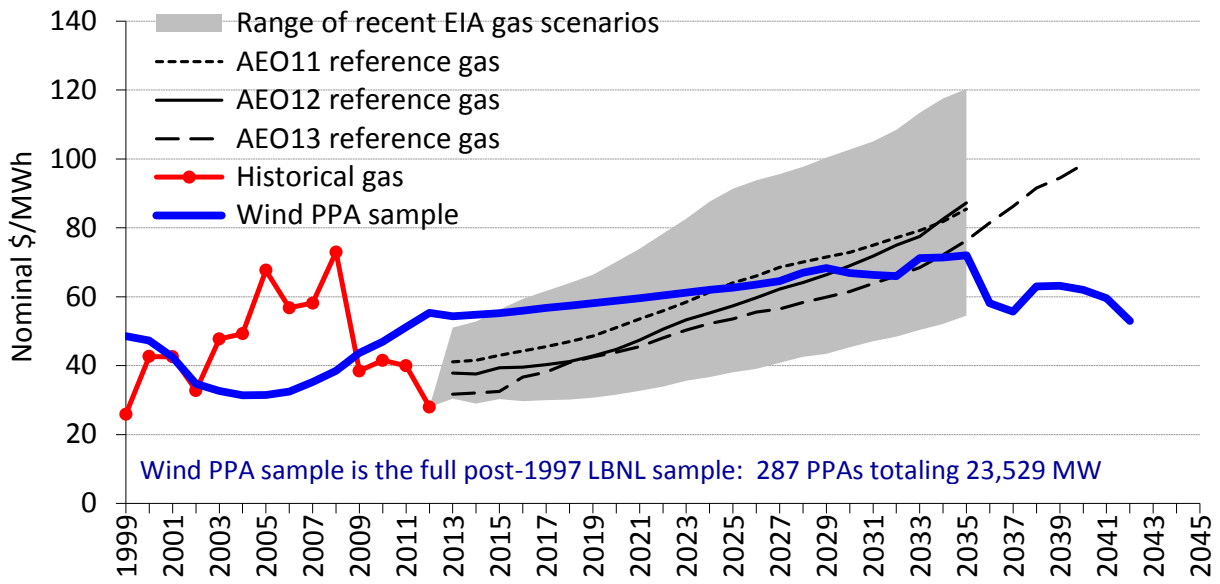


Figure 8. Comparison of Full Wind PPA Sample to Projected Range of Natural Gas Prices

As shown, the generation-weighted average wind PPA price from within the entire LBNL sample was significantly *below* gas-fired generators' fuel costs from 2003-2008. Ever since the sharp drop in natural gas prices in 2009, however, the average wind PPA price has been above-market, and – looking ahead – it lies above the three reference case fuel cost projections until 2025 (AEO11), 2030 (AEO12), and 2032 (AEO13 early release). Thus, if natural gas prices actually end up following any of these three reference case projections into the future, then the wind contracts in the LBNL sample will, on average nationwide, be above market (as defined here; see Section 3.1 for simplifying assumptions) until the crossover years noted.

[26] Using implied *average* heat rates to convert from $/MMBtu to $/MWh is likely a conservative practice, given that wind is more likely to displace less-efficient gas-fired units with higher heat rates on the margin.

Focusing instead on the cone of uncertainty, however, the average wind PPA price shown in Figure 8 penetrates the cone in 2015, and thereafter serves as a hedge against many of the higher-priced fuel cost projections modeled by the EIA, with the degree of potential price protection increasing over time. Hence, if minimizing exposure to these potentially significant long-term gas price increases is desirable, then Figure 8 suggests that wind power could be an effective tool to help achieve that goal.

While Figure 8 represents the entire LBNL sample (including wind projects built as far back as 1998), Figure 9 focuses on just the most recent projects in our sample – specifically, those that signed PPAs in 2011 or 2012 (and most of which were built in 2012).[27] As shown earlier in Figure 2, wind PPA prices have fallen considerably in recent years (Wiser and Bolinger 2012), driven by a combination of installed cost reductions (Bolinger and Wiser 2012) and performance improvements (Wiser et al. 2012). As such, this recent sub-sample of contracts likely better reflects current wind PPA pricing (at least on a national average basis), which means that Figure 9 provides a more accurate national representation of the choice between wind and gas facing resource planners today. The downside of restricting the sample to just the most recent contracts, of course, is that sample size is reduced considerably, to just 3.7 GW. The regional composition of this sub-sample, however, is similar to the regional composition of the possible PPA universe shown earlier in Table 1, suggesting that the sub-sample is at least broadly representative of the U.S. as a whole.

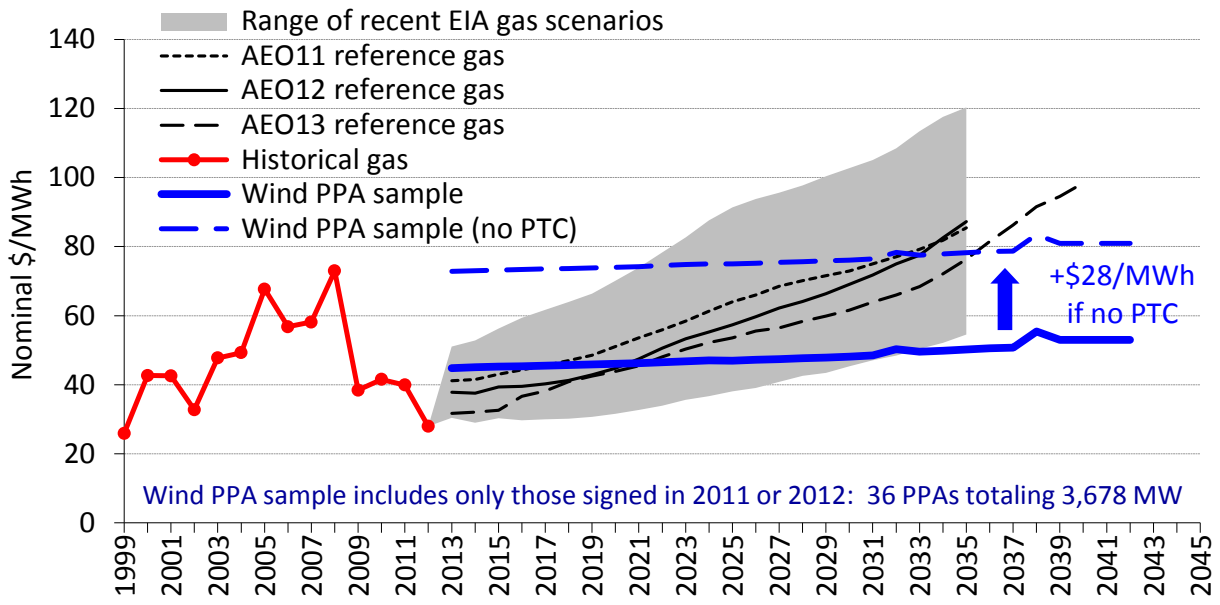


Figure 9. Comparison of Recent Wind PPA Sub-Sample to Projected Range of Natural Gas Prices

[27] Because of the then-scheduled expiration of the PTC at the end of 2012 and considerable uncertainty over whether or in what form it might be extended, there were very few wind PPAs signed in 2012. Instead, most of the build-out of wind projects in 2012 involved projects that had signed PPAs back in 2011 or earlier. The LBNL sample shown in Figure 9 includes 3,196 MW of wind capacity that signed a PPA in 2011, and another 482 MW that signed a PPA in 2012.

Figure 9 shows that these recent wind PPA prices are quite competitive with natural gas fuel cost projections. The average wind PPA price holds steady in the mid-$40/MWh range, and by 2022 lies below all three reference case gas price projections, eventually falling outside of the cone of uncertainty altogether in 2033. In other words, not only do these recent wind PPAs provide ample long-term hedge value, but they are also, on average, competitive natural gas fuel savers in the near-term when compared to reference-case natural gas price projections for the U.S. as a whole.

As discussed earlier in Section 2.1, however, the wind PPA prices in the LBNL sample reflect the receipt of government incentives, most notably the federal PTC. The PTC is a 10-year, inflation-adjusted income tax credit with a post-tax value that stood at $22/MWh in 2012, which translates into a pre-tax, revenue-equivalent value of $28/MWh (in nominal dollars) levelized over a 20-year period.[28] In other words, without the benefit of the PTC, wind PPA prices could potentially increase by as much as $28/MWh in order to compensate for the loss of the credit in providing the same financial return to investors. As shown by the dashed blue line in Figure 9, shifting the recent wind PPA price curve upwards by this amount results in a significant challenge to wind's near-term competitiveness as a natural gas fuel saver. Even without the benefit of the PTC, however, these contracts still provide some long-term hedge value in later years of the comparison.

In summary, Figures 8 and 9 demonstrate that – even in today's low gas price environment, and with the promise of shale gas having driven down future gas price expectations – wind power can still provide protection against many of the higher-priced natural gas scenarios contemplated by the EIA. This is particularly true among the most recent PPAs in the LBNL sample, which likely better represent current wind PPA pricing, at least on a national average basis. These newer wind contracts not only provide ample long-term hedge value, but on average are also directly competitive as a natural gas fuel saver (at least when compared to reference-case gas price projections) in the near term. Without the benefit of the PTC, wind's near-term competitiveness is challenged, but long-term hedge value still remains.

[28] This conversion involves grossing up the PTC's after-tax value by the marginal income tax rate (to get to a pre-tax revenue-equivalent value) and then levelizing the 10-year pre-tax revenue stream over a 20-year period (since 20 years is the average term of the PPAs in the LBNL sample). The resulting 20-year levelized pre-tax value of $28/MWh likely represents an upper bound to the PTC's value, since it assumes the same cost of capital with and without the PTC. In practice, if the PTC did not exist, wind developers would likely forego expensive tax equity in favor of cheaper debt capital, resulting in a lower overall cost of financing without the PTC, and hence a lower value attributed to the PTC itself.

5. Conclusions

Expanding production of the United States' vast shale gas reserves in recent years has put the country on a path towards greater energy independence, enhanced economic prosperity, and (potentially) reduced emissions of greenhouse gases and other pollutants. The corresponding expansion of gas-fired generation in the power sector – driven primarily by lower natural gas prices – has also made it easier and cheaper to integrate large amounts of variable renewable generation, such as wind power, into the grid. Opportunities abound for even greater cooperation and coordination between cheap natural gas and wind power in the years ahead (Lee et al. 2012).

At the same time, however, low natural gas prices have suppressed wholesale power prices across the nation, making it harder for wind and other renewable power technologies to compete on cost alone – even considering their recent cost and performance improvements. A near-term softening in policy-driven demand from state-level RPS policies (in large measure because wind and other renewables have, in recent years, been added at a pace that exceeds state RPS targets), coupled with a likely phase-out of the federal PTC over time, may exacerbate wind's challenge in the coming years.

If wind power finds it more difficult to compete with gas-fired generation on the basis of near-term cost, it will increasingly need to rely on other attributes, such as its "portfolio" or "hedge" value, as justification for inclusion in the power mix. This article finds that wind's hedge value is as important today as it has ever been – i.e., despite the current low gas price environment, wind power can still provide a useful hedge against rising natural gas prices, particularly over the long term.

At least from a hedging perspective, this long-term hedge value is arguably more important than whether or not wind is competitive as a natural gas fuel saver in the near term. This is because short-term gas price risk can already be effectively hedged using conventional instruments like futures, options, and bilateral physical supply contracts. It's only when one tries to lock in prices over longer terms – e.g., greater than five or ten years – that these conventional hedging instruments come up short. It is over these longer-term durations where inherently stable-priced generation options like wind power hold a rather unique competitive advantage.

Recent statements from two prominent buyers of wind power – the Public Service Company of Colorado ("PSCo") and Google – highlight the importance of long-term hedge value in their purchase decisions. For example, in testifying before regulators about its recent 25-year PPA with the 200 MW Limon II wind project, PSCo noted that "Whenever wind energy is generated from the Limon II facility, it will displace fossil-fueled energy on the Public Service system, mostly energy generated from natural gas. We think of this wind contract as an alternative fuel, with known contract pricing over 25 years that will displace fuels where the pricing is not yet known. That is the essence of the fuel hedge" (Haeger 2012). PSCo also notes the difficulties of replicating this same degree of long-term price stability through the natural gas market: "We typically don't have a lot of long-term natural gas contracts…especially ones that go out 25

years. So this [the Limon II wind contract] is basically providing a long-term fuel contract or energy contract at known prices" (Haeger 2011).

Google, meanwhile, has entered into long-term PPAs with at least two different wind projects, with the primary purpose of hedging the cost of electricity at its data centers. When asked about these wind PPAs, a Google official stated "We see value in getting a long-term embedded hedge. We want to lock in the current electricity price for 20 years. We are making capital investment decisions [regarding data centers] on the order of 15 to 20 years. We would like to lock in our costs over the same period. Electricity is our number one operating expense after head count." He went on to say that Google's interest is primarily long-term in nature: "We are less concerned about hedging our cash flows on a quarter by quarter basis. We are more concerned about the long term." As such, even though the wind PPA prices that Google is paying are apparently above-market in today's low wholesale power price environment, "We just want to ensure the project is there in the later years" – i.e., when wholesale power prices are less certain and therefore price protection is presumably more important (Chadbourne & Parke LLP 2011).

At least for these two prominent and very different purchasers of wind power in the U.S., long-term hedge value appears to be an important consideration. Greater and more widespread recognition of wind's portfolio value among other potential wind power purchasers could help the nation to move forward – even within an era of low natural gas prices, and even if the PTC is eventually phased out – with *both* gas-fired *and* renewable generation.

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SUPPLEMENTARY MATERIALS

www.sciencemag.org/content/350/6262/805/suppl/DC1
Materials and Methods
Supplementary Text
Figs. S1 to S48
Tables S1 to S3
Captions for Data Sets S1 and S2
Acknowledgments
References (*30–173*)
Data Sets S1 and S2

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CLIMATE CHANGE

Slow adaptation in the face of rapid warming leads to collapse of the Gulf of Maine cod fishery

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Several studies have documented fish populations changing in response to long-term warming. Over the past decade, sea surface temperatures in the Gulf of Maine increased faster than 99% of the global ocean. The warming, which was related to a northward shift in the Gulf Stream and to changes in the Atlantic Multidecadal Oscillation and Pacific Decadal Oscillation, led to reduced recruitment and increased mortality in the region's Atlantic cod (*Gadus morhua*) stock. Failure to recognize the impact of warming on cod contributed to overfishing. Recovery of this fishery depends on sound management, but the size of the stock depends on future temperature conditions. The experience in the Gulf of Maine highlights the need to incorporate environmental factors into resource management.

Climate change is reshaping ecosystems in ways that affect resources and ecosystem services (*1*). Fisheries, with their tight coupling between ecosystem status and economic productivity, are a prime example of interacting social-ecological systems. The social and ecological value of a fishery depends first and foremost on the biomass of fish, and fishing has often been the dominant driver of the status of the resources and economics of the fishing community. Modern fisheries management is designed to reduce harvesting levels in response to low stock biomass (and vice versa), creating a negative feedback that, in theory, will maintain steady long-term productivity (*2*).

A failure to detect changes in the environment, or to act appropriately when changes are detected, can jeopardize social-ecological systems (*3*). As climate change brings conditions that are increasingly outside the envelope of past experiences, the risks increase. The Gulf of Maine has warmed steadily, and the record warm conditions in 2012 affected the American lobster fishery (*4*). Here, we consider how ocean warming factored into the rapid decline of the Gulf of Maine cod stock (*5*).

We used sea surface temperature (SST) data to characterize temperature trends in the Gulf of Maine since 1982 and over the decade 2004–2013. We compared the Gulf of Maine SST trends to trends around the globe. Variability in Gulf of Maine SST was related to an index of Gulf Stream position as well as the Pacific Decadal Oscillation (PDO) and Atlantic Multidecadal Oscillation (AMO). We then examined the impact of temperature conditions in the Gulf of Maine on the recruitment and survival of Atlantic cod. The resulting temperature-dependent population dynamics model was used to project the rebuilding potential of this stock under future temperature scenarios.

From 1982 to 2013, daily satellite-derived SSTs in the Gulf of Maine rose at a rate of 0.03°C year^{-1} (R^2 = 0.12, P < 0.01, n = 11,688; Fig. 1A). This rate is higher than the global mean rate of 0.01°C year^{-1} and led to gradual shifts in the distribution and abundance of fish populations (*6–8*). Beginning in 2004, the warming rate in the Gulf of Maine increased by a factor of ~7, to 0.23°C year^{-1} (R^2 = 0.42, P < 0.01, n = 3653). This period began with relatively cold conditions in 2004 and concluded with the two warmest years in the time series. The peak temperature in 2012 was part of a large "ocean heat wave" in the northwestern Atlantic that persisted for nearly 18 months (*4*).

The recent 10-year warming trend is remarkable, even for a highly variable part of the ocean such as the northwestern Atlantic. Over this period, substantial warming also occurred off western Australia, in the western Pacific, and in the Barents Sea, and cooling was observed in the eastern Pacific and Bering Sea (Fig. 1B). The global ocean has a total area of 3.6×10^8 km^2, yet only 3.1×10^5 km^2 of the global ocean had warming rates greater than that in the Gulf of Maine over this time period. Thus, the Gulf of Maine has warmed faster than 99.9% of the global ocean between 2004 and 2013 (Fig. 1C). Using SSTs from 1900 to 2013, the likelihood of any 2° × 2° segment of the ocean exceeding this 10-year warming rate is less than 0.3%. According to this analysis, the Gulf of Maine experienced decadal warming that few marine ecosystems have encountered.

As a first step toward diagnosing the potential drivers of the recent warming trend, we correlated the quarterly temperatures in the Gulf of Maine with large-scale climate indicators (table S1). An index of Gulf Stream position (*9*) has the strongest and most consistent relationship with Gulf of Maine temperatures. The correlations with the Gulf Stream Index (GSI) are positive and significant in all quarters, with the

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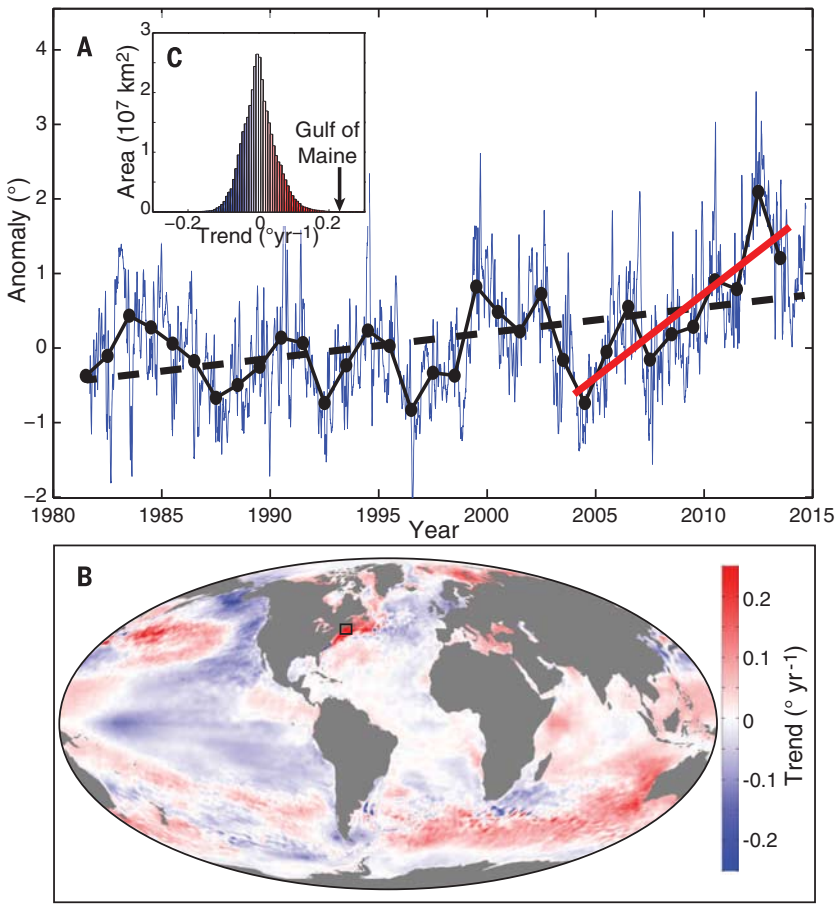

Fig. 1. Sea surface temperature trends from the Gulf of Maine and the global ocean. (**A**) Daily (blue, 15-day smoothed) and annual (black dots) SST anomalies from 1982 to 2013, showing the long-term trend (black dashed line) and trend over the decade 2004–2013 (red solid line). (**B**) Global SST trends, 2004–2013. The Gulf of Maine is outlined in black. (**C**) Histogram of global 2004–2013 SST trends, with the trend from the Gulf of Maine indicated at the right extreme of the distribution.

Table 1. Linear models relating Gulf of Maine summer temperature to climate indicators. GSI, Gulf Stream Index; PDO, Pacific Decadal Oscillation Index; AMO, Atlantic Multidecadal Oscillation Index. The final model uses all three indices. The first set of statistics refers to the models fit to the entire 1982–2013 record. The models were also fit to the 1982–2003 period, then projected onto the 2004–2013 period. The rightmost two columns summarize the out-of-sample performance of the models.

Time series 1	Time series 2	1982–2013			2004–2013 (out of sample)	
		R^2	P	AIC	r^2	P
GSI	—	0.39	0.00	63.92	0.50	0.00
	PDO	0.58	0.00	54.41	0.54	0.00
	AMO	0.66	0.00	48.15	0.64	0.00
PDO	—	0.45	0.00	60.77	0.28	0.01
	AMO	0.50	0.00	59.78	0.32	0.01
AMO	—	0.23	0.01	71.06	0.11	0.13
All		0.70	0.00	45.99	0.65	0.00

strongest correlation occurring in summer (r = 0.63, P < 0.01, n = 31). The PDO (*10*) is negatively correlated with the Gulf of Maine temperatures during spring (r = −0.50) and summer (r = −0.67). Summer temperatures are also positively correlated with the AMO (*11*) (r = 0.48, P < 0.01, n = 31).

Building on the strong correlations with summer temperatures, we developed multiple regression models for summer Gulf of Maine temperatures using combinations of the three indices (Table 1). As judged by Akaike information criterion (AIC) score, the best model used all three indices, and this model explained 70% of the variance in Gulf of Maine summer temperature (R^2 = 0.70, P < 0.01, AIC = 46.0, n = 31). This model was slightly better than one using GSI and the AMO (R^2 = 0.66, P < 0.01, AIC = 48.2, n = 31). We refit each model using data from 1982 to 2003 and then applied the model to the 2004–2012 period. The three-index and GSI-AMO models had nearly identical out-of-sample performance, explaining 65% and 64% of the variance, respectively.

A long-term poleward shift in the Gulf Stream occurred during the 20th century and has been linked to increasing greenhouse gases (*12*). Previous studies have reported an association between Gulf Stream position and temperatures in the northwestern Atlantic (*7*, *13*), and an extreme northward shift in the Gulf Stream was documented during the record warm year of 2012 (*14*). Although the Gulf Stream does not directly enter the Gulf of Maine, northward shifts in the Gulf Stream are associated with reduced transport of cold waters southward on the continental shelf (*15*, *16*). The association between Gulf of Maine temperature and the PDO suggests an atmospheric component to the recent trend. A detailed heat budget calculation for the 2012 event (*17*) found that the warming was due to increased heat flux associated with anomalously warm weather in 2011–2012. These results suggest that atmospheric teleconnections from the Pacific, changes in circulation in the Atlantic Ocean, and background warming have contributed to the rapid warming in the Gulf of Maine.

The Gulf of Maine cod stock has been chronically overfished, prompting progressively stronger management, including the implementation of a quota-based management system in 2010. Despite these efforts, including a 73% cut in quotas in 2013, spawning stock biomass (*SSB*) continued to decline (Fig. 2A). The most recent assessment found that *SSB* in this stock is now less than 3000 metric tons (mt; 1 mt = 1000 kg), which is only 4% of the *SSB* value that gives the maximum sustainable yield (SSB_{msy}) (*5*). This has prompted severe restrictions on the commercial cod fishery and the closure of the recreational fishery.

The Gulf of Maine is near the southern limit of cod, and previous studies have suggested that warming will lead to lower recruitment, suboptimal growth conditions, and reduced fishery productivity in the future (*18*–*20*). Using population estimates from the recent Gulf of Maine cod stock assessment (*5*), we fit a series of stock-recruit models with and without a temperature effect (table S2). The best models exhibited negative relationships between age-1 recruitment and summer temperatures (table S3). Gulf of Maine cod spawn in the winter and spring, so the link with summer temperatures suggests a decrease in the survival of late-stage larvae and settling juveniles. Although the relationship with temperature is statistically robust, the exact mechanism for this is uncertain but may include changes in prey availability and/or predator risk. For example, the abundance of some zooplankton taxa that are prey for larval cod has declined in the Gulf of Maine cod habitat (*21*). Warmer temperatures could cause juvenile cod to move away

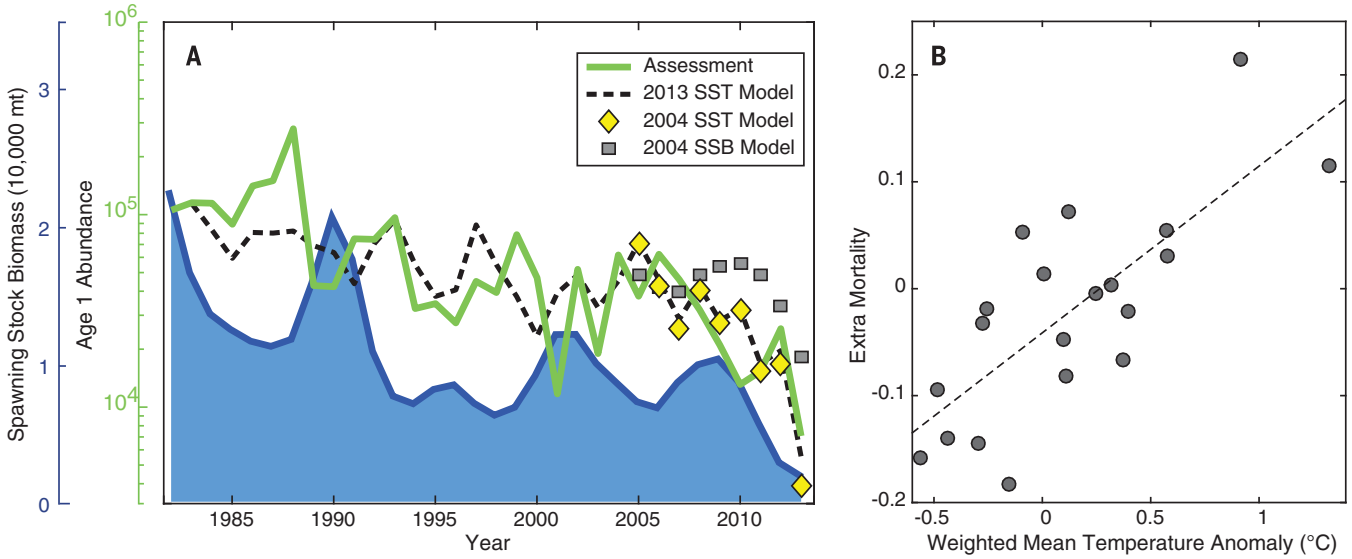

Fig. 2. Relationships between Gulf of Maine cod and temperature. (**A**) Time series of Gulf of Maine cod spawning stock biomass (blue) and age-1 recruitment (green) from the 2014 assessment. Cod age-1 recruitment was modeled using adult biomass and summer temperatures (dashed line). The gray squares are recruitment estimated using a model without a temperature effect fit to data prior to 2004. The yellow diamonds are a temperature-dependent model fit to this earlier period. (**B**) Mortality of age-4 cod as a function of temperature (R^2 = 0.57, P < 0.01, n = 21). The temperature is composed of the fall values from the current year and 3 years prior, weighted using the coefficients from the linear model.

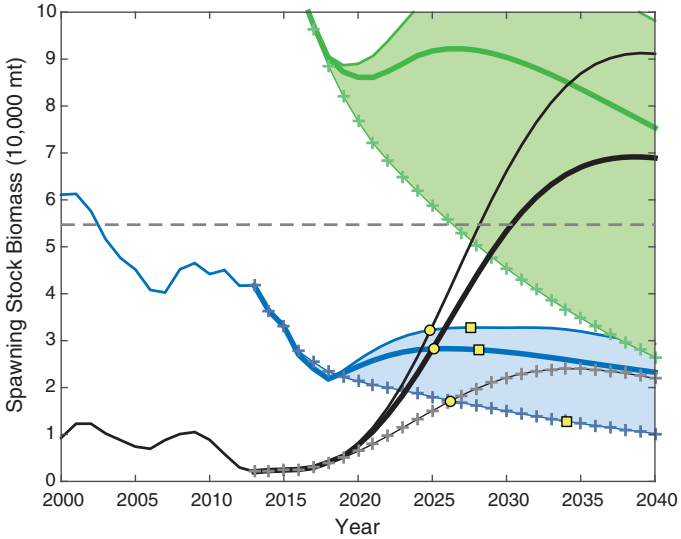

Fig. 3. Temperature-dependent rebuilding potential of Gulf of Maine cod. We simulated a population growing from the 2013 biomass (black curves) without fishing under three temperature scenarios: a cool scenario (solid line) represented by the 10% lower bound of the CMIP-5 ensemble of climate model projections, a warm scenario (heavy line) represented by the climate model ensemble mean, and a hot scenario (plus signs) with warming at the 0.07° year^{-1} rate observed in the summer in the Gulf of Maine since 1982. This population is contrasted against an estimate of the temperature-dependent SSB_{msy} (blue lines and shading), an estimate of SSB_{msy} without accounting for temperature (gray dashed line), and the carrying capacity of the population (green lines and shading). The yellow circles mark where the rebuilding population reaches the temperature-dependent SSB_{msy}; squares denote when a population fished at F = 0.1 would be rebuilt.

from their preferred shallow habitat into deeper water, where risks of predation are higher (*22*).

We also looked for other signatures of temperature within the population dynamics of cod. We found a strong association between the mortality of age-4 fish and fall temperatures from the current year and the second year of life (Fig. 2B, R^2 = 0.57, P < 0.01, n = 21). Age 4 represents an energetic bottleneck for cod because of the onset of reproduction and reduced feeding efficiency as fish transition from benthic to pelagic prey (*23*). Elevated temperatures increase metabolic costs in cod (*24*), exacerbating the energetic challenges at this age. The average weight-at-age of cod in the Gulf of Maine region has been below the long-term mean since 2002 (*25*), and these poorly conditioned fish will have a lower probability of survival (*26*).

The age-4 mortality relationship improves significantly with the addition of temperatures from the second year of life (table S6). This suggests that a portion of the estimated age-4 mortality reflects mortality over the juvenile period that is not explicitly captured in the assessment. Temperature may directly influence mortality in younger fish through metabolic processes described above; however, we hypothesize that predation mortality may also be higher during warm years. Many important cod predators migrate into the Gulf of Maine or have feeding behaviors that are strongly seasonal. During a warm year, spring-like conditions occur earlier in the year, and fall-like conditions occur later. During the 2012 heat wave, the spring warming occurred 21 days ahead of schedule, and fall cooling was delayed by a comparable amount (*4*). This change in phenology could result in an increase in natural mortality of 44% on its own, without any increase in predator biomass (see supplementary text).

If fishing pressure had been effectively reduced, the population should have rebuilt more during the cool years and then declined less rapidly during the warming period. Instead, fishing mortality rates consistently exceeded target levels, even though fishermen did not exceed their quotas. The quota-setting process that is at the heart of fisheries management is highly sensitive to the number of fish aging into the fishery in each year. For Gulf of Maine cod, age classes 4 and 5 dominate the biomass of the stock and the catch (*5*). The temperature-mortality relationship in Fig. 2B means that during warm years, fewer fish are available for the fishery. Not accounting for this effect leads to quotas that are too high. The resulting fishing mortality rate was thus above the intended levels, contributing to overfishing even though catches were within prescribed limits. Socioeconomic pressures further compounded the overfishing. To minimize the impact of the quota cuts on fishing communities,

the New England Fishery Management Council elected to defer most of the cuts indicated for 2012 and 2013 until the second half of 2013. The socioeconomic adjustment coupled with the two warmest years on record led to fishing mortality rates that were far above the levels needed to rebuild this stock.

The impact of temperature on Gulf of Maine cod recruitment was known at the start of the warming period (*20*), and stock-recruitment model fit to data up to 2003 and incorporating temperature produces recruitment estimates (Fig. 2A, yellow diamonds) that are similar to the assessment time series. Ignoring the influence of temperature produces recruitment estimates that are on average 100% and up to 360% higher than if temperature is included (Fig. 2A, gray squares). According to a simple population dynamics model that incorporates temperature, the spawning stock biomass that produces the maximum sustainable yield (SSB_{msy}) has been declining steadily since 2002 (Fig. 3) rather than remaining constant, as currently assumed. The failure to consider temperature impacts on Gulf of Maine cod recruitment created unrealistic expectations for how large this stock can be and how quickly it can rebuild.

We estimated the potential for rebuilding the Gulf of Maine cod stock under three different temperature scenarios: a "cool" scenario that warms at a rate of 0.02° year^{-1}; a "warm" scenario that warms at 0.03° year^{-1}, the mean rate from climate model projections; and a "hot" scenario that follows the 0.07°C year^{-1} trend present in the summer temperature time series. If fishing mortality is completely eliminated, populations in the cool and warm scenarios could rebuild to the temperature-dependent SSB_{msy} in 2025, slightly longer than the 10-year rebuilding timeline established by U.S. law, and the hot scenario would reach its target 1 year later (Fig. 3). Allowing a small amount of fishing (F = 0.1) would delay rebuilding by 3 years in the cool and warm scenarios and 8 years in the hot scenario. Note that estimating SSB_{msy} without temperature produces a management target that may soon be unachievable. By 2030, a rebuilt fishery could produce more than 5000 mt year^{-1} under the warm scenario, a catch rate close to the average for the fishery for the previous decade. Under the hot scenario, the fishery would be 1800 tons year^{-1}—small, but potentially valuable. Thus, how quickly this fishery rebuilds now depends arguably as much on temperature as it does on fishing. Future management of Gulf of Maine cod would benefit from a reevaluation of harvest control rules and thorough management strategy evaluation of the application of temperature-dependent reference points and projections such as these.

As climate change pushes species poleward and reduces the productivity of some stocks, resource managers will be increasingly faced with trade-offs between the persistence of a species or population and the economic value of a fishery. Navigating decisions in this context requires both accurate projections of ecosystem status and stronger guidance from society in the form of new policies. Social-ecological systems that depend on a steady state or are slow to recognize and adapt to environmental change are unlikely to meet their ecological and economic goals in a rapidly changing world.

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SUPPLEMENTARY MATERIALS

www.sciencemag.org/content/350/6262/809/suppl/DC1
Materials and Methods
Figs. S1 to S6
Tables S1 to S5
References (*27–35*)

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EXTINCTION EVENTS

Body-size reduction in vertebrates following the end-Devonian mass extinction

Lauren Sallan[1]* and Andrew K. Galimberti[2]†

Following the end-Devonian mass extinction (359 million years ago), vertebrates experienced persistent reductions in body size for at least 36 million years. Global shrinkage was not related to oxygen or temperature, which suggests that ecological drivers played a key role in determining the length and direction of size trends. Small, fast-breeding ray-finned fishes, sharks, and tetrapods, most under 1 meter in length from snout to tail, radiated to dominate postextinction ecosystems and vertebrae biodiversity. The few large-bodied, slow-breeding survivors failed to diversify, facing extinction despite earlier evolutionary success. Thus, the recovery interval resembled modern ecological successions in terms of active selection on size and related life histories. Disruption of global vertebrate, and particularly fish, biotas may commonly lead to widespread, long-term reduction in body size, structuring future biodiversity.

Body size plays a crucial role in life histories, affecting generation times, energy demands, and population sizes (*1*, *2*). Size increases (Cope's rule) are thought to define Phanerozoic biodiversity, resultant from coordinated active trends, preferential survival of larger-bodied forms (lineage sorting), or passive diffusion (*2*–*4*). In contrast, the Lilliput effect—that is, temporary size reduction after mass extinction—is supported by few observations and remains under dispute (*4*, *5*). This effect is widely considered a passive result of extinction

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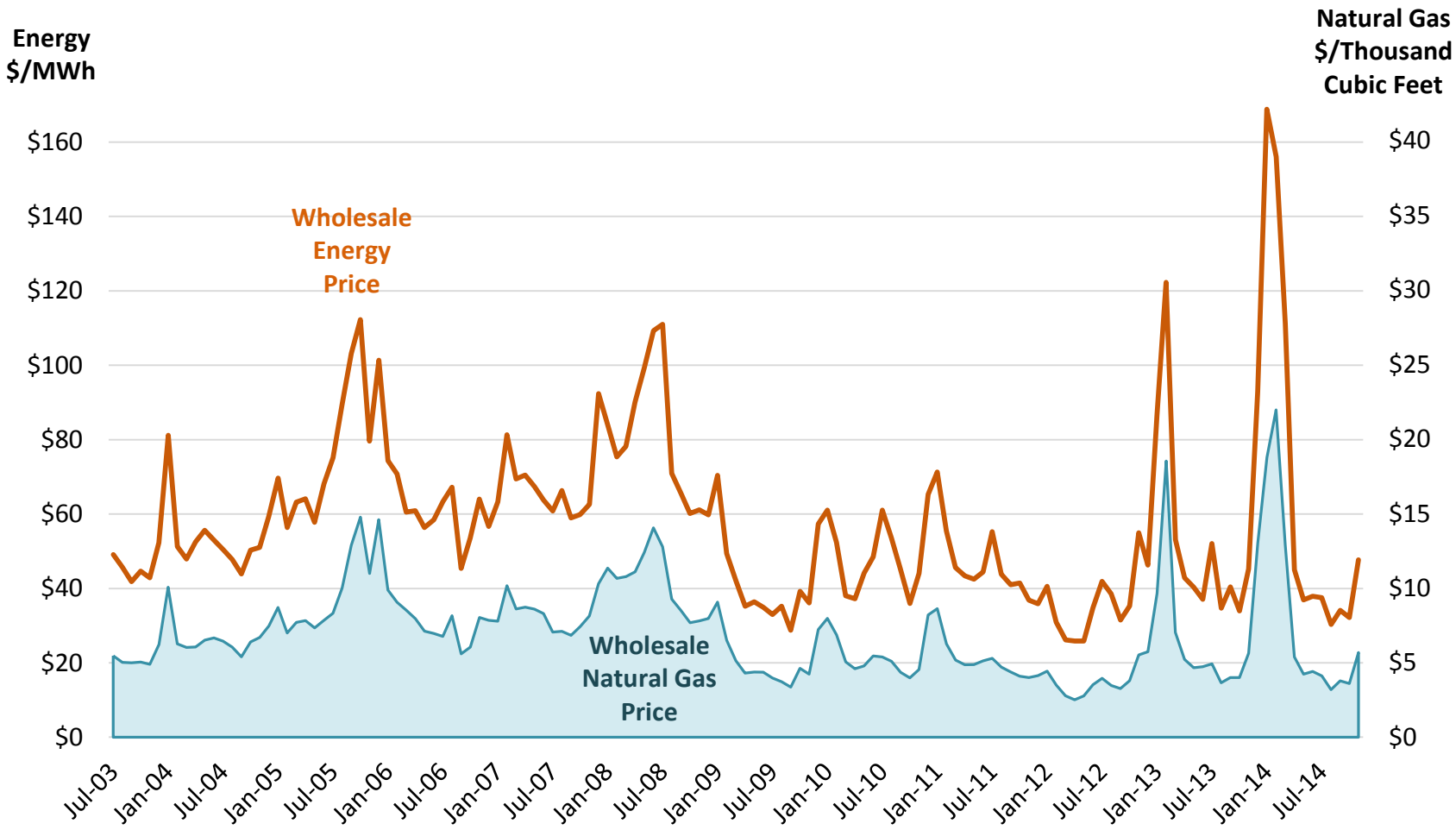
Benefits of Long-Term Wind Contracts

July 1, 2015

2. Value of Wind in Hedging Energy Prices

In New England, volatile natural gas prices generally set the price of electricity in the wholesale market. Long-term wind contracts can help to hedge this volatility.



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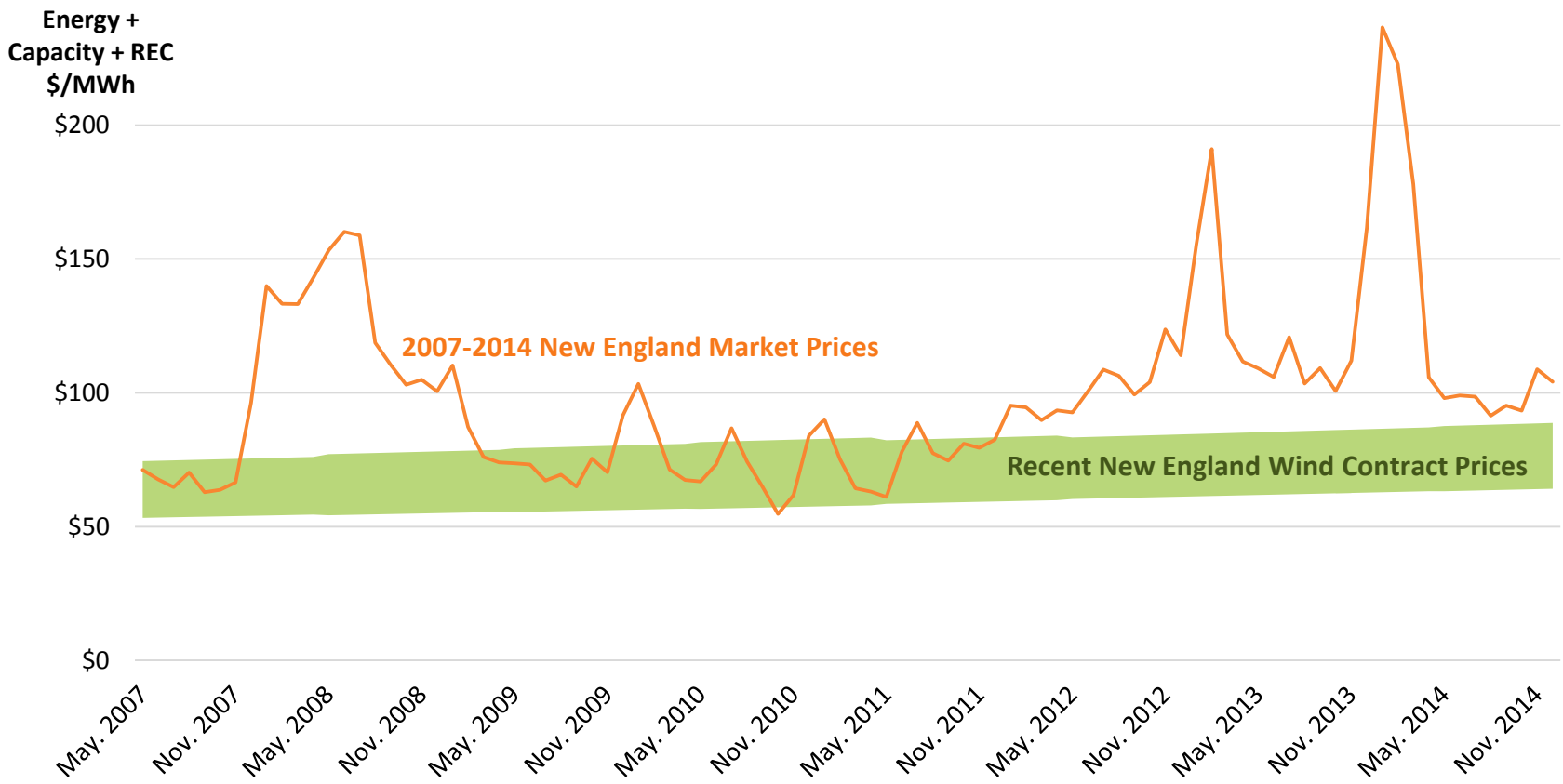
3. Value of Wind in Hedging Energy Prices

Renewable resources with their "free" fuel can provide an effective long term hedge, **like a 30 year fixed-rate mortgage,** against electricity market price volatility.



The orange line shows actual market prices from 2007-2014. The green shaded area shows the price of wind contracts, if you could have signed a contract in earlier years at today's wind prices. Of course, wind contract prices in 2007 would have been a bit higher, as technology has improved and costs have come down since then. Note that the wind contract prices have been adjusted for inflation.

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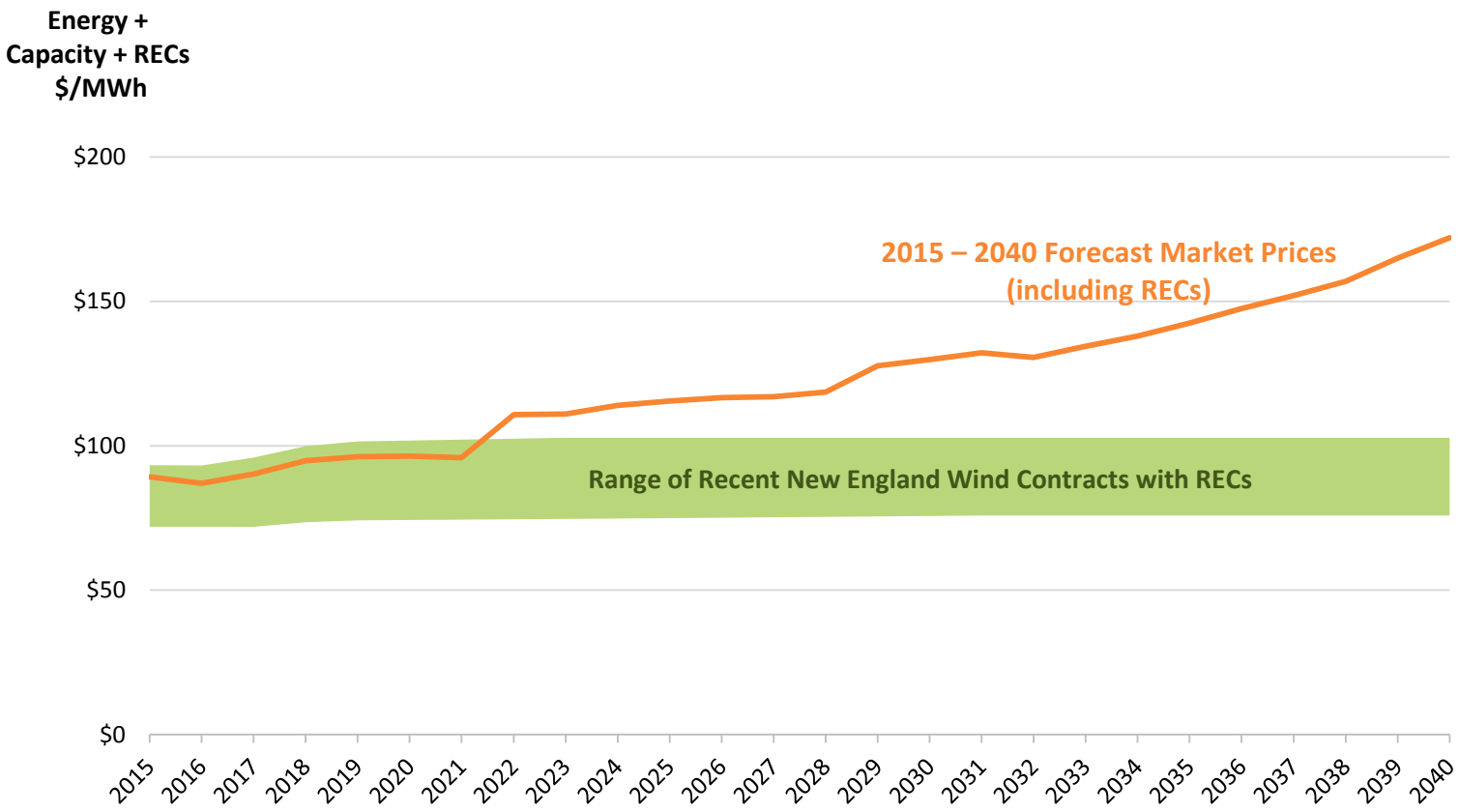
4. Wind Contracts Offer Low Price and Provide Hedge Against Rising Costs

Bundled contracts include the price of energy and renewable energy certificates (RECs), providing a hedge against rising costs of energy and environmental compliance .



Energy price forecast based on EIA Annual Energy Outlook 2014. Capacity market price forecast based on recent auction results. REC price forecast based on 2015 AESC forecast

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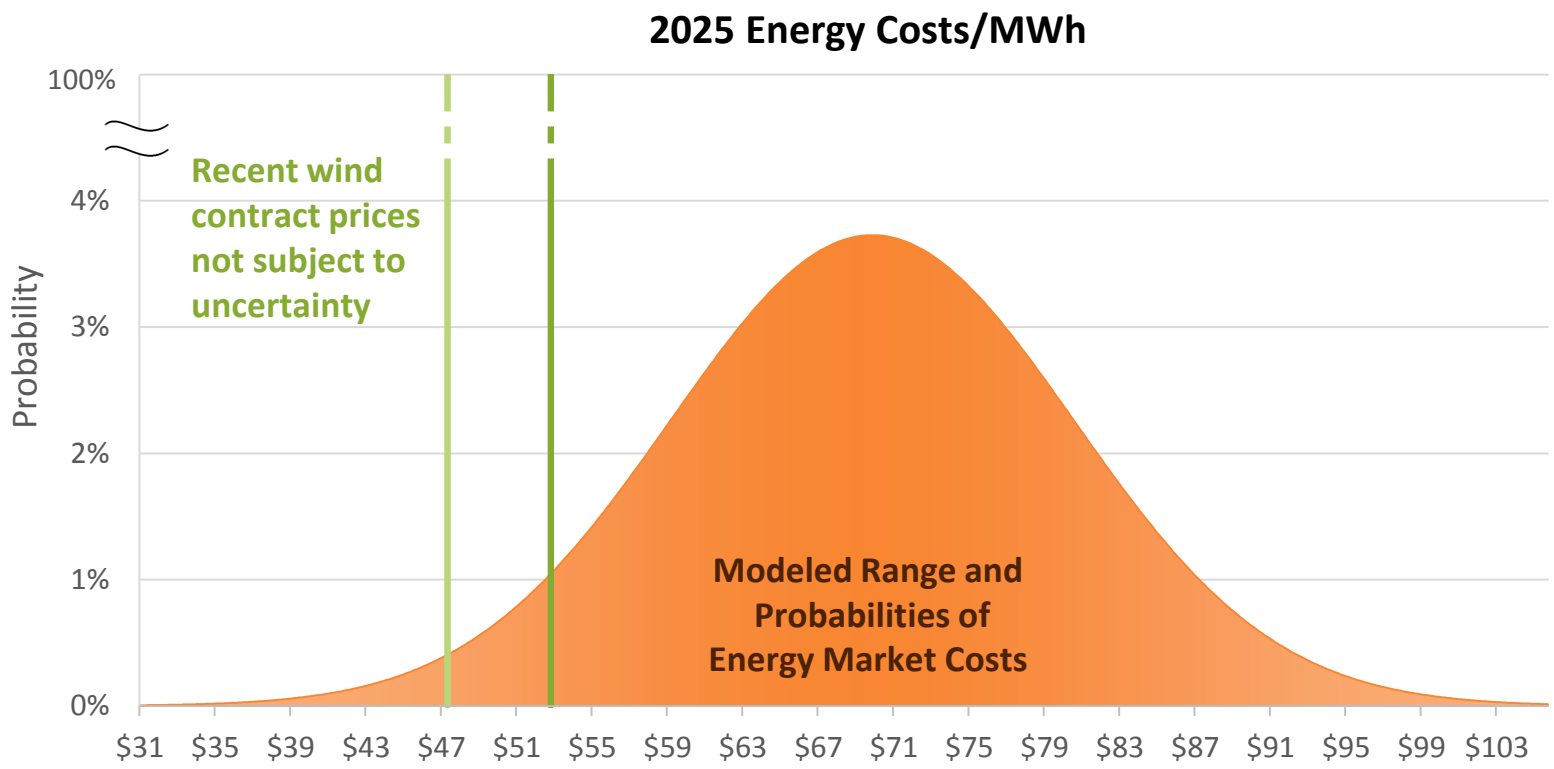
5. What is the hedge value of wind?

Future energy market prices are uncertain and can be represented using a probability distribution for each future year. In contrast, long-term wind contract prices are known with certainty. While energy market costs could be cheaper in the future, they are much more likely to be higher than wind contract costs.



Energy market costs are based on New England 2015 Avoided Energy Supply Costs under the scenario that energy efficiency programs continue. Probability assumes a normal distribution with a mean of 1 and a standard deviation of 0.15. Wind contract costs based on two recent Maine wind contracts, with capacity costs removed.

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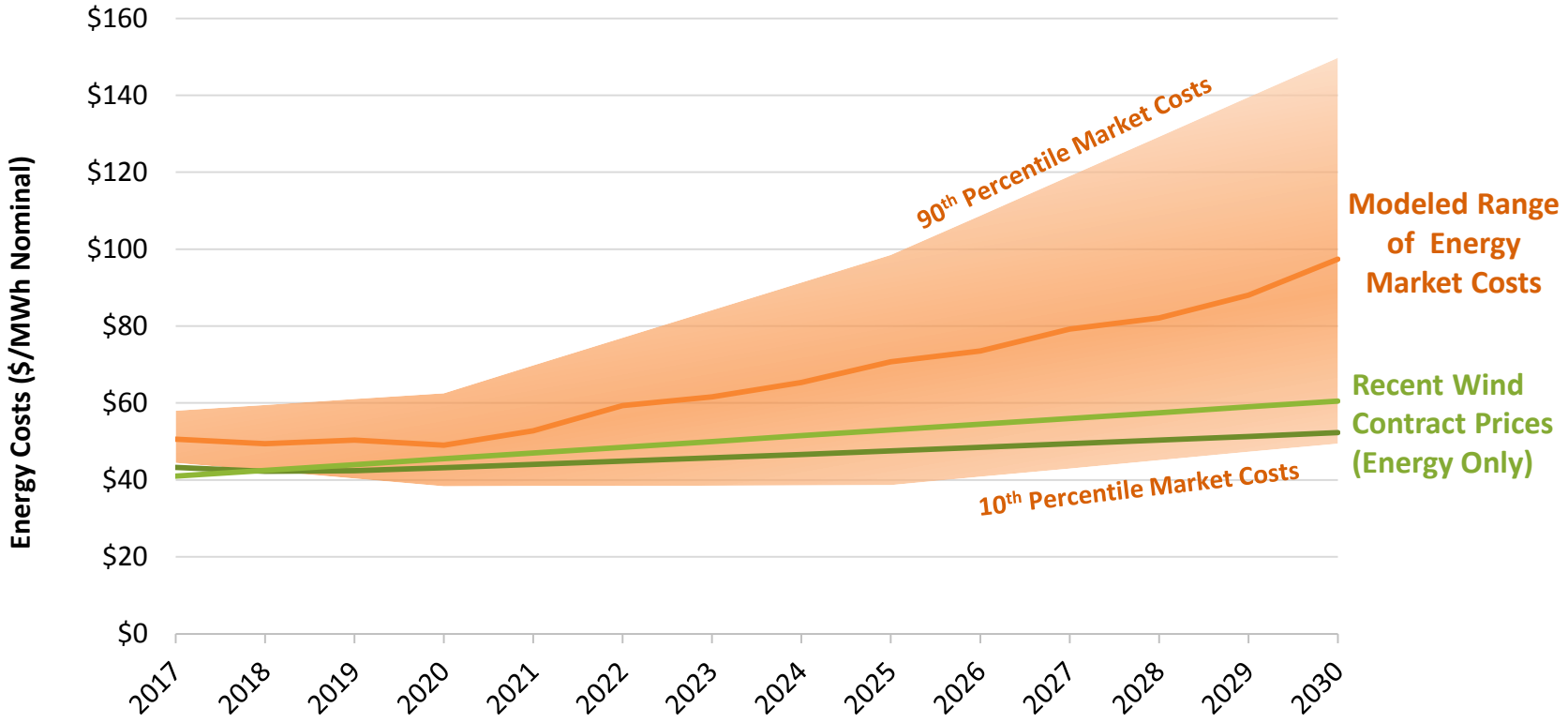
6. What is the hedge value of wind?

Uncertainty regarding future market prices increases over time, but wind contract prices do not. It is estimated that the levelized hedging benefit of wind is in the range of $13 - $16/MWh.



The prior slide compares wind contract prices with a range of possible market prices in one year, 2025. This slide shows the same idea, but for multiple years. The range of possible market prices increases further into the future. As this uncertainty in market prices grows, the wind contract price provides more value.

Energy market costs are based on New England 2015 Avoided Energy Supply Costs. Wind contract costs based on two recent Maine wind contracts, with capacity costs removed. Over the study period, the wind contracts provide a levelized benefit ranging from $13-$16/MWh, as compared to the higher energy market expected costs.

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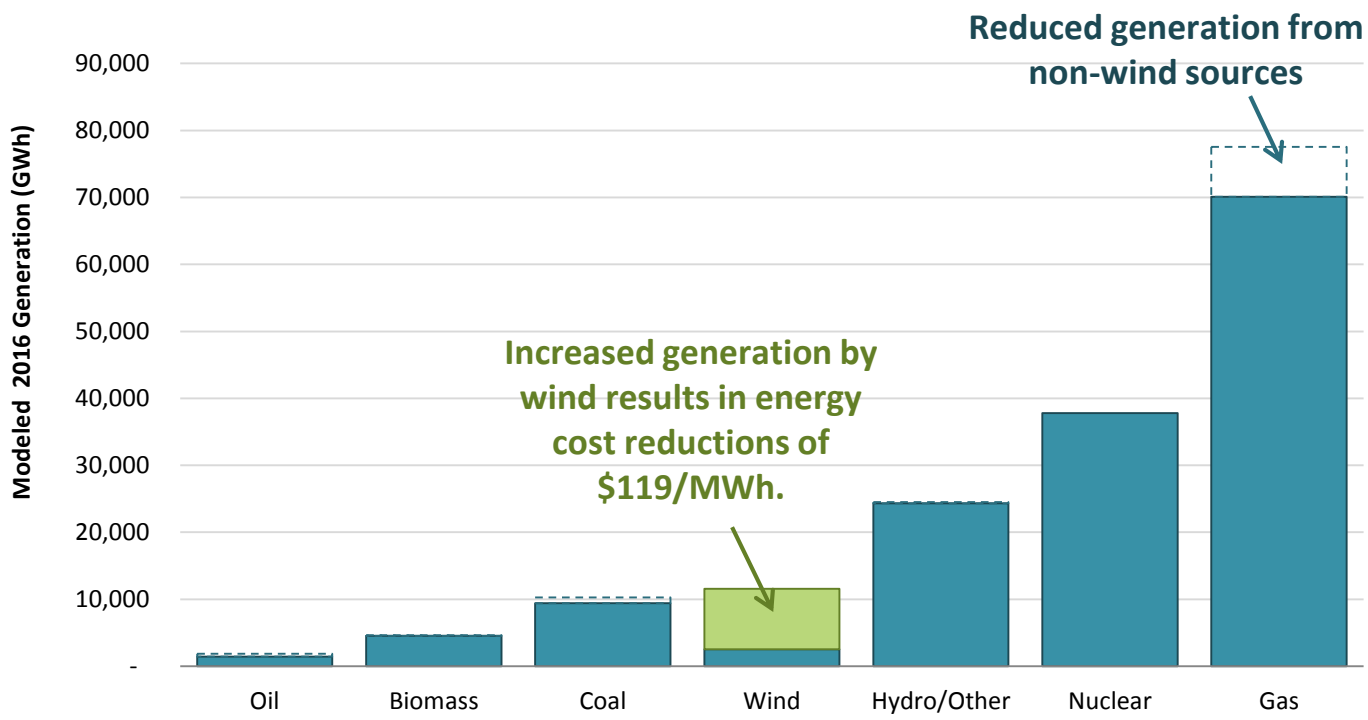
7. Wind Lowers Wholesale Energy Prices

ISO New England modeled a four-fold increase in wind (to 4 GW). The results indicate that annual wholesale energy costs would be reduced by over **$1 billion**, equivalent to $119 in savings per MWh of additional wind generation.

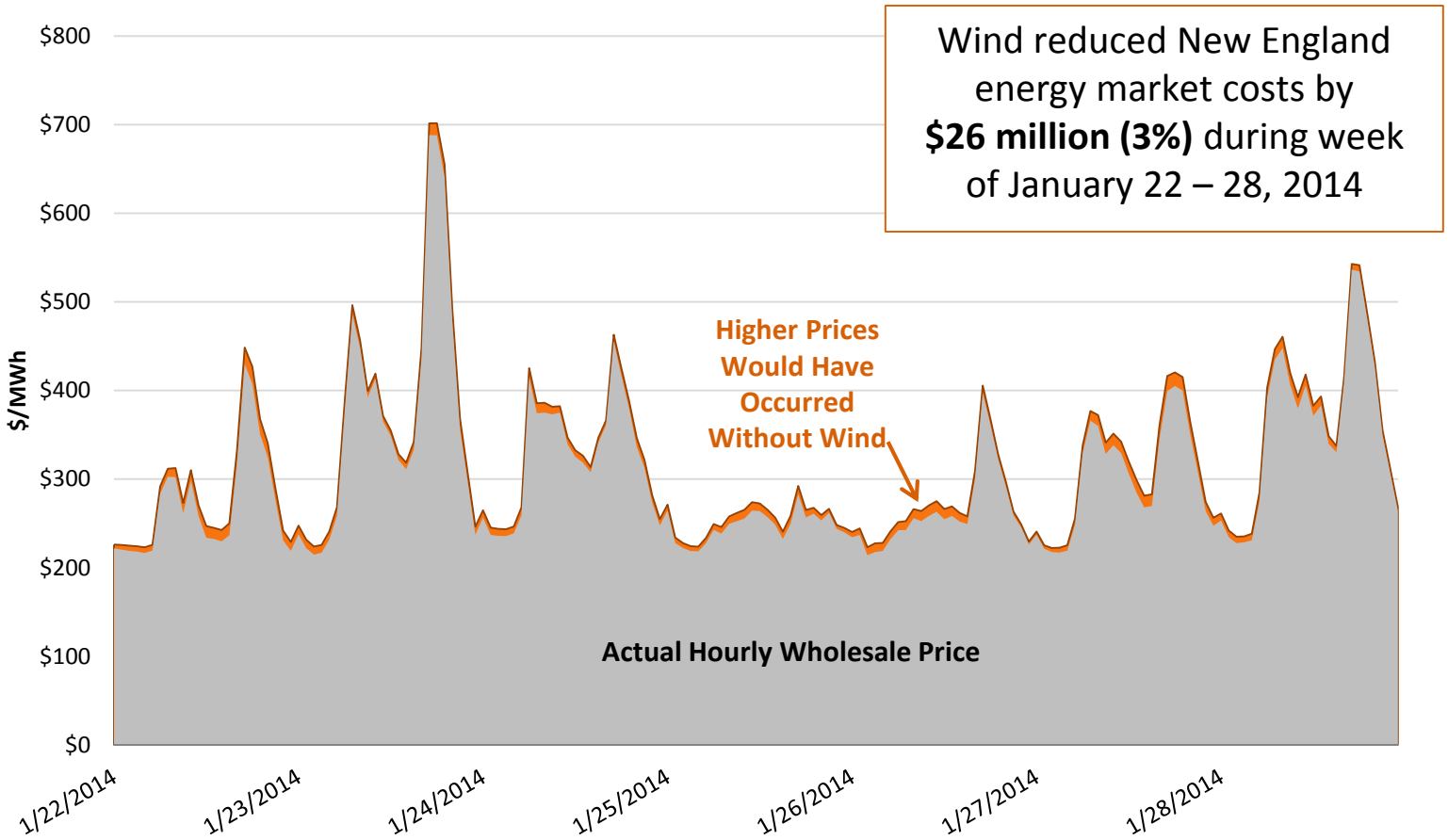
ISO New England Modeling Results from 2011 Economic Study



Graph based on ISO New England 2011 Economic Study, March 31, 2014 update, Case 5c, Expanded Wyman/Bigelow Contingencies, Table 6-11. Analysis assumed 4 GW of wind added to system in one year, with no retirements or deferred new entry, both of which would impact the results. The study year was 2016, but the price suppression effect is likely to continue for multiple years. Additional modeling would be required to quantify the amount and duration of this effect beyond 2016.

8. Value of Wind During Polar Vortex

Wind helped to lower market prices during the polar vortex. Although it only constituted approximately 1% of energy, wind reduced total energy market costs by approximately 3% during the Polar Vortex.



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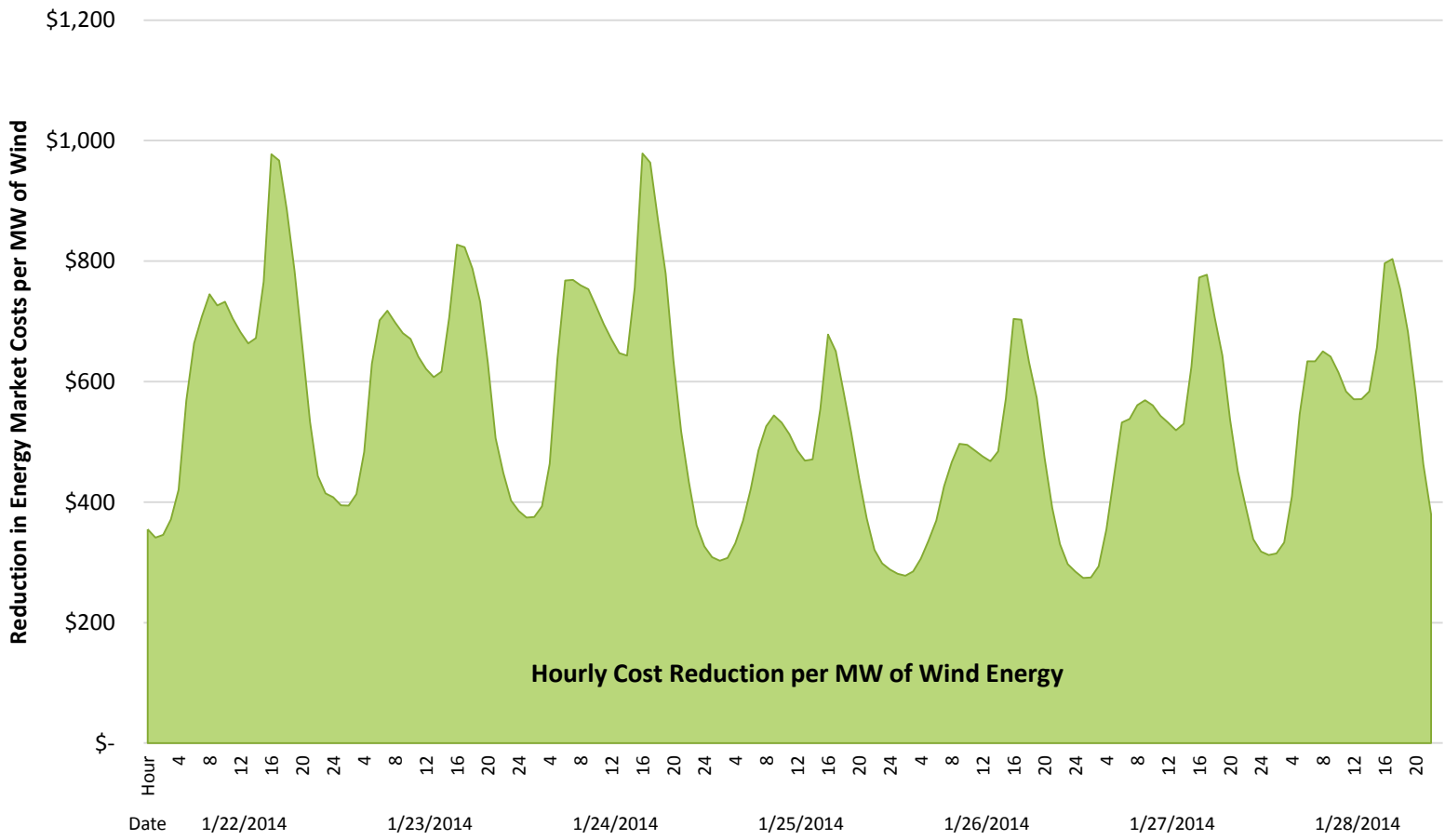
9. Hourly Cost Reduction During Polar Vortex

Each megawatt of wind energy produced during the polar vortex reduced wholesale energy costs by an average of **$544** each hour.



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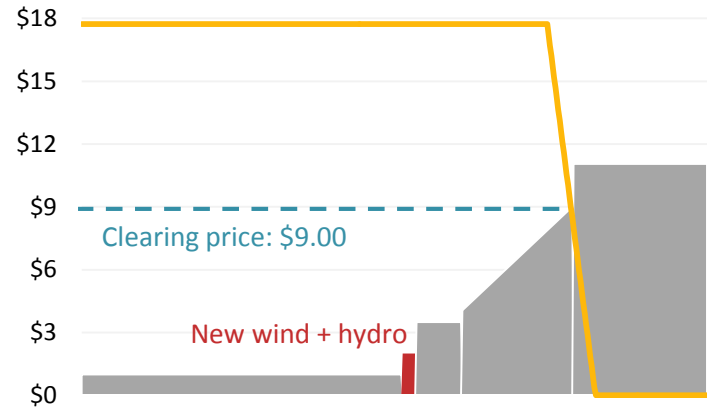
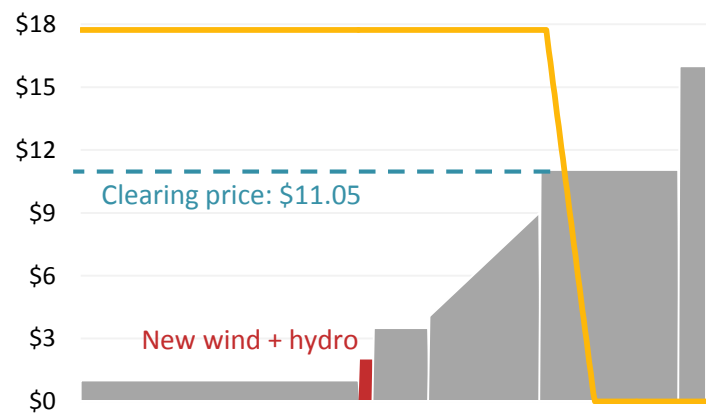
10. Reductions in Capacity

Potentially Large Impacts: Depending on supply and demand, in certain situations, adding 500 MW of wind and hydro could reduce capacity market costs by approximately **$900 million**.



Graphs are based on recent auction results and roughly approximate the current New England capacity market.
Savings estimates based on 35,000 MW of cleared capacity.

No Impacts: In other situations, adding 500 MW of wind and hydro will not alter the clearing price.



Graphs are based on recent auction results and roughly approximate the current New England capacity market.
Savings estimates based on 35,000 MW of cleared capacity.

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Sources and Notes

- **Slide 2:**
  - Wholesale energy price is the ISO-NE control area average day ahead LMP
  - Wholesale natural gas price is the Massachusetts Natural Gas Price Sold to Electric Power Consumers (Dollars per Thousand Cubic Feet), as reported by the EIA. Data released 2/27/2015, available at http://tonto.eia.gov/dnav/ng/hist/n3045ma3m.htm

- **Slide 3:**
  - New England Market Price = (Wholesale Energy Price) + (Wholesale Capacity Price) + (Actual REC Spot Market Price)
    - Where the wholesale energy price is the ISO-NE control area average day ahead LMP, the wholesale capacity price reflects the results of the New England Forward Capacity Market, and the REC spot market price is based on REC prices reported by the US Department of Energy (http://apps3.eere.energy.gov/greenpower/markets/certificates.shtml?page=5)
  - Recent Wind Contract Prices include:
    - Number Nine: (Energy price of $59) – (40% of the capacity market price)
    - Groton and Hoosac contracts for energy and RECs, plus the cost of capacity that a utility would be required to buy: (Energy + REC price range of $80-$89/MWh) + (100% of capacity market price)
    - Bull Hill contract for energy, RECs, and capacity: Bundled contract price range of $80-$89/MWh

    Note that these wind contract prices are then deflated to 2007 – 2014 dollars for this graph. The prices then increase over time due to inflation and varying capacity market prices.

- **Slide 4**
  - Energy market prices are Based on AEO 2014 Reference Case New England Natural Gas for Electric Generation Purposes (nominal) and an assumed heat rate of 7050, based on EIA forecast assumption (http://www.eia.gov/forecasts/aeo/assumptions/pdf/electricity.pdf)
  - Capacity market prices are based on recent auction results, and then escalated for inflation.
  - Recent Wind Contract Prices include:
    - Number Nine: (Energy price of $59) – (40% of the capacity market price)
    - Groton and Hoosac contracts for energy and RECs, plus the cost of capacity that a utility would be required to buy: (Energy + REC price range of $80-$89/MWh) + (100% of capacity market price)
    - Bull Hill contract for energy, RECs, and capacity: Bundled contract price range of $80-$89/MWh
  - REC prices for 2015 – 2030 are based on the REC forecast from the March 31, 2015 Avoided Energy Supply Component (AESC) Study Group report, Exhibit F-1 CT and MA Class 1 REC forecast through 2030 (http://ma-eeac.org/wordpress/wp-content/uploads/2015-Regional-Avoided-Cost-Study-Report1.pdf). 2031-2040 use 2030's forecast adjusted to nominal dollars.

Sources and Notes

- **Slide 5:**
  - Future energy market costs are based on the AESC 2015 Wholesale Energy Price Forecast for Massachusetts (Exhibit 6-3), which included energy efficiency effects in the forecast. Wind contract costs are for Weaver and Highland. All dollar values are in nominal terms.
  - There is no current consensus on the probability distribution of energy market prices, and we have therefore chosen to use a normal distribution with a mean of 1 and a steadily increasing standard deviation (ranging from 0.05 to 0.20).
  - This is but one of many ways to model the uncertainty regarding future energy market prices and hedge values. As stated by NREL in its 2012 Renewable Electricity Futures Study, "A variety of methods have been used to assess and sometimes quantify the benefits of fixed-price renewable energy contracts relative to variable-price fossil generation contracts, as well as the benefits of electricity supply diversity more generally. These methods have included risk-adjusted discount rates (e.g., Awerbuch 1993); Monte Carlo and decision analysis (e.g., Wiser and Bolinger 2006); portfolio theory (e.g., Bazilian and Roques 2008); market-based assessments of the cost of conventional fuel-price hedges (e.g., Bolinger et al. 2006); and various diversity indices (e.g., Stirling 1994, 2010). ***Many of these methods have proven controversial, and a single, standard benefit quantification has not emerged***." (emphasis added)

- **Slide 6:**
  - The "hedge value" of wind in this slide assumes a linear model with an expected value equivalent to the AESC 2015 Wholesale Energy Price Forecast for Massachusetts (Exhibit 6-3) compared with stable wind contracts (Weaver and Highland). The levelized benefit was calculated using a discount rate of 8 percent.

Sources and Notes

- **Slide 7:**
  - Graph based on ISO-New England 2011 Economic Study, March 31, 2014 update, Case 5c, Expanded Wyman/Bigelow Contingencies, Table 6-11.
  - The study year was 2016, but the price suppression effect is likely to continue for multiple years. Additional modeling would be required to quantify the amount and duration of this effect beyond 2016. Analysis assumed 4 GW of wind added to system in one year, with no retirements or deferred new entry, both of which would impact the results.
  - Results of ISO-NE study are not endorsed in any way by Synapse Energy Economics. A more complete study would
    - Phase in the 4 GW of wind over time;
    - Assess impacts on the energy and capacity markets from this new entry with low energy and capacity market bids;
    - Make realistic assumptions about the reaction of other market participants, i.e., resulting retirements and deferred new entry due to the entry of 4 GW of new wind;
    - Account for the supply curve impacts of such retirements and deferred new entry;
    - Model a longer study period in order to determine how long any price suppression impacts are likely to last; and
    - Make a realistic assumption about cost of transmission to integrate new wind and to handle retirements while still serving load reliably.

Sources and Notes

- **Slide 8:**
  - New England Energy Market Price is the ISO-NE control area hourly day ahead LMP for January 22 – January 28, 2014, which was the week with the greatest price spikes (averaging above $300/MWh on some days).
  - Hourly actual wind generation for January 22 – January 28 is from an ISO-NE data file located here: http://www.iso-ne.com/static-assets/documents/2014/11/hourly_wind_gen_2011_2014.xlsx
  - To determine the impact of wind generation, a regression analysis was performed to determine the relationship between load and price for the day ahead market. (A reduction in load shifts the demand curve to the left, which is equivalent to the effect produced by inserting wind in the supply stack, thereby shifting the supply curve to the right. Thus a 1 MWh reduction in load has the same effect as increasing wind output by 1 MWh.) This analysis produces predictions of what the higher prices might have been in the day ahead market without wind. The best fit was found to be an exponential curve, with an average savings of $9.1/MWh wind savings effect. In each hour, we took the change in price due to wind, and then multiplied this by the hourly load to get the DRIPE (Demand Reduction Induced Price Effect) for that hour. The sum of the DRIPE impacts for the week was found to be $26 million.

- **Slide 9:**
  - Slide 6 builds on Slide 5. First we calculate the hourly energy price without wind, using the results from the regression analysis described above, and then multiply this by the demand in that hour. This is what the day ahead wholesale energy costs would have been in that hour without wind. We then use actual prices multiplied by demand to determine the actual costs. The difference between these costs in each hour is then divided by the MW of wind output in that hour to determine the savings produced by wind per MWh for that hour. The weighted average is $544/hour of savings per MWh of wind for the period January 22- January 28, 2014.

- **Slide 10:**
  - Graphs show illustrative demand and supply curves, based on recent ISO-NE capacity market auction results. They are intended to roughly approximate the current New England capacity market.
  - Savings estimates are based on a plausible change in market clearing price due to the addition of 500 MW of low-cost resources, and assume 35,000 MW of cleared capacity. The savings are calculated as the product of the change in price and the 35,000 MW of cleared capacity.

Economic Impacts of Wind Energy Construction and Operations in Maine

2006-2018

Charles S. Colgan PhD
Maine Center for Business & Economic Research

University of Southern Maine

December 2014

Executive Summary

From 2006 to 2014, fourteen utility scale wind energy projects have been constructed or are currently under construction in Maine. The facilities are being built in nine counties with a total rated generating capacity of 614 megawatts. Projects planned for construction from 2015 to 2018 will add an additional 690 megawatts of capacity, bringing Maine's total current and planned wind generation capacity to 1.3 gigawatts.

Investment in Maine

Based on information provided by the companies that are leading the construction of the vast majority of this new wind energy generation, over $532.5 million has been spent in Maine on projects from 2006 to 2014. An additional $745.1 million anticipated over the next four years will bring the total spending in Maine on wind power to $1.28 billion by 2018. These figures do not include the costs of turbines, blades, and electrical gear bought from outside Maine.

Job Creation

These investments created or supported an average of 1,560 jobs per year from 2006-2018, with the largest employment anticipated in 2015 at over 4,200 jobs. While wind energy projects affect employment in all Maine counties (except York), the vast majority of these jobs are in rural areas of western, eastern, and northern Maine.

Employee Earnings

The jobs, including employment both directly and indirectly related to wind projects, will result in an increase in $1.14 billion in employee earnings over 2006-2018. The peak year for earnings will be $256 million in 2015. Earnings include both salaries and benefits. These figures mean that the majority of in-Maine expenditures on wind energy development goes to employee compensation.

Ongoing Employment

Once complete, wind energy projects can employ between 1 and 15 people on site for operations and maintenance. These employees, with the indirect effects, will account for an estimated 160 jobs from 2018 on. Periodic replacement and repair of turbines and towers will require employment levels comparable to the construction phase, which could result in 185-550 employees per year depending on the level of overhaul activity.

New Markets

The large amount of wind energy development in Maine has led a number of companies to begin development markets for their services to wind power projects outside of Maine. A survey of firms supporting wind energy development in and outside Maine found that 23 firms had $89.6 million in sales over 2011-2013, resulting in an average of 390 employees in Maine over this period and $61.3 million in earnings.

1. Introduction

The development of wind energy generation has become a significant industry in Maine over the past decade. Since the first utility scale[1] wind project at Mars Hill in Aroostook County went into operation in 2006, Maine has steadily been adding wind generation capacity. Fourteen projects are either operating or scheduled for completion in early 2015, and another four projects are set to begin construction from 2015 to 2018. When completed, these projects will have an installed capacity of 1304 megawatts (1.34 gigawatts), larger than any other single electric generating facility in Maine.

Region	County	Project	Rated Capacity (MW)	Construction Start Year	Operations Start Year
Aroostook	Aroostook	Mars Hill	42.0	2006	2007
Mid Coast	Waldo	Beaver Ridge	4.5	2007	2008
Eastern	Washington	Stetson	83.0	2008	2010
Mid Coast	Knox	Vinalhaven	4.5	2008	2009
Western	Franklin	Kibby	132.0	2008	2009
Eastern	Penobscot	Rollins	60.0	2010	2011
Eastern	Hancock	Bull Hill	34.0	2011	2012
Western	Oxford	Record Hill	50.0	2011	2012
Western	Oxford	Spruce Mountain	20.0	2011	2011
Western	Franklin	Saddleback	34.0	2014	2015
Aroostook	Aroostook	Oakfield	150.0	2014	2015
Eastern	Hancock	Hancock	51.0	2015	2016
Eastern	Penobscot	Passadumkeag	42.0	2015	2016
Kennebec	Somerset	Bingham	186.0	2015	2016
Western	Oxford	Canton	23.0	2015	2016
Aroostook	Aroostook	Number Nine	250.0	2015	2017
Eastern	Washington & Penobscot	Bowers	48.0	2016	2017
Eastern	Washington	Downeast	90.0	2016	2018
Total Capacity Completed or Begun 2006-2014			614.0		
Total Capacity Completed or Begun 2015-2018			690.0		
Total 2006-2018			1304.0		

Table 1 - Wind Energy Projects Included in the Analysis

Together, the construction of these projects will total $1.277 billion in spending in Maine over 12 years. This amount includes the development and permitting costs plus the costs of construction and turbine installation, which is carried out by Maine-based companies. Because the construction of wind generation projects is often in remote areas, it also includes the costs of food and lodging for the specialized workers required at each site. The figure does not include the costs of turbines, switching and transformer equipment that is needed to complete the projects; these are manufactured outside Maine and brought to each site. The report also examines the impacts of the operating period employment in each of the regions and the impacts of growing sales by Maine companies to contribute to wind energy development outside Maine.

[1] Utility level projects are designed to sell electricity into the wholesale market for electricity in New England or to sell directly into retail markets. They are distinguished from individual projects which provide electricity to designated users.

In addition to analyzing the construction of wind projects in Maine, the report also examines the economic impacts in Maine of the activities of Maine companies who assist in the development of projects outside Maine, both in the U.S. and internationally. The large amount of wind power development in Maine has provided companies the opportunity to develop substantial experience and expertise in the field, which is now being tapped by developers outside Maine.

This report examines the employment and earnings impacts of the development and operation of current and planned projects. The analysis is based on actual expenditure data provided by the two principal firms constructing wind power projects in Maine, Reed & Reed and Cianbro. This data was examined using models of regional economies in Maine developed by Regional Economic Models Inc. (REMI) of Amherst, MA, and maintained at the Maine Center for Business & Economic Research at the University of Southern Maine. The regions analyzed are single or multi-county regions:

- **Aroostook**
- **Cumberland**
- **Western:** Androscoggin-Franklin-Oxford
- **Eastern:** Penobscot-Piscataquis-Hancock-Washington
- **Kennebec Valley:** Kennebec-Somerset
- **Midcoast:** Sagadahoc-Lincoln-Knox-Waldo

2. Wind Power Projects in Maine

A. Expenditures in Maine

Table 2 summarizes expenditures on wind energy construction from 2006 to 2018. Projects through 2014 represent either completed or underway construction. Projects from 2015 to 2018 include the completion of some projects begun in 2014 and projects that will begin in 2015 to 2017. Future projects are in various stage of development including planning, permitting, and the securing of power purchase agreements with utilities.

2006	2007	2008	2009	2010	2011	2012
$5.94	$0.51	$76.65	$69.01	$62.74	$51.69	$24.59
2013	**2014**	**2015**	**2016**	**2017**	**2018**	**Total**
$22.78	$218.57	$271.79	$143.35	$254.97	$75.04	$1,277.62

Table 2 - Total expenditures on wind power developments in Maine by year in Millions of Dollars

Over this entire period, wind power investments will total $1.28 billion. From 2006 to 2014 the total expenditure for projects completed or begun before the end of 2014 was $532.5 million, which accounts for 614 MW. Projects planned to begin in 2015 or later will result in an estimated $745.1 million in investment for an additional 690 MW. The largest project in Maine designated Number Nine (at 250 MW capacity), is planned for 2016-2017 in Aroostook County.

Figure 1 shows the distribution of expenditures by region. Over the entire period, the Eastern region receives the most investment, followed by Aroostook County (on the assumption that the Number Nine project is built as planned). The Kennebec Valley and Western regions receive about the same amount of investment.

B. Employment Impacts

Table 3 shows the number of jobs estimated to have been created or supported in each region as a result of the expenditures in Table 2. Over the entire period, the wind projects increased employment in Maine by an average of 1,566 jobs per year. Projects through 2014 increased employment by an average of 1,037 jobs per year, which will increase to an average of 2,756 jobs from 2015-2018. The peak year for employment is expected to be 2015, when over 4,200 jobs will be created connected to wind energy development in Maine. The Bingham project in Somerset County will make the Kennebec Valley region the peak employment of all regions at years with over 2,200 jobs.

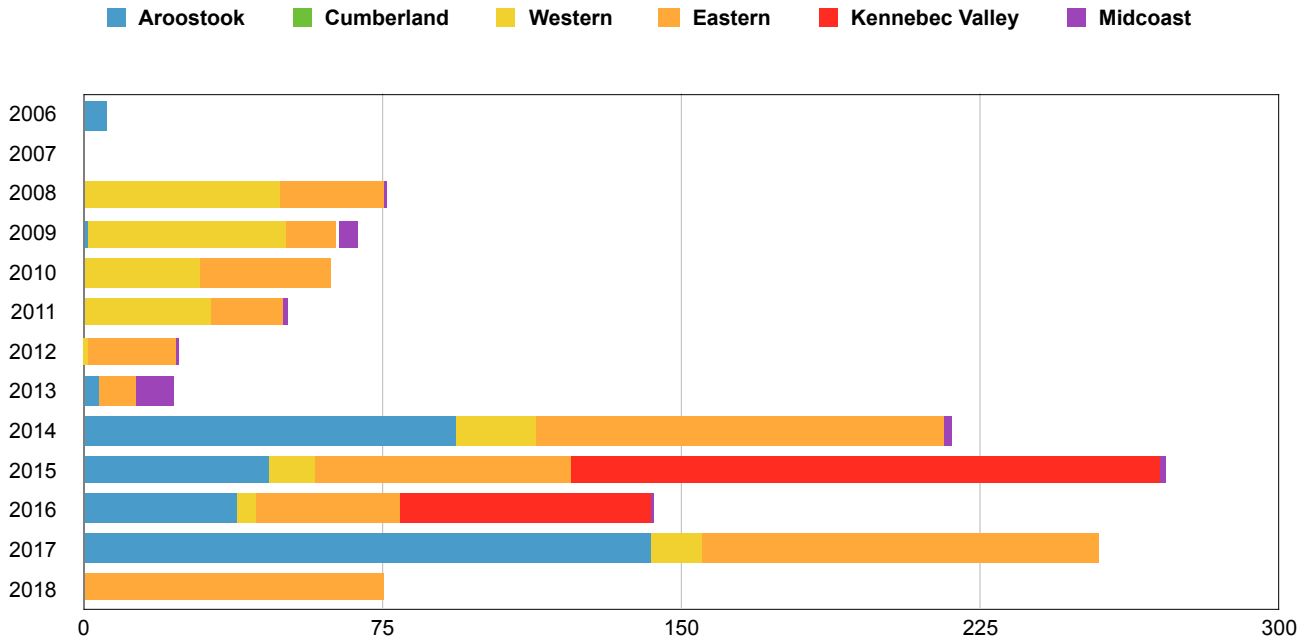

Figure 1 - Wind Development Expenditures by Region and Year

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Aroostook	139	10	3	17	8	-	-	55	1,441	693	552	1,988	-
Cumberland	-	-	46	52	37	37	16	16	16	65	49	36	58
Western	-	-	946	942	521	538	-	-	262	153	31	133	-
Eastern	2	1	536	264	539	321	358	85	1,640	1,022	523	1,413	973
Kennebec Valley	-	-	24	26	20	18	8	8	26	2,222	934	19	-
Midcoast	-	-	32	113	13	22	20	117	39	79	48	24	10
TOTAL	**141**	**11**	**1587**	**1414**	**1138**	**936**	**402**	**281**	**3,424**	**4,234**	**2,137**	**3,613**	**1,041**

Table 3 - Employment Impacts By Region

Not surprisingly, the construction industry is the largest industry affected by the projects, with about 54% of the jobs estimated. If the construction industry is used to approximate those jobs directly tied to the wind energy development, then the multiplier of the jobs is 1.85. On average across all years the construction industry employed 840 jobs per year, with indirect jobs of 740 per year. From 2014 on the construction industry will average over 1400 jobs per year, which will be about 6% of all construction jobs in Maine.

With large-scale construction projects, the jobs created are in one sense temporary, lasting the duration of each project. But the large and growing amount of wind energy investments means that many of the jobs have become effectively permanent, with a significant workforce at companies like Reed & Reed and Cianbro moving from project to project. Jobs in other industries, such as restaurants, hotels, and engineering are best described as "supported by" the wind projects. These are not necessarily new jobs, but a portion of each job's income earned in a given year derives from the wind development expenditures.

	Avg 06-14	Avg 15-18	Avg 06-18	Share of State 06-14	Share of State 15-18	Share of State 06-18
Aroostook	186	808	377	17.9%	29.3%	24.1%
Cumberland	24	52	33	2.4%	1.9%	2.1%
Western	357	79	271	34.4%	2.9%	17.3%
Eastern	416	983	591	40.1%	35.7%	37.7%
Kennebec Valley	14	794	254	1.4%	28.8%	16.2%
Midcoast	40	40	40	3.8%	1.5%	2.5%
Maine	**1,037**	**2,756**	**1,566**			

Table 4 - Employment Impacts by Region

Table 4 and Figure 2 track the employment impacts by region. Beginning in Aroostook County with Mars Hill in 2006, development employment shifted primarily to the western region from 2008-2011, and then shifted to the eastern region from 2012 on. Through the period analyzed, the eastern region accounts for the bulk of employment with 38%. Large projects under way and planned for the Kennebec Valley and Aroostook regions will bolster employment there in the next several years, but the eastern region will continue to dominate in employment.

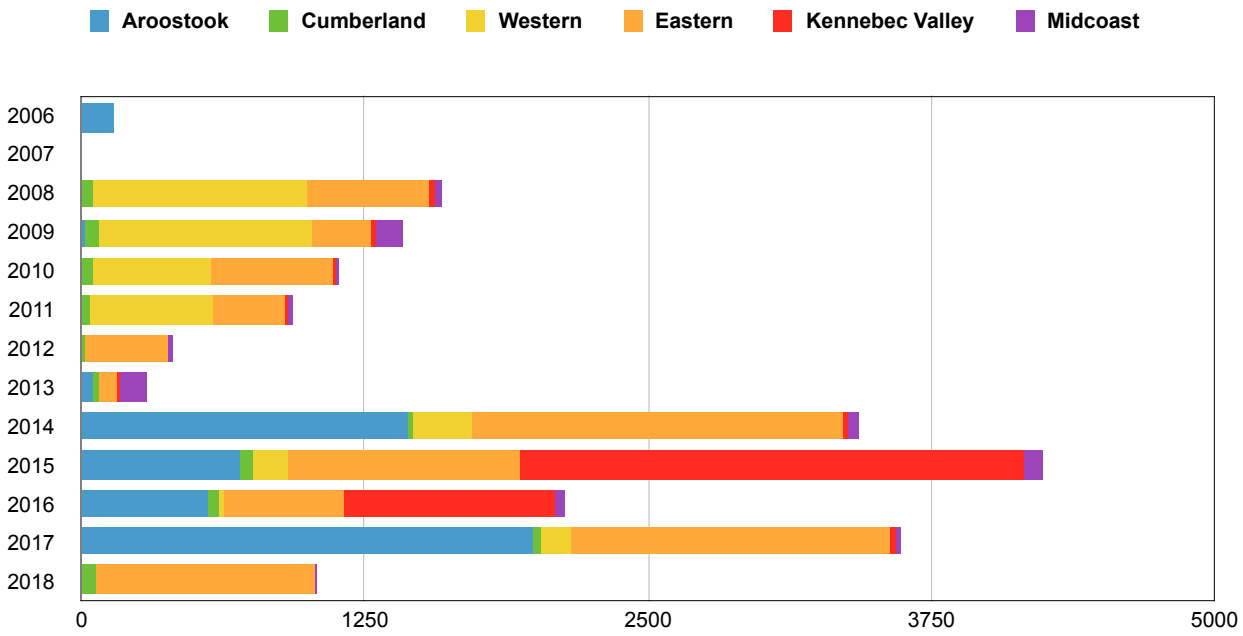

Figure 2 - Estimated Employment Impacts

While the dominant employment impacts are in the regions where the wind energy projects are located, there are employment effects in most of Maine, including Cumberland County, which sees employment gains from the various services that are provided to the wind energy there. York County is the only county in Maine without significant economic impact from wind energy development.

These employment estimates should be considered conservative. That is, they are probably somewhat lower than actual employment effects. This is because the evolution of the wind energy and supporting industries in Maine is continuing throughout the period, with more of the supporting inputs coming from Maine sources. This evolution is not fully captured in the data sets used for analysis because of lags in data reporting.

C. Earnings Impacts

Over 2006-2018, employee earnings increase in Maine by a total $1.137 billion. Projects through 2014 added $453.0 million, and it is anticipated that earnings will increase by a total of $687 million from 2015-2018. 2015 is expected to be the peak year for earnings gains with $256 million added to the economy.

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Aroostook	$5	$1	$0	$1	$0	$0	$0	$2	$63	$36	$31	$102	$8
Cumberland	$0	$0	$3	$3	$2	$3	$1	$1	$1	$4	$3	$2	$4
Western	$0	$0	$39	$41	$26	$27	$3	$0	$14	$10	$3	$8	-$2
Eastern	$0	$0	$22	$13	$27	$17	$19	$7	$86	$60	$36	$87	$66
Kennebec Valley	$0	$0	$1	$1	$1	$1	$1	$1	$2	$140	$67	$8	$3
Midcoast	$0	$0	$1	$5	$1	$1	$1	$7	$2	$5	$3	$2	$1
Total	**$5**	**$1**	**$66**	**$64**	**$57**	**$49**	**$25**	**$18**	**$168**	**$255**	**$143**	**$209**	**$80**

Table 5 - Increases in employee compensation from wind energy development (in Millions)

In this analysis, "earnings" includes wages and salaries paid, employee benefits such as health insurance, and the employer share of social security taxes. It does not include proprietors income, which is the income earned by businesses other than corporations.

The dollar amounts in this table are in constant 2005 dollars because the analysis does not include inflation, so the precise value of, for example, the $168.00 million in earnings in 2014 expressed in 2005 dollars in Table 5 is not estimated. As a rough guide, however, the Consumer Price Index can be used to "inflate" the 2005 dollars to 2014 levels. In this case the earnings estimated for 2014 would be $204.24 million in today's dollars.

D. Operating Period Employment

Once generating power, employment at wind power projects can be divided into two parts. First, each site requires at least one person to perform daily checks of equipment and perform routine maintenance on the site and the equipment. The number of people employed for these purposes varies by site and the number of turbines operating. In estimating operations employment, a rough guideline of 1 employee per 20 megawatts of installed capacity, with the condition that this will not fall below 1 employee. These assumptions yield the figures in Table 6. The analysis of the total employment estimates results in Table 7 and Figure 3 (following page).

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Aroostook	3	3	3	3	3	3	3	3	3	13	13	13	29
Western	0	0	0	0	9	10	13	13	13	16	17	17	17
Eastern	0	0	0	0	6	10	12	12	15	18	27	27	27
Kennebec	0	0	1	1	2	2	2	2	2	2	14	14	14
Mid Coast	0	0	0	0	1	1	1	1	1	1	1	1	1
TOTAL	**3**	**3**	**4**	**4**	**20**	**25**	**31**	**31**	**34**	**50**	**72**	**72**	**89**

Table 6 - Estimated Operating Period Employment by Region

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Aroostook	4	4	4	4	4	4	4	4	4	18	18	18	38
Western	0	0	0	0	18	21	28	28	28	33	35	34	34
Eastern	0	0	0	0	12	21	25	25	32	37	55	55	54
Kennebec	0	0	2	3	5	5	4	4	4	4	34	35	35
Midcoast	0	0	0	0	2	2	2	2	2	1	2	2	2
MAINE	**4**	**4**	**6**	**7**	**41**	**53**	**63**	**63**	**70**	**93**	**144**	**144**	**163**

Table 7 - Estimated Total Employment Effects of Operating Period Employment by Region

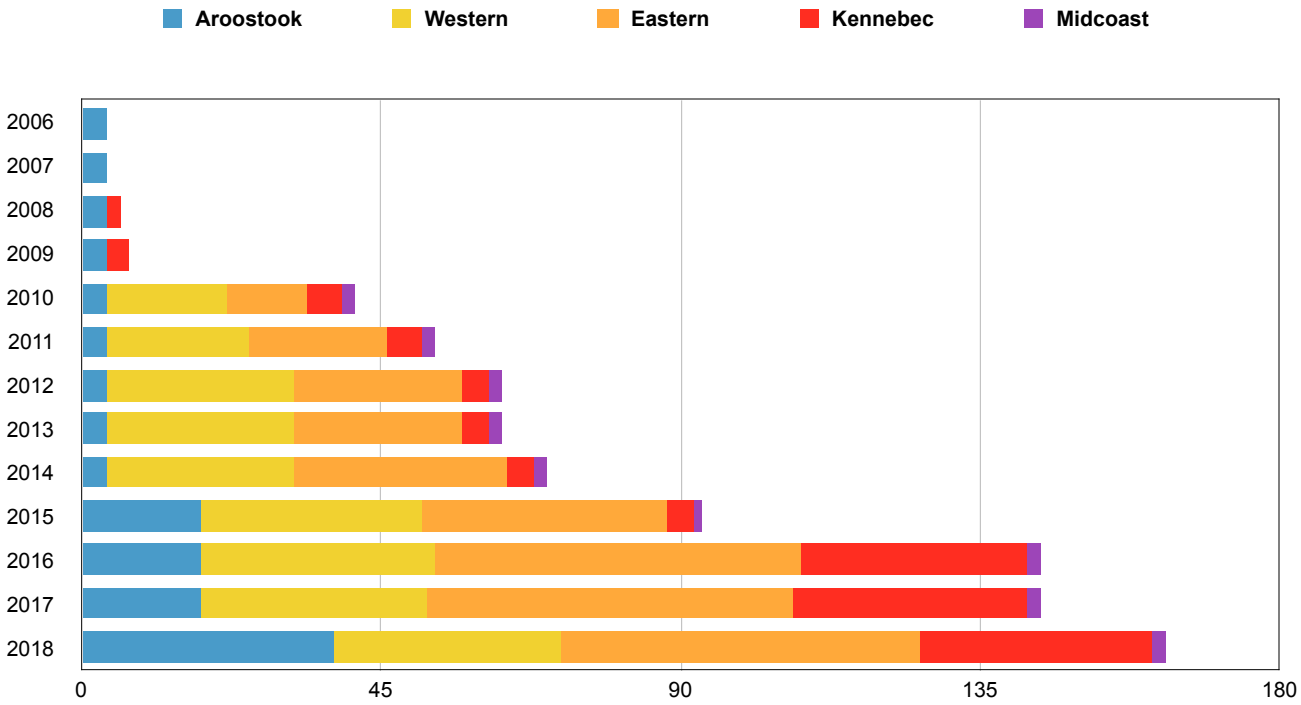

Figure 3 - Estimated Total Employment Effects of Operating Period Employment by Region

The multiplier effect for operating period employment is 1.8 statewide, but varies by region. The smaller economy of Aroostook County means that the multiplier is smallest there at 1.3. The multiplier in the other regions ranges from 2 to 2.4. This indicates that although operating period employment is relatively small, it does have a somewhat larger total employment effect.

The other part of employment during the operating phase occurs when major overhauls of the generation equipment are required, generally every 5-7 years. These maintenance periods require shutting down a turbine, taking it off the tower, conducting the overhaul and repairs, and then reinstalling the turbines. These projects require employment that is similar in scale to phases in the original construction periods.

The exact employment impacts from these operations cannot be estimated as precisely as the construction periods because the timing of these overhauls will vary by company and project. But with over 1300 MW of installed capacity in place after 2018, it is likely that each year will see between 100 and 300 employees engaged on overhaul and major repair operations. With the average construction multiplier of 1.85, this would imply total employment effects of between 185 to 550 employees per year in addition to the operations employment discussed above.

3. Maine Firms Supporting Wind Projects Outside of Maine

A survey of firms conducted by the Maine Ocean & Wind Industry Initiative in 2014 identified sales of $89.6 million by Maine firms outside of Maine over 2011-2013.

The survey had 68 responses about activities working on wind projects in Maine and elsewhere over 2011-2013. Six to eight firms (depending on the year) reported providing services to international projects, while 17-23 firms reported supporting projects in the U.S. but outside of Maine.

	2011	2012	2013
Cumberland	156	101	83
Western	11	13	6
Eastern	32	11	6
Kennebec Valley	52	96	39
Midcoast	184	351	26
TOTAL	434	571	159

Table 8 - Employment impacts of Maine firms supporting wind projects outside Maine

Firms reported that, on average for these three years, 6% of their wind-related revenues were from international projects and 24% was from projects elsewhere in the U.S. The remaining 70% of these firm's wind-related revenues that came from projects in Maine are assumed to be accounted for in data provided by prime contractors.

	2011	2012	2013
Cumberland	$11	$8	$7
Western	$1	$1	$0
Eastern	$2	$1	$0
Kennebec Valley	$3	$6	$3
Midcoast	$8	$9	$2
Total	**$25**	**$25**	**$12**

Table 9 - Wages and salaries from supporting wind projects outside Maine (in Millions)

Table 8 shows the estimated employment in Maine associated with $89.6 million in sales outside of Maine. This activity will normally vary by year, and this is demonstrated in these three years with a low of 159 employees in 2013 following a high of 571 employees in 2012. The average additional employment in Maine during these three years was 388 and total earnings increase of $61.3 million.

As with the estimates of employment from development in state, these estimates from outside Maine activities are very likely conservative. They are derived from a survey with a limited number of respondents and there are likely other companies that had small or one-time involvement outside of Maine and thus would be difficult to include in the sample frame from which the data is derived.

conservation law foundation

For a thriving New England

CLF Maine 53 Exchange Street, Suite 200
Portland, ME 04101
P: 207.210.6439
F: 207.221.1240
www.clf.org

June 29, 2016

Via Electronic Mail
Stacie R. Beyer
Chief Planner
Land Use Planning Commission
106 Hogan Road, Suite 8
Bangor, ME 04401

Re: LUPC Substantive Review of Petition to Remove Milton Twp.

Ms. Beyer:

LUPC has asked for input on whether Milton Twp. should be removed from the expedited permitting area and, in particular, whether the following statutory criteria for doing so are met: First, the removal would not have an unreasonable adverse impact on the States' ability to meet the state goals for wind energy development (Criterion A); and second, the proposed removal is consistent with the principal values and goals of the Comprehensive Land Use Plan (Criterion B). For the reasons below, we believe that removal of Milton Twp. would have an unreasonable adverse impact on the State's wind energy goals and therefore it should remain in the expedited permitting area.

The Conservation Law Foundation uses the law, science and the market to create solutions that preserve our natural resources, build healthy communities, and sustain a vibrant economy. Our principal focus is on climate change, both addressing its root causes and promoting solutions to its challenges. To that end, CLF has been a long and consistent supporter of renewable energy such as wind energy. Appropriately sited, wind energy projects provide clean energy and benefit local communities and businesses.

Maine has aggressive goals for wind energy development, including 2,000 MW by 2015 and 3,000 MW (including 300 or more from facilities in coastal waters) by 2020. With less than 1,000 MW currently operating or under construction, Maine is far short of those goals. While there are several large wind energy projects currently proposed in Maine, mid-sized projects, similar to the proposal to develop approximately 40 MW in Milton Twp., are what have been developed in Maine to date. These are the types of projects that will be critical if Maine is going to make meaningful progress toward meeting its goals for wind energy development.

At this time, CLF cannot comment on the specific resources that may be present and impacted in Milton Twp. as is necessary before any project receives a permit from DEP. From a planning and zoning perspective, however, keeping wind energy as an allowed use in Milton Twp. is appropriate based on location and surrounding land uses. Milton Twp. is surrounded by organized towns, including Rumford, which has a paper mill and natural gas plant. The Spruce Mountain Wind Project is located in the adjoining town of Woodstock, and the Record Hill Wind Project is located north of Milton Twp. This is not an area within the jurisdiction's remote core that hosts more sensitive recreational or other resource values and where development may not be appropriate. Instead, it is the type of area where LUPC has traditionally encouraged development and where we believe development is best suited.

It is no secret that there are some groups who seek to prevent any further development of wind energy in Maine, contrary to Maine's legislatively set goals for wind energy development by 2020. Removal of a viable and suitable area for wind energy development such as Milton Twp. would unreasonably impede the State's ability to meet its goals and therefore we believe the area should remain within the expedited permitting area.

We appreciate the opportunity to provide comments to LUPC on this petition.

Very truly yours,

Sean Mahoney
Executive Vice President
Director, CLF Maine

CommunityConcepts
finance corporation

240 Bates Street
Lewiston, ME 04240
Phone (207) 795-4065

17 Market Square
South Paris, ME 04210
Phone: (207) 743-7716
www.ccfcmaine.org

RECEIVED
JUN 29 2016
LUPC - DOWNEAST

June 22, 2016

Stacie R. Beyer; Chief Planner
Maine Land Use Planning Commission
106 Hogan Road, Suite 8
Bangor, ME 04401
Stacie.R.Beyer@maine.gov

Dear Stacie:

On behalf of Community Concepts Finance Corporation (CCFC), the organization funded by Oxford County to provide economic development services I am writing to request the Commission keep Milton Twp. in the expedited permitting area for wind power. CCFC acts as a catalyst for economic growth that contributes to the quality of life and overall prosperity of Oxford County's business community, 36 municipalities and unorganized territories through collaboration with a variety of private, public and nonprofit partners.

We believe keeping Milton Twp. zoned to allow an expedited review for wind power projects is appropriate. Working to expand opportunity, bring jobs and economic development to Oxford County, we see firsthand how difficult it is to attract quality jobs and businesses that will provide the capital to grow our region. While there are many successful wind development projects nearby – such as Spruce Mountain, Sunday River and Record Hill, the region continues to suffer with a downturn in the forest products industry as well as job losses in the manufactured housing industry.

Wind energy projects have had a significant impact on Maine's economy over the last decade. According to the, Economic Impacts of Wind Energy Construction and Operations in Maine, study done by the University of Southern Maine - over $532.5 million has been spent in Maine on projects from 2006 to 2014. An additional $745.1 million is anticipated, bringing the projected total spending in Maine on wind power to $1.28 billion by 2018. These investments have created or will create or support an average of 1,560 jobs per year from 2006-2018, with the largest employment expected in 2015 at over 4,200 jobs. Oxford County and Western Maine have benefited from some of these projects, and we hope more of this economic activity comes to our region.

There is no question that changing the zoning for Milton Twp. would remove a potential form of economic development needed more now than ever. One thing we have consistently heard from the business community is the need for regulatory consistency and predictability. Changing the zoning not only introduces uncertainty, but it would create an additional regulatory burden to what is already a difficult and significant permitting process. The lengthy and expansive DEP permitting process provides the opportunity for stakeholders to have a voice in any development proposal. As we have seen around the state - the current system works. Good

projects have been permitted, while others have been denied or never made it to the application stage.

We ask that you do not change the process and zoning for Milton Twp. Instead, keep Milton Twp. in the expedited permitting area so a project can be developed, proposed, and evaluated fully by the DEP to determine whether it should proceed.

Yours in Service,

Glen E. Holmes
Director of Operations

RECEIVED
JUN 29 2016
LUPC - DOWNEAST

From: dwayneb @megalink.net
To: Beyer, Stacie R
Subject: Milton Plantation Wind Farm
Date: Wednesday, June 29, 2016 2:32:34 PM

Ms. Beyer, Comments on Ever Power Milton Project

Criterion A

A petition from the Citizens of Milton Plantation has been submitted to Maine Land Use Planning Commission for the removal from the "Expedited Permitting Area". As a Bethel Resident living less then 1 1/4 miles from all proposed towers just across the town line I would agree with the Citizens petitioning for the removal from "Fast Track" and "Expedited Permit Area". With the millions of acres in Maine, I can not believe the state can't meet the goals of there objective. Being a state with values like Welcome to Maine ! "The way life should be " Or "Vacationland," I must wonder why we would let this destruction of land and views be destroyed forever in a four season Vacation/Living area ? Again there are millions of acres in Maine to consider.

Criterion B

The Western Maine Mountain area is priceless. The 5 top industries in Maine are vital to this areas comprehensive Planning Healthcare, Retail, Tourism, Educational Service's, and Construction. With the closures of 5 Mills, Logging company's and the Recession of 2008 The Towns of Bethel, Woodstock ,Greenwood and surrounding towns have done a great job developing Maine's top 5 Industries. Examples are Mt. Abram and Sunday River Ski Resort, which has grown the construction of first and second homes. None of this well planned and organized growth was "Fast Tracked" It followed a fair due process so all parties involved could be WELL informed. All environmental issue were addressed. We can not forget that in planning we try to make things harmoniously fit. Fast Tracking Turbines, that Ever Power would like to build would not fit the economic interests of this region.

Dwayne Bennett
729 Rt. 232
Bethel Maine

Emily Ecker
168 Cushman Hill Rd.
Woodstock, Maine 04219
207-357-9954
eecker@gmail.com

June 28, 2016

Ms. Stacie Beyer
Maine Land Use Planning Commission
Chief Planner, Acting Capacity
106 Hogan Rd., Suite 8
Bangor, Maine 04401

Dear Ms. Beyer,

I am writing in strong support of removing Milton Township in Oxford County from the Expedited Permitting Area for Wind Energy Development.

I live in the town of Woodstock and supported the Spruce Mountain Wind project that currently has ten turbines. Patriot Renewables LLC, the developer, made great efforts to communicate with with the Woodstock planning board, selectmen, and town manager to permit the project. The outcome was that the majority of the community supported the project and it was an economic benefit to the town and the State of Maine.

In contrast, Everpower, the developer of the Milton Wind Project been very secretive. Town selectmen and managers in the neighboring towns, most likely impacted, were not contacted and hardly knew anything about the proposed project. To this day, there is scant information about the project. Everpower's process has resulted in an atmosphere of self-created mistrust.

While Milton is in the expedited zone, the project will be literally on Woodstock's border and extremely close to Bethel. The neighboring town of Greenwood will also be impacted. All of these incorporated towns are out of the expedited zone. There is a strong disconnect here in terms of regulatory oversight of towns – one unorganized in the expedited zone and the other organized towns in the unexpedited zone.

If Everwater's proposal is approved, there will be a total of 22 turbines. This increased total density in a relatively small area that is highly dependent on tourism, and has many neighboring residents, should require a rigorous review.

There is no apparent decrease of the two criteria upon which to judge whether or not Milton should be kept in the expedited zone.

> *Criterion A.* The proposed removal will not have an unreasonable adverse effect on the State's ability to meet the state goals for wind energy development in [Title 35-A] section 3404, subsection 2, paragraph C.
>
> *Criterion B.* The proposed removal is consistent with the principal values and the goals in the comprehensive land use plan adopted by the Maine Land Use Planning Commission pursuant to Title 12, section 685-C.

Local residents in Woodstock, Bethel and Greenwood or Milton, whether or not they are in the expedited zone, should be protected by a full range of available state and local review for industrial scale development in their communities.

Therefore, I strongly request that Milton be removed from the Expedited Permitting Area for Wind Energy Development.

Sincerely,

Emily Ecker

cc: Senator John Patrick, Maine Legislature

From: Ed Rosenberg
To: Beyer, Stacie R
Subject: Milton Township wind power petition
Date: Wednesday, June 29, 2016 5:00:09 PM

By listening to the will of the people of Milton who signed the petition to have Milton Township removed from the Expedited wind power development area will allow full due process and adequate time for a full review by all interested parties and there would be no adverse impact on the policy goals for power generated by wind.

Lack of Transparency: Ever Power says they don't know where these towers would be built but they have been secretly meeting with individual land owners where towers would be sited or land that abuts where towers would be located for over 2 years offering large sums of money from $12,000 to 25,000 per year for 20 years to sign neighborhood agreements requiring that land owners not speak out against the wind power project.

The abutting towns of Woodstock, West Peru, Bethel and Rumford did not learn of this prospective wind tower development project until 3 weeks ago. Woodstock, West Peru and Greenwood selectmen have sent letters objecting to Milton Township not being taken off the expedited wind power development list. Other towns would have sent letters, but the selectmen are not meeting again before June 29th.

Mahoosuc Land Trust, which monitors the conservation easements on two parcels of land on each side of the lots on top of Chamberlain Mountain on property that the nature conservancy had formerly owned was not aware of this prospective wind development project.

Expedited Areas are intended to reward "well –sited projects", however there is no evidence that this site is well-sited. Only recently has the meteorological tower been placed in the area and no data has been shared by Ever Power for consideration by Milton Township or the surrounding towns.

I own an 11.5 acre lot less than 1 mile from the summit of Chamberlain Mountain and 30 acres of land at the top of my land off of Cushman Hill Road that 4 of my children plan on building homes that face Chamberlin Mountain less than 2 miles away and less than 500 feet below Chamberlain in elevation. We all deserve full due process as this impacts all of our futures not some process that has to be completed in 180 days.

Ed Rosenberg
PO 210
Bryant Pond, ME 04219

From: Graham Dodge
To: Beyer, Stacie R
Subject: upcoming hearing on Aug 10
Date: Wednesday, June 29, 2016 2:57:53 PM

Stacie R. Beyer

Maine Land Use Planning Commission

106 Hogan Road, Suite 8

Bangor, ME 04401

Dear Ms. Beyer,

I am in favor of the wind turbines and believe that keeping wind power as an allowed use is consistent with the current uses, activities and objectives for Milton Township. While I am not a full-time resident, I believe that we need to invest in renewable, clean energy and that the benefits outweigh the costs in this case. To that end, I would like to see the proposal move forward in the most thoughtful and responsible way possible.

Thank you for your consideration.

Sincerely,

Graham Dodge

From: Heather Brown
To: Beyer, Stacie R
Subject: upcoming hearing on Aug 10
Date: Wednesday, June 29, 2016 3:03:05 PM

Stacie R. Beyer
Maine Land Use Planning Commission
106 Hogan Road, Suite 8
Bangor, ME 04401

Dear Ms. Beyer,

I am in favor of the wind turbines and believe that keeping wind power as an allowed use is consistent with the current uses, activities and objectives for Milton Township. While I am not a full-time resident, I believe that we need to invest in renewable, clean energy and that the benefits outweigh the costs in this case. To that end, I would like to see the proposal move forward in the most thoughtful and responsible way possible.

Thank you for your consideration.

Sincerely,
Heather Dodge

From: Jenifer Taylor
To: Beyer, Stacie R
Subject: Proposed Bryant Mt. Wind Project
Date: Wednesday, June 29, 2016 10:30:26 AM

June 29, 2016

Dear Stacie,

We would like to submit our comments in support of the wind project in Milton Twp, ME.

I fully support the wind mill project in Milton Twp Me because I feel it will benefit our area in more ways then just a power source. As a parent of children in our local school district I feel the funding of different school programs will greatly improve our children's future! Also the tax revenue that town will receive will help repair our roads that are in GREAT need of improvement!!!

Please add my comment in support of this wind mill project!

Regards,

Jenifer Buck

1073 Rte 232 Milton Twp Me

Bancroft Contracting Corporation

23 PHILLIPS ROAD SOUTH PARIS, ME 04281
Tel (207) 743-8946
Fax (207) 743-0636

June 20, 2106

Stacie R. Beyer
Maine Land Use Planning Commission
106 Hogan Road, Suite 8
Bangor, Maine 04401
Stacie.R.Beyer@maine.gov

Dear Stacie:

Please accept this letter as support for keeping Milton Township in the expedited permitting area for wind power. As President of Bancroft Contracting Corporation, I'm supportive of any economic development activity that has the potential to benefit my company, the hardworking people I employ, and the region in general.

Bancroft Contracting Corp., founded in 1977 and headquartered in South Paris, Maine, is roughly 20 miles from the proposed development site. We employee from 160 to 225 people depending on seasonal demand. We work actively to maintain and grow our workforce. Supporting efforts such as this is one way we try to ensure opportunities exist for our business and employees.

Having undertaken projects in the wind power industry Bancroft is familiar with the needs of the industry. We believe Milton Township is a suitable place for a wind project. Surrounding towns already have large scale commercial development including Spruce Mountain in Woodstock, Record Hill in Roxbury, and the mill in Rumford. And, it's my understanding that the site is well-positioned with relation to transmission lines, so the cost and environmental impact of additional transmission infrastructure would be limited.

Having grown up and lived most of my life in the general area, I know the importance of snowmobiling, ATVing and outdoor recreation to the residents and visitors of the region. Wind power is not inconsistent with those activities. Neither is forestry or timber harvesting, which much of the region was built upon and many people and businesses still rely on today.

It is often said that Maine is a tough place to do business due to regulatory burden and inconsistency. I see it firsthand in my line of work and this situation is one more example. The Legislature zoned Milton Township and places like it for 'expedited' permitting because it met the criteria for wind development. Removing it from the 'expedited' area would send a negative message to not only potential wind developers, but to any other business seeking a stable regulatory environment. The DEP permitting process is a robust one that allows ample opportunity for stakeholders to have a voice in any development proposal. Keeping Milton Township in the 'expedited' area would allow the DEP process to play out as envisioned by the Legislature. It will also send a message to potential developers that Maine is a place worthy of doing business.

It is for these reasons that I respectfully request that Milton Township be kept in the 'expedited' area. In an area lacking economic opportunities, this project has the potential to bring jobs and investment to the region.

Please do not hesitate to contact me should you have questions.

Respectfully submitted,

Mark Bancroft
President

Maine Forest Products Council

The voice of Maine's forest economy

Companies represented on the MFPC Board

American Forest Mgmt.
Anderson Equipment
Baskahegan Co.
BBC Lands LLC
Cross Insurance
Family Forestry
Farm Credit East
Fontaine Inc.
Hancock Lumber
H.C. Haynes
Huber Resources
Innovative Natural Resource Solutions
J.D. Irving
JM Cote Co.
Katahdin Forest Mgmt.
Key Bank
LandVest Inc.
Limington Lumber
Louisiana Pacific
Maibec Logging
Nicols Brothers
Pingree Associates
Pleasant River Lumber
Plum Creek
Prentiss & Carlisle
ReEnergy
Richard Wing & Son
Robbins Lumber
Sappi Fine Papers
Southern Maine Forestry
Stead Timberlands
Timber Resource Group
Timberstate G.
Verso Paper
W.T. Gardner & Sons

Date: June 29, 2016

To: Chairman Commissioners, Land Use Planning Commission

Cc: Nick Livesay, Executive Director, Land Use Planning Commission

From: Patrick Strauch, Executive Director, Maine Forest Products Council

Re: Substantive Review; Milton Township petition

We would like to include the enclosed policy paper in the record of the LUPC substantive review of the Milton Township Petition for removal from the Expedited Wind Power Zone.

Sincerely,

Patrick J Strauch

535 Civic Center Dr., Augusta ME04330 207-622-9288 info@maineforest.org www.maineforest.org

Maine Forest Products Council

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Wind power in the managed forest

Comments by the Maine Forest Products Council for the LUPC wind power zoning review process

The Maine Forest Products Council (MFPC) represents more than 300 member companies, including logging contractors, paper mills, biomass energy facilities, pellet manufacturers sawmills and the owners of more than 9 million acres of commercial forest land, most located within the LUPC jurisdiction. For the reasons discussed below, we believe it is important for LUPC to keep areas currently zoned to allow wind power in the expedited permitted area. Wind power provides important economic benefits to landowners that host such projects. It's important to know that it is compatible with traditional forest uses and therefore will help maintain Maine's working forests, which are the cornerstone of the Maine economy. Finally, the Maine DEP has a robust permitting process in place to ensure that any specific site is appropriate for wind development and that potential impacts are adequately addressed.

Introduction

Maine's forest products industry has an $8.5 billion annual economic impact, including 33,538 jobs, according to a 2016 study by the University of Maine. Timber production is the primary economic activity on our forestlands, but the $1.2 billion agriculture and $8.2 billion tourism industries also rely on forestland.

Since natural resource commodities vary in return in the marketplace -- saw log crops, for example, take at least 70 years to mature -- forestland owners need opportunities to diversify income from their land. That helps them stabilize their investment and supports their core function of sustainable forest management. Other export products that have been traditional parts of the forest economy include water and ice, hydropower, sand, gravel and granite.

Innovation not only is critical to diversifying landowners' income, but also in long-term sustainability. Mainers have a long tradition of creating new products for changing needs and the forest products industry has been remarkably adaptable. In fact, lack of innovation and capital investment usually is the downfall of uncompetitive manufacturers.

Our industry already is adapting to the challenges in national and international fiber markets. For example, the types of paper being produced is moving away from media print and toward tissue and packaging and labeling paper. Oriented strand mills in

535 Civic Center Dr., Augusta ME04330 207-622-9288 info@maineforest.org www.maineforest.org

Easton and Houlton manufacture specialized chipboards used throughout North America in modern home construction. The domestic and international markets for wood pellets for both thermal and electrical needs are growing. Innovation in wood extracts is a rapidly growing opportunity as well.

Landowners, too, are adapting by expanding their income streams through traditional means, such leasing small areas of land as recreational camps, and more modern activities, such as long-term leases for cell phone towers.

Wind energy projects can diversify forest landowners' investments

Energy production in Maine's forests also has a long tradition, but changes are occurring here as well. Hydropower and biomass energy have been used since before Maine became a state. Now wind power has become an affordable energy source without fuel cost or air emissions. For some landowners, wind power can be part of a long-term sustainability plan and it is compatible with other forest uses.

Record Hill wind project in Roxbury

Wind power projects are an opportunity for those who own land with higher wind value that is not far from transmission lines. As the transmission system is built throughout the state, wind resources near these lines can be used to meet the needs of the regional electric system for generation diversity, price stability and reduced carbon emissions.

Installation of wind power facilities on forested acres is a very small percent of the acreage base – commonly less than 1 percent – and will not alter sustainable harvest goals for the state. The sites best for wind are often the worst for growing trees, as the soils are thinner and less productive and the conditions are more severe. Pads range from .5 to 2.5 acres, depending on turbine size.

The Record Hill project in Roxbury, for example, is at about 2,100 feet elevation and the difference in the height and quality of the trees from the lower edge of the parcel to the higher ridge is very noticeable.

Wind projects also bring an additional benefit for landowners: Improved road quality and increased access to areas where access might otherwise be too expensive. Skidding distances also are reduced; forest fire protection is enhanced and some recreation activities are easier to access. Wind power does not interfere with the traditional recreational uses that many landowners allow, including hunting and snowmobiling.

Wind power expedited zones and landowner rights

Revisiting an established zoning determination is a significant precedent that is being established in the LUPC jurisdiction, even if the window of opportunity is limited. In the expedited wind power process, a petitioner can request a zoning change on expansive parcels of land that they do not own. This precedent is concerning to MFPC members regardless of whether they benefit from wind projects on their land. We urge the Commission to carefully examine this process in the light of the policy precedent for other zoning changes for a variety of land uses. Should a small but vocal minority of residents be able to determine the opportunities for zoning on the majority of the township in which they reside?

Honoring the rights of landowners and the participation of residents and property owners is an established criterion in the LUPC Purpose and Scope statute. Similarly, you are encouraged in the statute to "encourage and facilitate regional economic viability." Zoning decisions are only the first step in a process of establishing wind power projects, which relies on a comprehensive permitting process to evaluate site-specific issues.

Forest landowners want to be able to manage their land and natural resources in compatible, sustainable ways. As uses for forest resources change, landowners expect and need to have the ability to adapt and access new markets. Land use zoning should allow for innovation and adaption with these resources.

Impacts on neighbors, both real and perceived, are considered during the regulatory permitting process. Zoning should not obstruct the opportunity for a beneficial land use to adapt and balance with other uses in each location.

Summary

- Landowners need diverse income streams to balance the cyclical nature of wood pricing and the long time frames for returns on investment.
- Wind power facilities are compatible with the "Working Forest" model important for Maine's economy.
- The footprint of pads, roads and transmission lines is a small percentage of the forestland base.
- Increased forest management intensity can result in the site location of these projects, but the restrictions still allow operable forest operations to occur at the foot of these structures.
- While taxes on a lease area are very significant, the remaining properties in the town or LUPC can enjoy significant tax relief, in some cases as much as a 10 mill difference in the tax rate.
- Just like 2 x 4s, electrons from Maine's forests can help some landowners stabilize investment and sustainably manage forestland.
- Landowner rights are a statutory consideration in reversing previous zoning decisions.

Date: June 29, 2016

To: Commissioners, Land Use Planning Commission

Cc: Nick Livesay, Executive Director, Land Use Planning Commission

From: Jeremy Payne, Executive Director, Maine Renewable Energy Association

Re: Substantive Review; Milton Township petition

On behalf of the Maine Renewable Energy Association, thank you for the opportunity to submit the following comments regarding the petition to remove Milton Township from the expedited wind permitting area ("EPA").

Since the passage of LD 828, which created the ability for residents of Milton Township to petition the Land Use Planning Commission ("LUPC") to remove land they do not own from the EPA, the statute now requires that the commissioners consider two items when examining this petition: 1) will Milton's proposed removal have an unreasonable adverse effect on the state's ability to meet its wind power goals; and 2) is the proposed removal consistent with the Comprehensive Land Use Plan ("CLUP").[1]

What we know is that EverPower Holdings, Inc. is interested in siting a 40MW project, the Bryan Mountain Wind farm ("BMWF"), in Oxford County. Under current law, and without Milton's removal, the BMWF would go through a rigorous regulatory permitting process before the Maine Department of Environmental Protection ("MDEP"). Additionally, this process affords plentiful opportunity for input from local residents. In recent years, some have tried to describe Maine's wind energy laws as "rubber stamped" – nothing could be further from the truth. In fact, our wind permitting process takes approximately 10 months for MDEP to complete(and is anything but a guaranteed approval) – and this does not include any of the appeals processes afforded to project opponents. All told, the permitting process and appeals can place at risk the investment capital for up to three years. When most people hear the word 'expedited,' I doubt they expect the process will take 36 months to receive an answer. I hear from prospective developers and investors often, and the uncertainty associated with permitting a wind farm would only be exacerbated by allowing Milton Township to be removed.

Currently, Maine has 710 megawatts ("MW") of installed and operational wind farms – this means the state has already come up substantially short in its statutory goal of hosting 2,000 MW by 2020. The next goal is to host 2,700 MW by 2020[2] -- if the state is to achieve that goal, and given the uncertainty of today's permitting process, removing Milton Township would absolutely create an unreasonable adverse impact on the state's ability to meet its wind goals.

[1] http://www.mainelegislature.org/legis/bills/bills_127th/chapters/PUBLIC265.asp
[2] http://www.mainelegislature.org/legis/statutes/35-A/title35-Asec3404.html

Further, introducing a new level of uncertainty may have the effect of chilling the investment climate and causing companies to choose other states to deploy their capital. As has been stated repeatedly by Governor Paul LePage, "investment capital goes where it is welcome, and stays where it is appreciated." Adding an additional layer of regulatory approval for the BMWF may scare off this **$**104 million investment and harm the state's ability to meet its statutory goal.

This area of the state is certainly familiar with the investment and employment that accrues to Maine from the wind industry. Currently, Oxford County hosts three wind farms – Record Hill, Spruce Mountain, and Canton – totaling 93MW. In fact, Dr. Charlie Colgan found that Western Maine (which includes Oxford, Franklin and Androscoggin Counties) from 2008-2016 has received more than $160 million in employee earnings.[3] And consistent with that type of investment, the CLUP recognizes the societal importance of hosting energy facilities, and specifically encourages them to be sited in areas consistent with those found in Milton Township.

From a statewide perspective, wind development has been an economic boon for Maine. Again, Colgan found that from 2006-2014 over $530 million was spent in Maine on wind farms. 1,560 jobs annually were created or supported by these investments. This investment is projected to grow to increase to $745 million – or a total of $1.28 billion by 2018.

Importantly, the benefits of hosting wind farms in Maine also extend to protecting our environment. Sustainable Energy Advantage analyzed the emissions benefits of Maine wind farms and found the following benefits from operating projects[4]:

- In 2013, reduced CO2 emissions by 490,000 tons – the equivalent of eliminating CO2 pollution from 94,000 cars;

- By 2020 will reduce CO2 emissions by an additional 2 million tons – the equivalent of removing pollution from more than 400,000 cars; and

- In 2013, eliminated sulfur oxide (SOx) emissions by 201 tons; and nitrogen oxide (NOx) emissions by 123 tons – notably, pollution from SOX and NOX emissions are known to cause acid rain, smog, acidification in lakes, rivers and oceans, and respiratory and cardiovascular illnesses.

Further, the citizenry of Maine has long supported the harvesting of its natural resources – especially for energy (e.g. biomass, hydropower) – including the development of wind farms in certain areas of the state. According to a poll compiled by Goodwin/Simon Strategic Research in August of 2013, 87% of a broad cross-section of Maine people believes "wind power is the type of zero emission, clean and renewable energy source that should be encouraged in Maine."[5]

In conclusion, if Maine is to meet its wind power goals, and continue to benefit from the economic, employment, and clean air benefits of wind farms, it needs projects such as BMWF in Oxford County to be able to count on the fact their investment capital will be both welcomed and appreciated.

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[3] http://www.windforme.org/pubs/Colgan-Report-2015.pdf

[4] http://www.windforme.org/pubs/Emissions-Report-2015.pdf

[5] http://www.windforme.org/pubs/WindForME_Press_121213.pdf

From: pjml @megalink.net
To: Beyer, Stacie R
Subject: Milton Plantation Expedited Area
Date: Wednesday, June 29, 2016 2:14:29 PM

Dear Ms. Beyer and Commissioners:

I would like to make known my support for keeping Milton Plantation in the expedited area for commercial wind power projects.

It is a resource based form of development consistent with the State's energy goals. There is existing transmission infrastructure available in this area. The use of land on which the project would be located (as well as neighboring land) is compatible with wind energy; it is a synergistic use that allows timber harvesting and recreational use (hunting, hiking, snowmobiling, etc.) to continue alongside wind energy generation.

I am a woodland owner in Milton Plantation and am in support of wind power development in this area.

Thank you.

Sincerely,

Paula JM Lamb

June 26th 2016

Stacie R Beyer,
Chief Planner
106 Hogan Rd, Suite 8
Bangor, Maine 04401

To whom it may concern,

My name is Rev. Ronnie P. Floyd and I am a part-time resident at 154 Roger Farnum Road in Milton Plantation. Although because of the nature of my work I am at present required to live where I am assigned to, Milton Plantation is the only place I call my own, the place I go whenever I can get away for a few days, and where I plan to spend my retirement. Thus, I have a vested interest in not only the value of my property but also the environment of our valley. I write to you to oppose expedited status for the development of wind farms in our region. Although in general I believe people have the right to do what they want with their own land, when their choices adversely affect their neighbors in serious ways it strikes me that local communities should have a say in the ways other people's choices affect them and their property. People buy property in Milton Plantation precisely because it is remote and pristine. Although there is no expectation that it will stay this way forever nature teaches us that gradual growth is always preferable to rapid cancerous expansion.

The people living in our unincorporated territory are by and large lower income working people; they choose to live far away from economic opportunities in more developed areas because they value the quiet beauty of our area. Herein lies my biggest objection to expedited status for the development of wind turbines in our area. We don't have a lot of resources financially to hire a cohort of fancy lawyers or spend huge amounts of time writing letters and staying involved. The developers of wind power depend on this fact along with the low value of land when they develop wind in rural areas like ours because time and time again richer, ironically enough pro-Wind, elites have rejected wind in their own back yards. I am currently assigned in Hyannis, Massachusetts. Yesterday walking through Hyannis port, past million dollar houses including the famed Kennedy Compound, I looked out over the beautiful vistas of Natucket Sound and thought to myself, thank God they didn't develop wind off shore. Wind failed in the Sound because of the millions of dollars of lobbying resources and influence of these property owners. Just down the road in slightly less rich Falmouth they built the turbines, which are now turned off as a result of resident complaints about noise, health effects, and the impact of property values. Our nation was built on the idea of equal protection under the law, and it would be a travesty of justice if places like Hyannis Port and Falmouth where many of the most vocal proponents of wind live are protected from wind farms while poor areas like Milton Plantation have wind forced upon them with no local oversight or consideration of the impacts or opinions of working class local residents. The point is not to stop the creation of wind farms, but to give poor people in rural areas the same protection that the law gives rich people in places like Falmouth and Kennebunkport.

Finally, I am not a specialist, I am sure you have those on both sides of the issue who can tell you about the numerous environmental impacts of this supposedly environmentally friendly energy source, but let me ask a few questions. I would point out that many residents close to turbines complain about a variety of health impacts from the so-called "farm flicker". What recourse will local residents have if they experience similar adverse health impacts? Will the wind farmers pay their medical bills? Will they buy them out and help relocated them to somewhere else? And if so at what price(?), the depressed price that the wind farms cause? Also, as many of my neighbors and I are hunters what impact will these farms have on

game in the area? Like most hunters I am a conservationist who believes in protecting bio-diversity, what impacts will these turbines have on species in the area including birds, which I understand are in great danger from these turbines and species like *Myotis lucifugus,* a bat which is a native to our region and already endangered? Maine has lost more than 90% of its *cave bat* population in recent years and evidence shows that these helpful creatures, which eat bugs (God knows we have enough these), are attracted to wind turbines, what other species will be killed off or be massively impacted by wind farms in are area? People have a right to know the answers to the simple questions and it is the duty of government to protect our rights by demanding that a legal process be observed even in poor rural areas like Milton Plantation. In fact I would argue that perhaps the state's duty to protect our areas is greater than others because of the inability of local residents to effectively advocate for themselves against power companies. We would not allow a hydro-electric, nuclear, or clean-coal plant to be built without oversight, where is the equal protection in allowing this politically favored business to go unregulated?

The question seems simple to me: do we respect the rights and opinions of local residents by maintaining the normal process for rezoning that allows time for studies, debate, and serious consideration or do we short circuit the process so that an out of state energy concern can quickly change the face of our valley in order to turn a buck? It seems to me that it is governments job to protect the weak to ensure that there is equal justice under law, and not special justice for those with means or political influence. I understand that the state has set goals for wind power production, but I hardly believe that the only way to achieve these goals is by removing the protections of due process that a normal zoning process affords those without resources. My hope is that you deny expedited status to wind farms in our region of Oxford County.

Respectfully,

Rev. Ronnie P. Floyd

From:	trey dodge
To:	Beyer, Stacie R
Subject:	LUPC Petition
Date:	Wednesday, June 29, 2016 2:36:56 PM

I wanted to make sure to get my opinion in before the deadline.
I am in favor of the current wind power as an allowed use as I feel it is in use with other activities and objectives. I am a property owner in Milton Township through Chamberlain LLC.
Furthermore I am in favor of most forms of renewable energy, especially domestic ones.
Thank you for your time.
Regards,
Trey Dodge

From: Jenifer Taylor
To: Beyer, Stacie R
Subject: Proposed Bryant Mt. Wind Mill Project
Date: Wednesday, June 29, 2016 10:46:08 AM

June 29, 2016

Dear Stacie,

I would like to submit my comments in support of the wind mill project in Milton Twp ME.

I support the wind mill project in because as a construction worker, and having to travel our roads every day, they are in need of critical attention and repair!! The funding our schools would receive would greatly help different programs that are in need of extra funding the our school district can not afford on its own. The jobs the project would create while under construction would not only benefit our area but surrounding areas!

Please add my comment for support of this project.

Sincerely,
Wayne Buck Jr
1073 Rte 232 Milton Twp Me

RECEIVED
JUN 29 2016
LUPC - DOWNEAST

Town of Woodstock, Maine
Est. 1815
PO Box 317
Bryant Pond, ME 04219
Phone 207-665-2668 FAX 207-665-2667
E-Mail bp7ring2@megalink.net

Stacie R. Beyer
M.L.U.P.C.
106 Hogan Road
Bangor, ME 04401

June 13, 2016

Dear Stacie,

The Woodstock Board of Selectmen respectfully request that the Land Use Planning Commission remove Milton Township from the Expedited Permitting Area For Wind Energy Development. We do so for several reasons, foremost of which is our obligation to the citizens of Woodstock who, because of our contiguous border with Milton Township, will be in jeopardy of negative impacts to their property values, scenic views and quality of life.

Woodstock currently has ten wind turbines in operation and in 2013 enacted a Commercial Wind Energy Facility Ordinance that among other things requires a minimum setback of one mile to the property line of any non-participating property owner. In addition, there are sound restriction requirements.

We, the Selectmen of Woodstock, only recently learned of a potential 12 turbine wind farm that may have very serious consequences not only for Woodstock and Milton Township residents, but also for our neighboring communities of Bethel, Rumford and Greenwood.

We strongly feel that any wind farm developer should be obligated to inform and work closely with the communities to be impacted. This has not occurred.

In order for elected officials of a community to carry out due diligence on behalf of the community which they represent we must be fully informed. We must also have time, which the expedited permitting process limits and which also limits the standards of review when evaluating visual impacts as well as negative impacts to the natural environment.

Our greater community gains much of its economic vitality from outdoor activities and scenic views. Any potential negative impact must be weighed carefully.

Please, give us the opportunity to fulfill our elected obligations.

Thank you for considering our request.

RECEIVED
JUN 29 2016
LUPC - DOWNEAST

Sincerely,

Ronald Deegan | Stephen Bies | Michael Nadeau

Woodstock Board of Selectmen