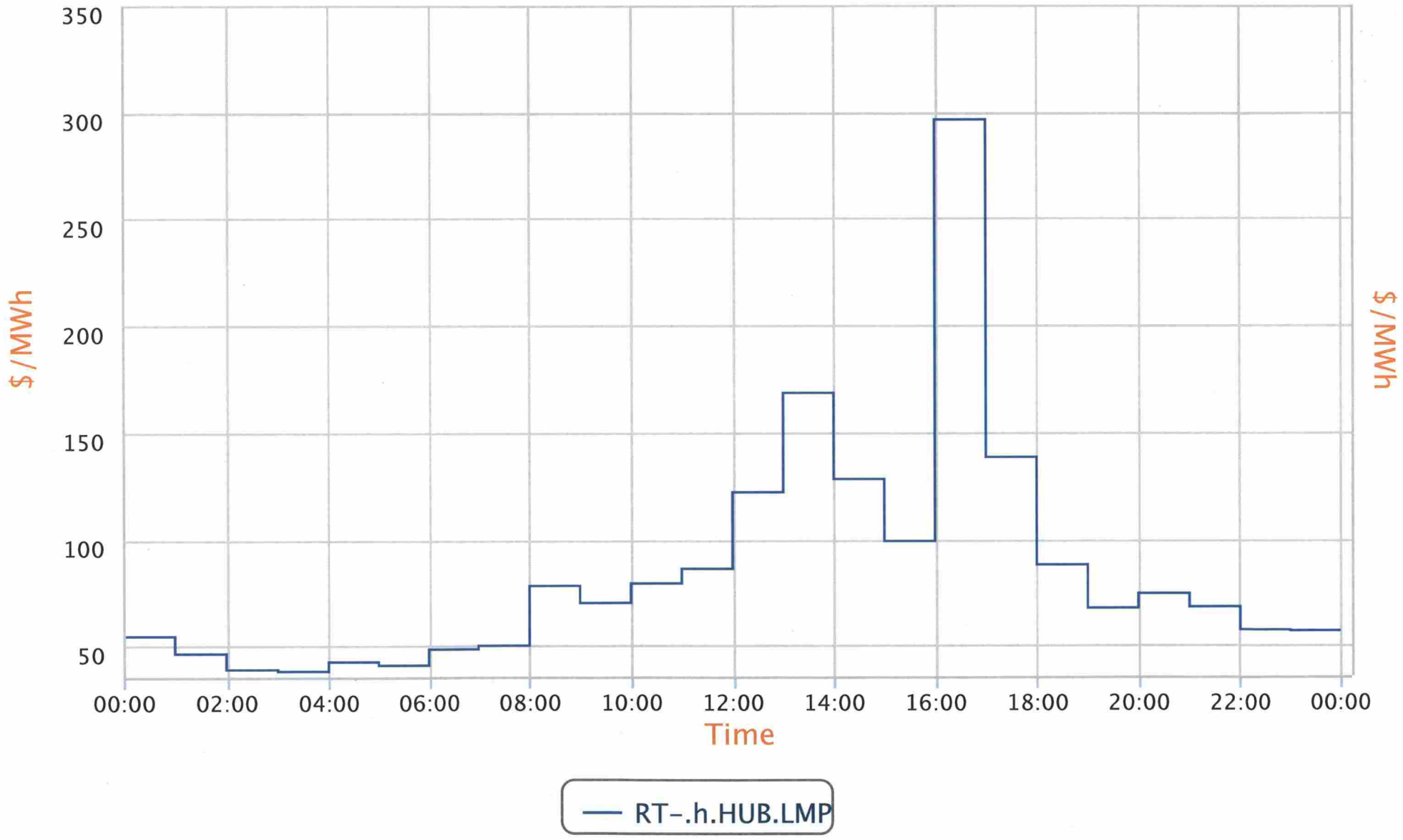
MAINE PUBLIC UTILITIES COMMISSION

THE ECONOMICS OF RENEWABLE ENERGY POLICY

Presented to the
Joint Standing Committee on
Energy, Utilities and Technology
October 21, 2013

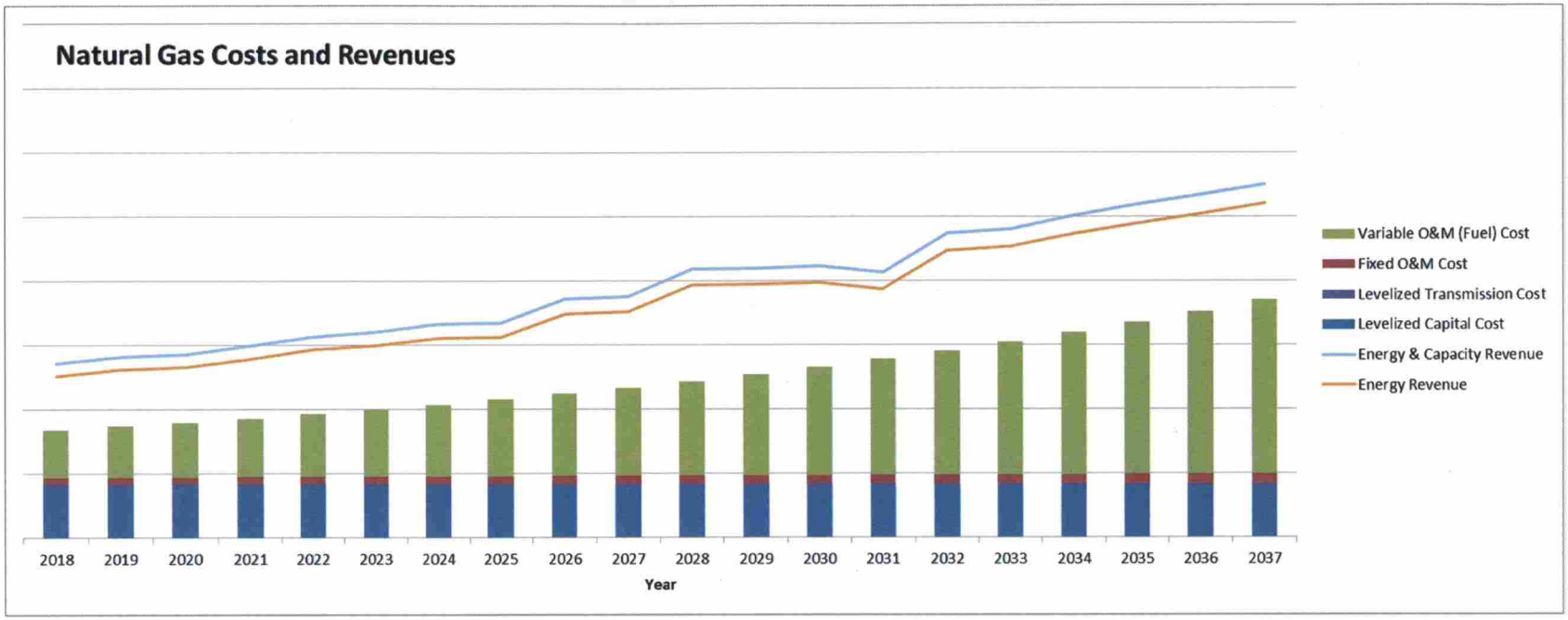
Hourly LMP Graph

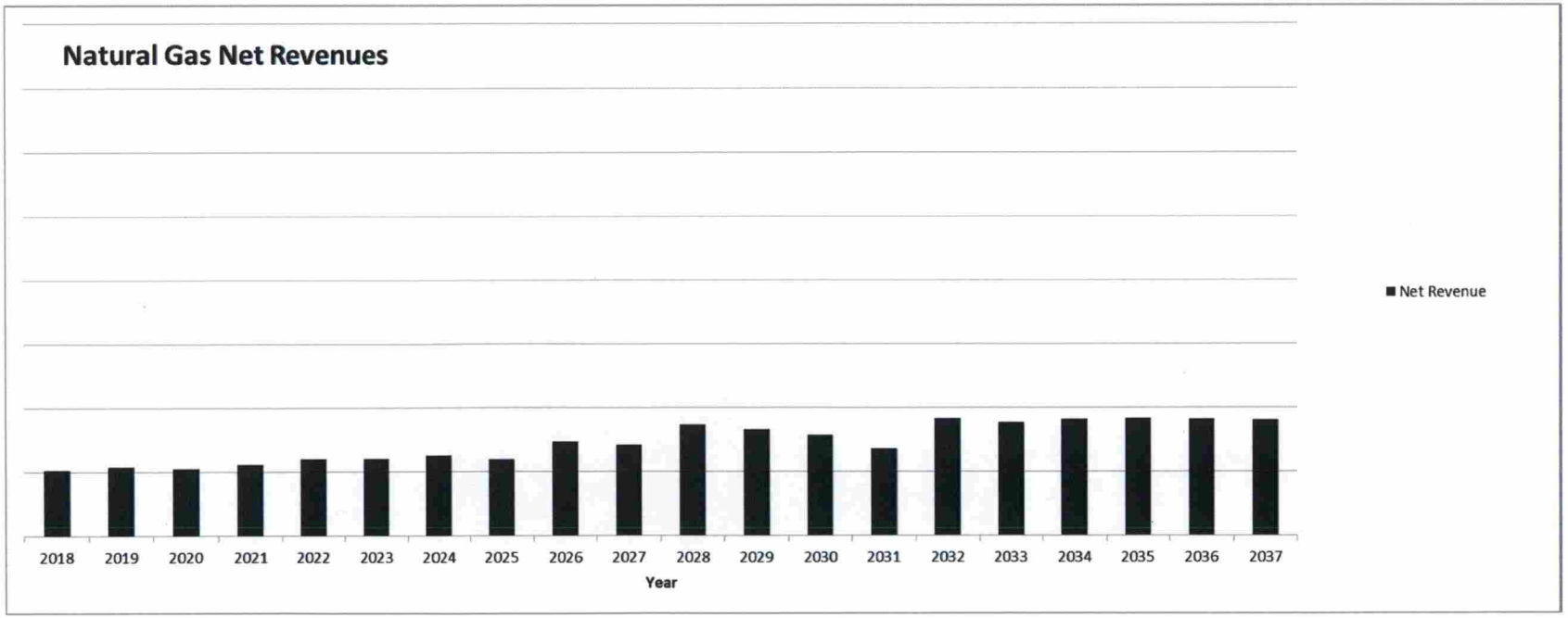
Date: 07/05/2013



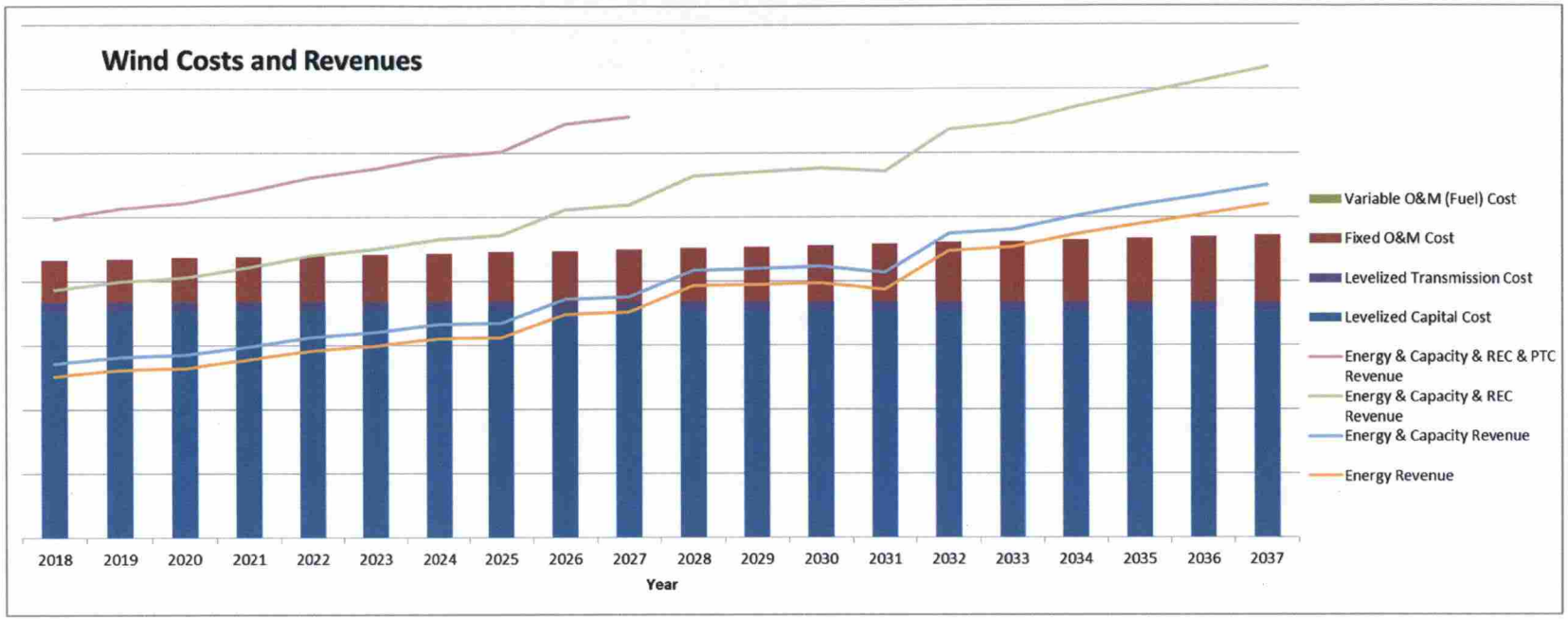
SREC Prices	Jul-13	Aug-13	Sep-13
Delaware			
2012	$10.00	--	--
2013	--	$25.00	$33.00
Maryland			
2011	--	$122.00	$111.00
2012	$125.00	$128.00	$120.01
2013	$130.00	$133.00	$130.00
Massachusetts			
2012	--	--	--
2013	$222.53	$236.62	$241.01
New Jersey			
2011	$115.25	--	--
2012	$115.25	$116.00	$125.00
2013	$120.25	$121.00	$130.01
2014	--	$130.00	$134.01
Ohio			
In-State			
2012	--	--	--
2013	--	$40.00	$41.00
Out-of-State			
2012	--	--	--
2013	$12.00	$13.00	--
Pennsylvania			
2011	--	$4.01	--
2012	$8.00	$5.01	--
2013	$10.00	$13.00	$9.00
2014	--	$13.00	$13.26
Washington, D.C.			
2011	--	--	$480.00
2012	$470.00	$480.00	$480.00
2013	$470.00	$480.00	$480.00

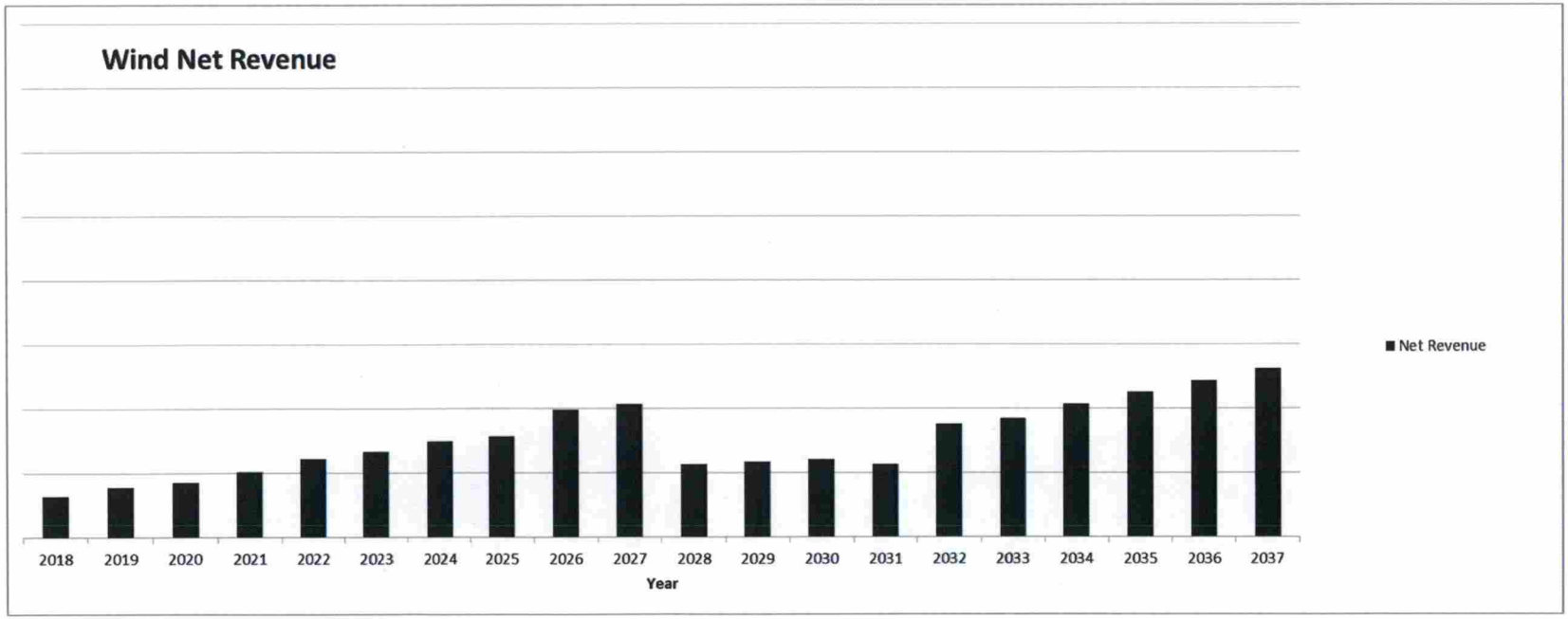
Illustrative Cost and Revenue Structure for a Natural Gas Generator

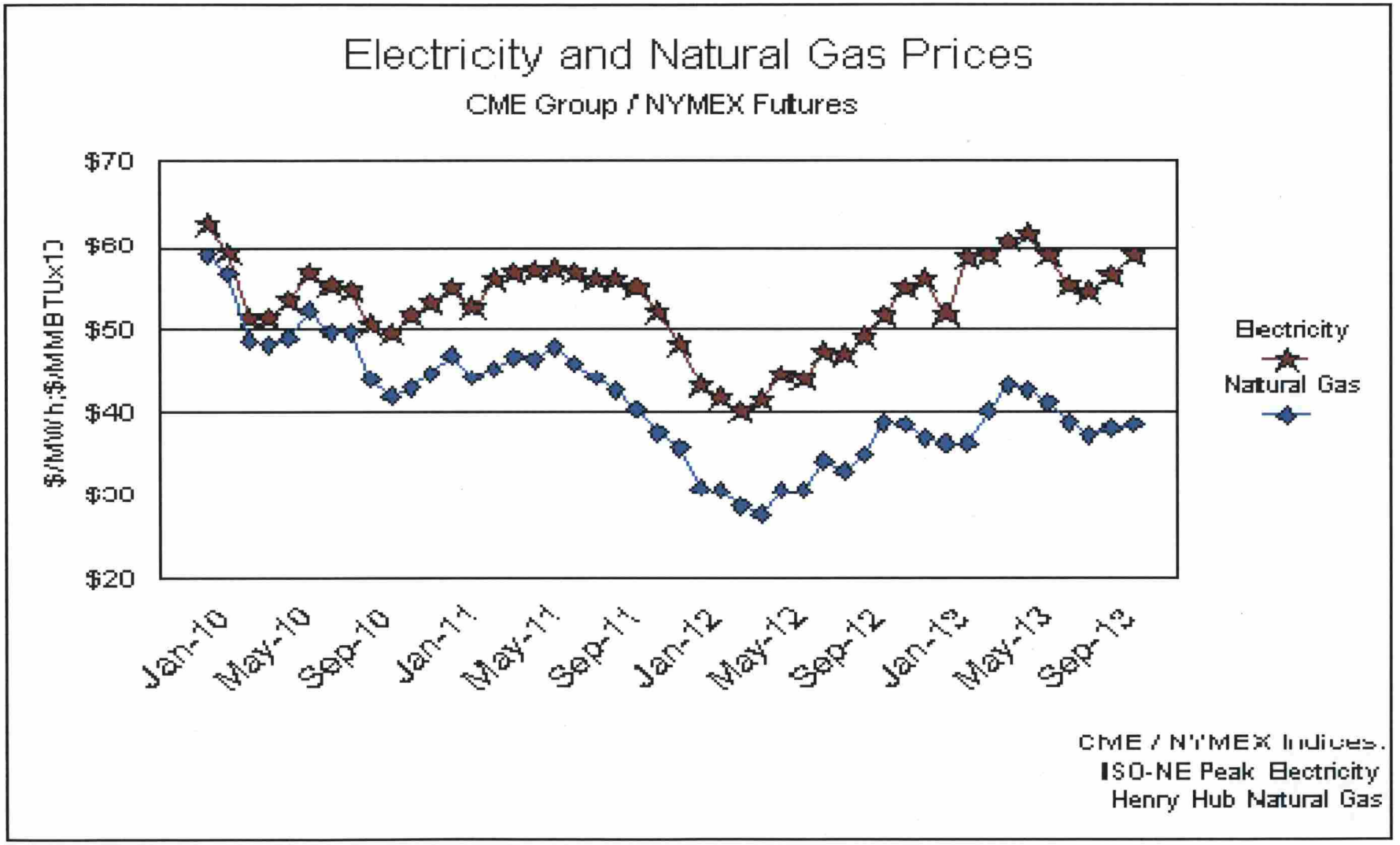




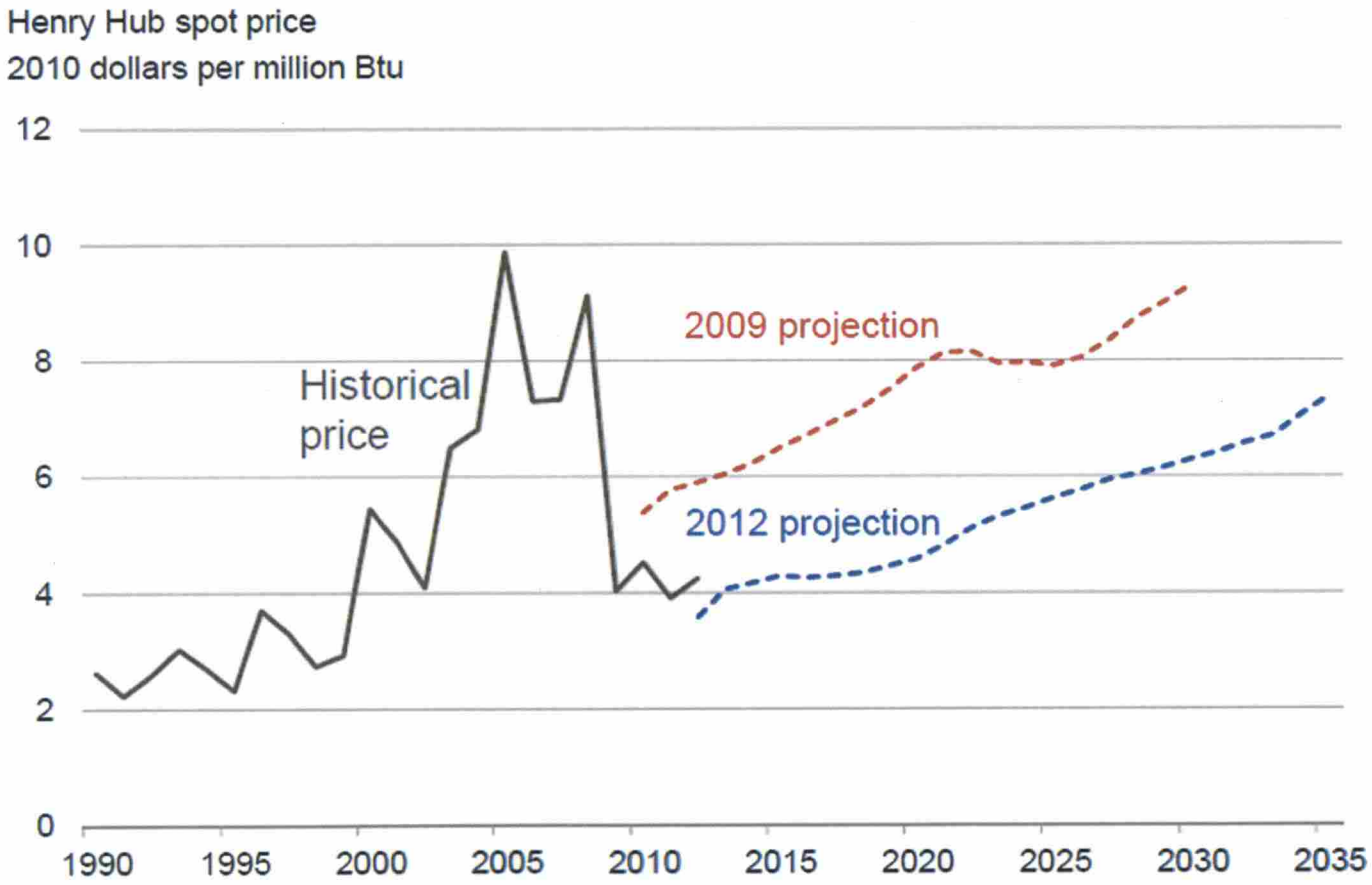
Illustrative Cost and Revenue Structure for a Wind Generator






Electricity and Natural Gas Prices
CME Group / NYMEX Futures
$/MWh;$/MMBTUx10
$70
$60
$50
$40
$30
$20
Jan-10
May-10
Sep-10
Jan-11
May-11
Sep-11
Jan-12
May-12
Sep-12
Jan-13
May-13
Sep-13
Electricity
Natural Gas
CME / NYMEX Indices:
ISO-NE Peak Electricity
Henry Hub Natural Gas

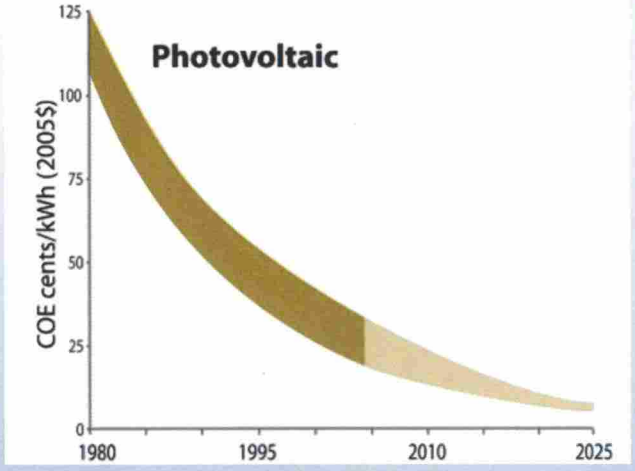
Current and projected U.S. natural gas prices have declined

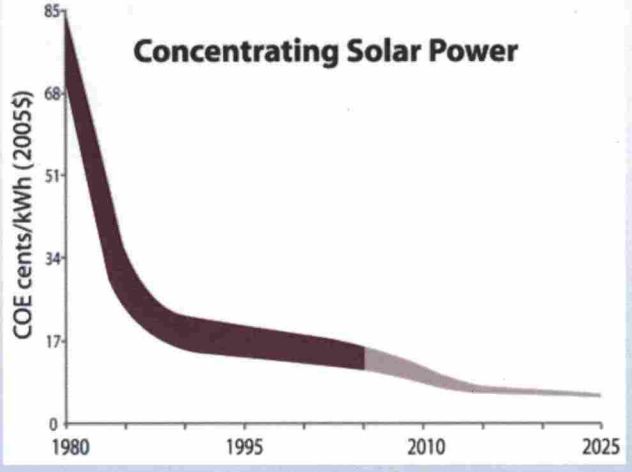


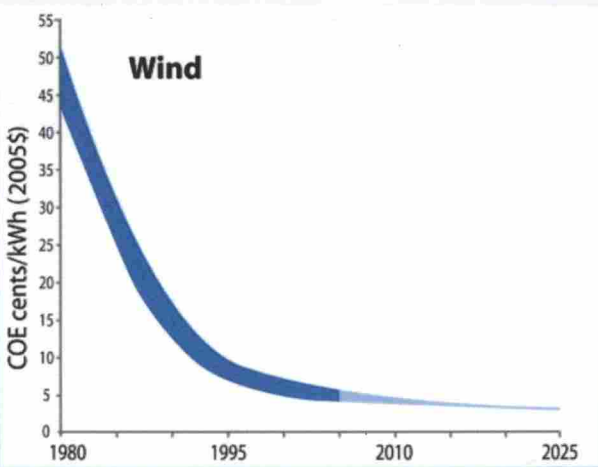
Data source: U.S. Energy Information Administration, Annual Energy Outlook 2009 (updated) and 2012, Reference case.

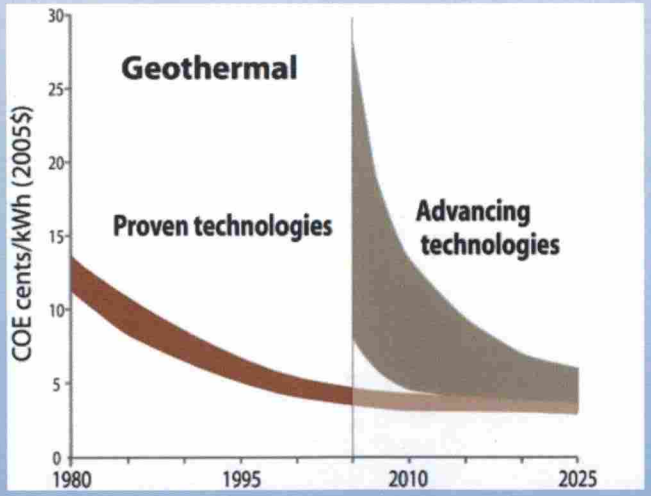
Renewable Energy Cost Trends

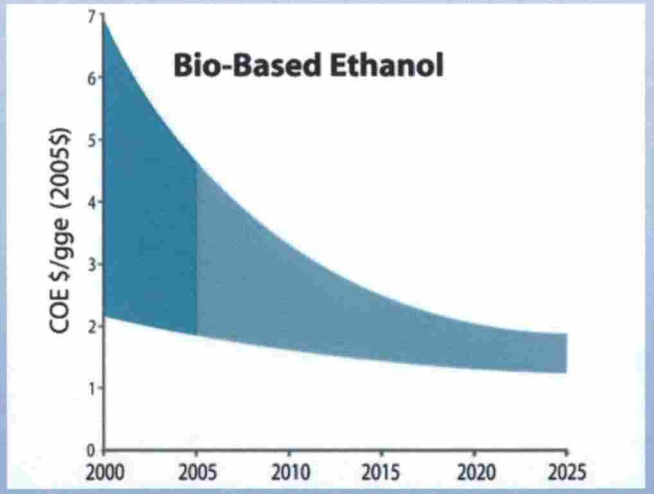
Levelized cost of energy in constant 2005$[1]











Source: NREL Energy Analysis Office (www.nrel.gov/analysis/docs/cost_curves_2005.ppt)

[1]These graphs are reflections of historical cost trends NOT precise annual historical data. DRAFT November 2005

EAO Energy Analysis Office
Understanding Energy Issues

NREL National Renewable Energy Laboratory

Wind PPA Price Trend, 1996-2012

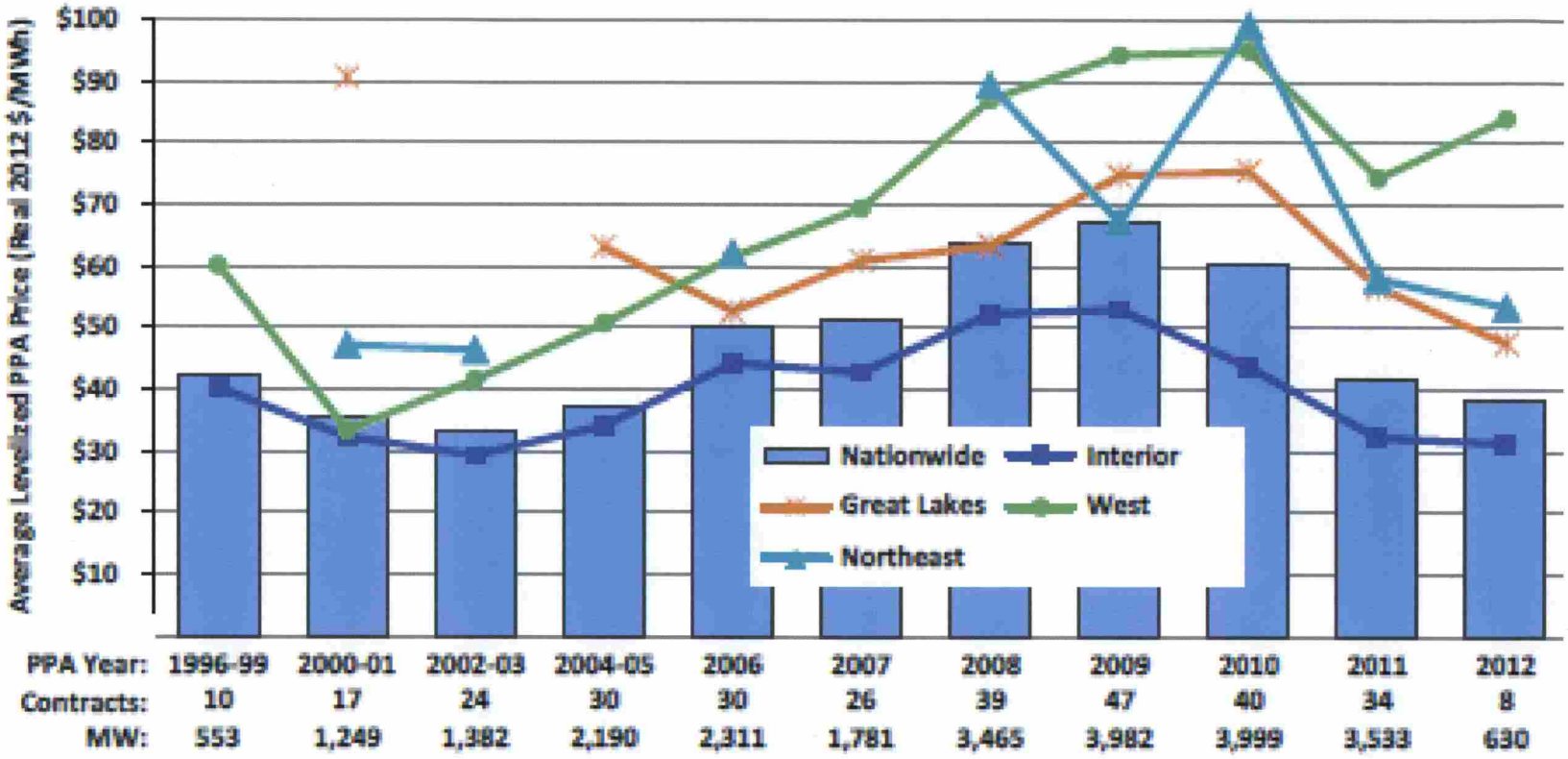
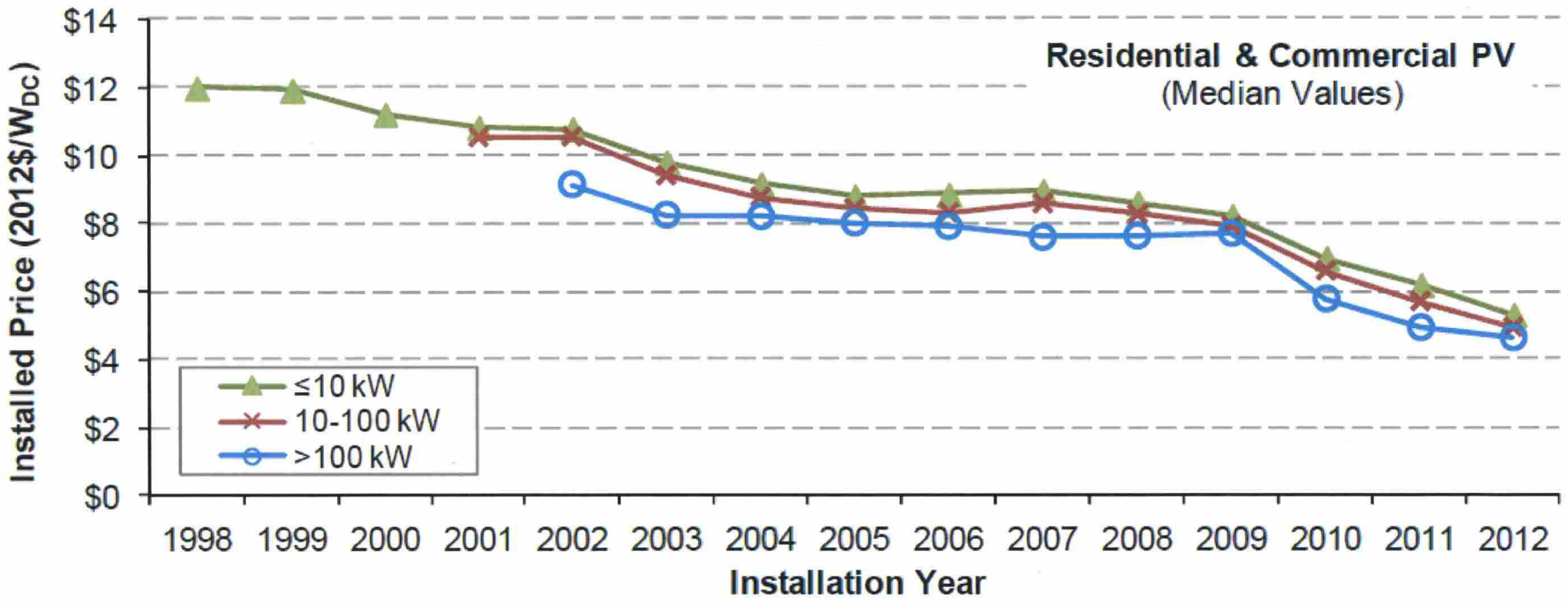


Figure 33. Generation-Weighted Average Levelized Wind PPA Prices by PPA Execution Date and Region

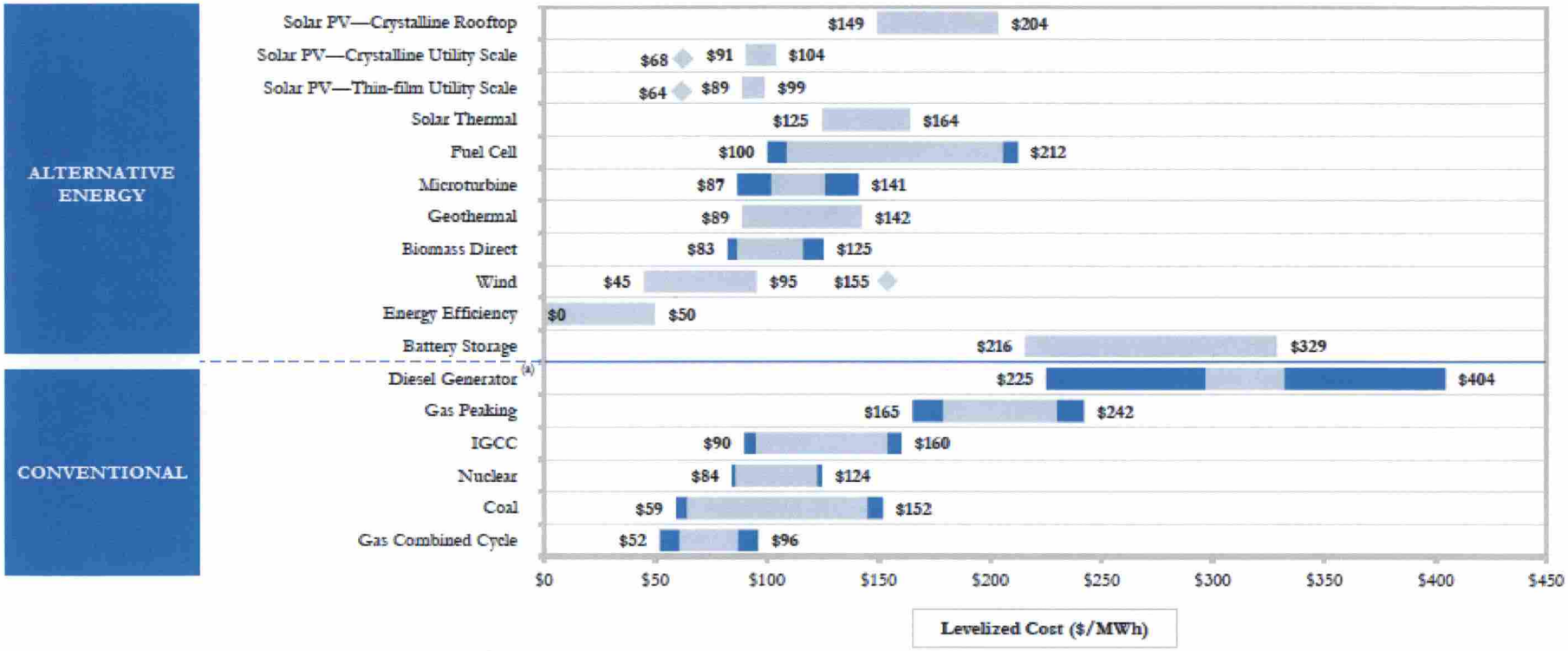
Source: DOE, 2012 Wind Technologies Market Report, p. 51

Solar PV Price Trend, 1998-2012



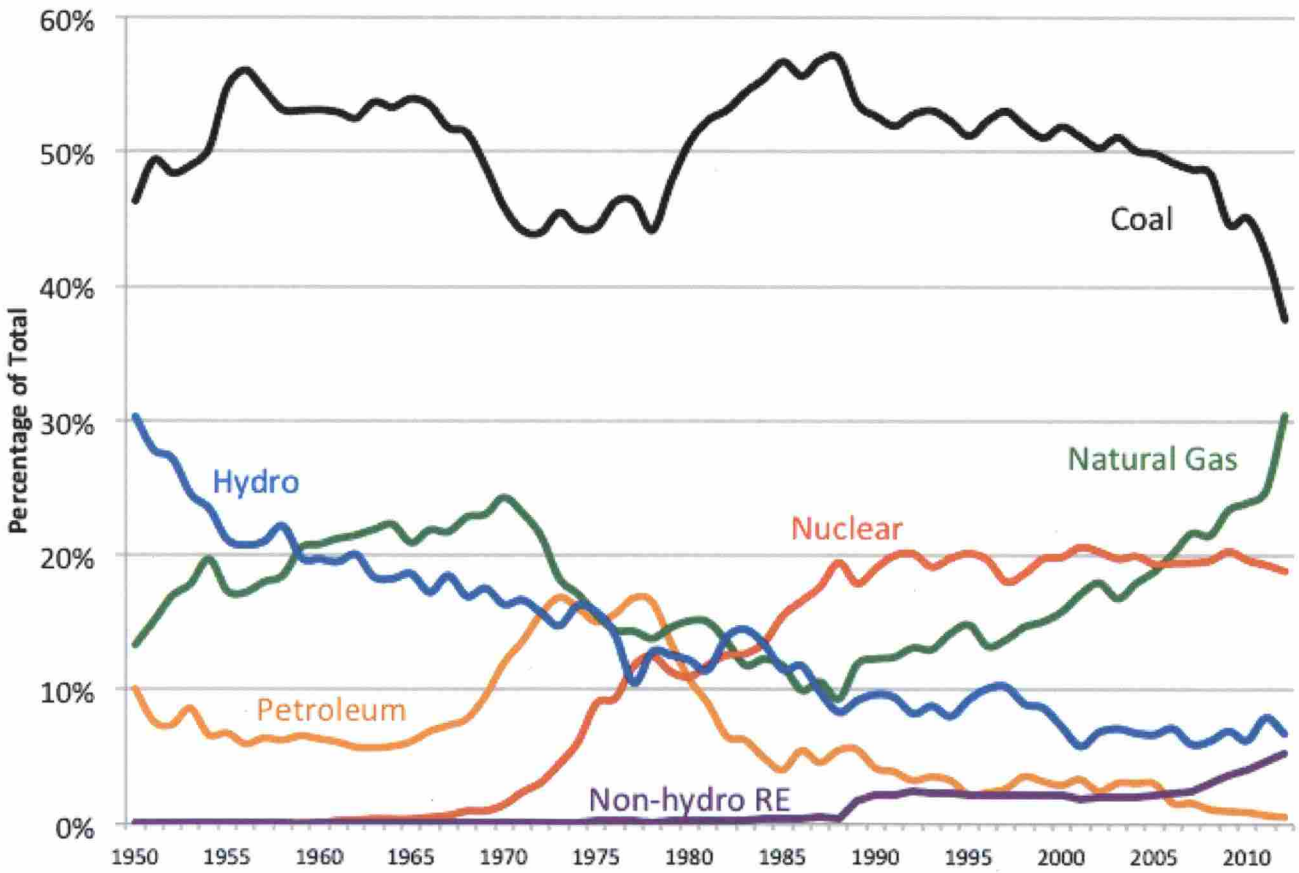
Source: LBNL, *Tracking the Sun VI: An historical summary of the installed price of photovoltaics in the United States from 1998-2012*, July 2013, p. 13

Levelized Cost of Electricity



Source: *Public Utilities Fortnightly*, October 2013, p. 6

Net U.S. Power Generation Share by Source, 1949-2012



Source: https://financere.nrel.gov/finance/content/us-power-sector-undergoes-dramatic-shift-generation-mix ; data from EIA

Wall Street Journal
Six Myths About Renewable Energy
The impact on jobs and other assumptions that don't hold up anymore

By
Keith Johnson
Sept. 22, 2013 5:17 p.m. ET

Old ideas die hard.

The country has been debating renewable energy for decades—how much we should support it, what place it should have in our energy policy, how big an impact it actually has.

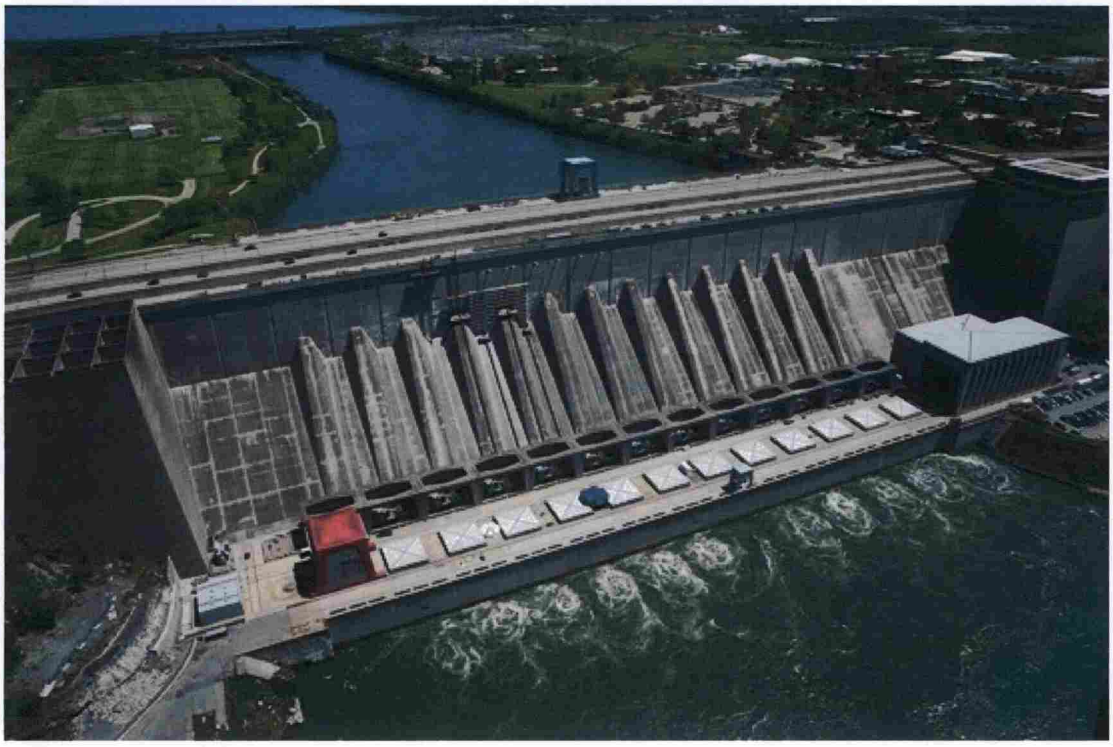
Yet many of the things we think we know about renewable energy go back to the earliest arguments. Many of the debating points we hear today are based on outdated facts and assumptions that don't hold up anymore.

So, we set out to look at a few persistent myths or beliefs held by both supporters and critics of renewable energy. We've focused largely on wind and solar power, in part because they've shown explosive growth in recent years but also because they are at the center of political debates over energy.

MYTH NO. 1: Renewables Are an Insignificant Source of Power

One of the most persistent criticisms of renewables is that they account for a fraction of the U.S. electricity system—despite years of federal subsidies and breakneck growth.

When looking at "newer" renewable energies such as wind and solar power, that's largely true. Wind accounts for about 5% of generation capacity and a little over 4% of U.S. electricity production, or roughly one-tenth what coal provides.



Including hydroelecric power, renewables account for about 14% of U.S. electricity output. *Getty Images*

But the criticism overlooks one important point: Conventional hydroelectric power, such as the Hoover Dam, is also renewable energy. Taken together, hydroelectric and other sources—biomass, geothermal, solar and wind—combined to account for 12% of U.S. electricity production last year, and close to 14% so far this year. The entire nuclear fleet provides about 19%.

It's also important to remember the scale of the country's renewable efforts. The U.S. has the second-biggest electricity system in the world, accounting for about 20% of the entire world's generation capacity. Wind power's 5% of that pie is a big slice. The 60-odd gigawatts of wind power installed in the U.S. amounts to more electricity-generation capacity than in the entire country of Australia or Saudi Arabia, and as much as all of Mexico. It's about half as much power as in France or Brazil.

To be sure, the wind doesn't always blow. Wind farms produce only about one-third of their listed capacity, while a nuclear plant produces almost 100%. But even that discounted amount of electricity generated by U.S. wind farms is huge in global terms—54% of all the juice generated by Mexico, 26% of France and Brazil, 62% of Australia, 64% of Turkey and more than twice that of Switzerland.

The seemingly small share of power produced by renewable energy at the national level also reflects the fact that some states have a lot of green power and some have practically none. Texas has the biggest electricity system in the country, and gets 11%

of its juice from renewables, nearly all from wind. New York and Georgia both have large power sectors, but get relatively small amounts from renewables.

MYTH NO. 2: Renewables Can Replace All Fossil Fuels

The flip side of critiques of renewable energy is boosterism. A handful of proponents describe a future where 100% of energy needs can be met affordably and reliably by renewables.

Shifting heavily to solar and other renewables may be technically feasible but would raise several big practical challenges. *Associated Press*

Focusing on electricity, researchers at the National Renewable Energy Laboratory tackled this question. They found that, technically, by 2050 the U.S. could get 80% of its electricity from renewable energy and keep the lights on every hour, every day, in every corner of the country. (Their study didn't consider a 100%-renewable scenario.)

Perhaps. But getting there would be a long, tough slog. The study found that the U.S. would need to install about 20,000 megawatts of renewable generating capacity every year for a couple of decades, gradually ramping up to about 40,000 megawatts every year. The study found no reason to doubt the global renewable-energy industry's ability to eventually meet that level of production. What might be trickier, the study found, is finding a place to put all those wind farms, solar arrays and hydroelectric facilities.

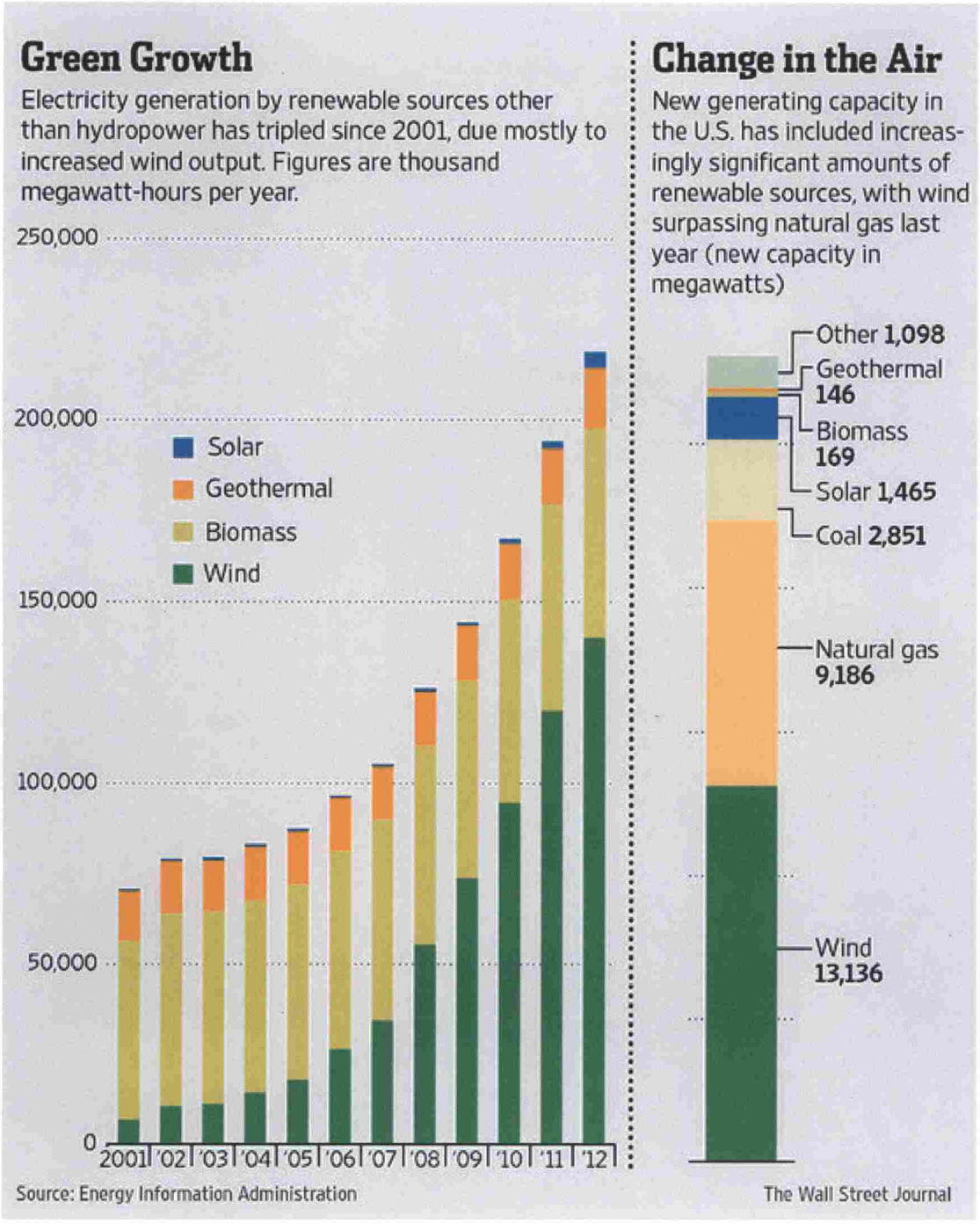
Managing the big upfront capital costs of wind and solar power would be another obstacle. And down the road there could be another challenge: Areas with lots of variable power could see wholesale power prices close to zero at times. That would complicate the economic case for fresh investments in generation capacity year after year.

The U.S. would also need to virtually duplicate the entire existing network of transmission lines by 2050 to handle 80% renewable energy. The study notes that the trick would be figuring out where the lines would go, who would pay for them, and which state and local governments would be in charge.

In other words, there's no technical reason renewable energy can't provide 80% of the power in the U.S. by midcentury. But there are a host of challenges that would have to be met first.

MYTH NO. 3: Renewables Are Too Expensive

Forget about problems down the road. Another criticsm of renewables in the here and now: They're expensive ways to generate electricity.



One new, comprehensive comparison of wholesale electricity prices, in the Journal of Environmental Studies and Sciences, concludes that coal-generated power costs 3 cents a kilowatt-hour; new gas plants would produce juice at 6.2 cents; wind power costs 8 cents; and solar photovoltaic, 13.3 cents.

But there are two big issues to bear in mind. First, costs are falling fast—thanks largely to technological advances such as larger wind turbines and cheaper components for solar-power arrays—so in some places, solar and wind power can cost even less.

The latest price data for wind-energy power-purchase agreements, released by the Department of Energy last month, showed that nationwide, the price of wind-generated electricity fell to just over 4 cents per kilowatt-hour nationwide, not counting the 2.2-cent federal tax subsidy. In some regions, well-sited wind farms produce electricity for closer to 2 cents.

Likewise, Lawrence Berkeley National Laboratory just released its latest report on the costs of installing solar power. Costs for small-scale solar residential arrays fell by about 13% in the past year, driven largely by cheaper solar components due to a global supply glut. Utility-scale prices also fell.

There's also the question of hidden costs. Coal-fired electricity, for instance, has nasty side effects, including air pollution, health impacts and carbon-dioxide emissions that contribute to global warming (all of which factored into the Obama administration's proposal Friday for new limits on coal emissions)—and those don't show up in coal's price tag. If coal and other fossil fuels had to tally the total costs their use imposed on society, coal wouldn't be the cheapest source of electricity, and clean-burning renewables wouldn't look nearly so pricey.

Add all the hidden costs together, and the total cost of different power sources looks quite different, according to that recently published study. At an existing coal-fired plant, the cost goes up by 6 cents per kilowatt-hour, making its true cost 9 cents; at a new coal plant, it would go up by about 4 cents to 13.2 cents. New natural-gas-fired electricity would go up by 1.3 cents, bringing its total to 7.5 cents. But wind and solar and nuclear energy don't go up—because they don't cause asthma, and they don't emit carbon dioxide.

A few cautions when comparing the cost of different power sources. Gas plants are often used to meet peaking power demand, when they can fetch higher prices. Solar power also produces during hours of high demand, and its power is more valuable. But wind power produces more at night and less in the daytime, so its electricity is less valuable to the system.

Furthermore, different energy sources have additional costs that muddy direct comparisons. Nuclear plants have decommissioning costs, waste storage and liabilities that aren't always fully priced in. Variable sources such as wind and solar power need extra transmission lines and special efforts to integrate their power into the grid, which isn't included in the cost.

MYTH NO. 4: Variability Dooms Renewable Energy

The sun doesn't always shine, and the wind doesn't always blow, so wind farms and solar arrays generally punch below their weight. A 100-megawatt wind farm will generate on average the equivalent of 34 megawatts of power that's available full time.

Granted, there are forms of renewable energy that almost always generate power: geothermal plants and hydroelectric facilities, for example. But since the bulk of growth in renewables in the U.S. comes from wind and solar power, their variability is a flashpoint for critics and a technical challenge for grid operators. Variability costs money to deal with, requires some level of backup power to offset and can even lead to renewable-energy generation being wasted, note researchers at the Lawrence Berkeley National Laboratory. When power-grid operators either don't want or can't handle wind power, for instance, they just dump it—a process called curtailment.

As wind power spreads, the fact that output isn't always available from any one location is becoming less important. *Bloomberg*

Still, things are improving rapidly. Consider the situation with wind power. Curtailments have fallen steadily in recent years as system operators have gotten better at using forecasting and integrating wind power. Investment in new transmission lines has also picked up pace, enabling wind farms in isolated locations to offer power more readily to a wider area.

That is the key to overcoming the natural variability of renewables such as wind and solar power. Individual wind farms may be very volatile. But scores of wind farms over thousands of square miles show less volatility—the wind is always blowing somewhere. As grid operators have added more wind in more locations to their systems, as well as the lines to carry that wind, integrating wind power into the electricity system has become easier.

Take Texas. Four years ago, facing severe transmission constraints, the state was dumping 17% of all the wind power it produced. In 2012, after adding more wind farms and almost 2,600 miles of transmission lines, curtailments were below 4%, and wind power provided 10% of the electricity in the nation's biggest power market.

MYTH NO. 5: Cheap Natural Gas Is the Enemy of Renewable Energy

With the boom in U.S. natural-gas production, many concluded that renewable energies would be battered by a relatively clean, cheap fuel source. While natural gas has transformed the electricity sector, gas and renewables are actually complementary, not rivals.

A glance at national trends makes clear that the two energy sources can grow together. Natural-gas electricity generation rose 34% from 2009 to 2012. Wind generation rose 92% in the same period and solar generation almost fourfold, though the renewables grew from a much smaller base.

Granted, cheap natural gas makes it difficult for wind power to compete without federal subsidies. But researchers are finding that gas and wind complement each other as part of a balanced electricity-generation portfolio.

Look at it from a utility's perspective. Natural-gas plants have low upfront costs, don't rely on fickle federal subsidies, and their output can be dispatched to meet swings in power demand. Gas, therefore, gives reliable power now, with little worry in the short term about federal policies.

But over the longer term, volatile gas prices could be deadly—as could environmental rules from Washington. That makes the wind farms and other renewable-energy projects an appealing way to hedge. Almost all of their costs are up front—there's no fuel to buy, so no worries about volatile prices. Because renewable energy doesn't produce any harmful emissions, it doesn't face the specter of future federal rules—and indeed could benefit from state rules mandating green power.

MYTH NO. 6: Renewable Energy Means Millions of Green Jobs

During the 2008 campaign, Barack Obama touted the prospect that investing in clean energy could produce five million "green jobs." The idea of creating jobs helped underpin the $90 billion clean-energy stimulus in 2009 and later efforts, and remains a staple of administration rhetoric.

But renewable energy has not been the job creator that its boosters envisioned. While the amount of wind and solar power has more than doubled since President Obama took office, renewable-energy jobs have not.

The hardest part of sizing up green jobs is figuring out what a green job is. The Bureau of Labor Statistics came up with an expansive definition: goods or services that benefit

the environment or make a company more environmentally friendly. According to the most recent data from the BLS, the U.S. had 3.4 million green jobs in 2011. But the categories are generous, to say the least. Private-sector green jobs included petroleum and coal-products manufacturing (3,244 jobs); school and employee bus drivers (166,916); logging (8,837); paper mills (18,167); and iron and steel mills (33,812). The numbers get so fuzzy as to become all but meaningless as an indicator of employment potential from clean energy.

Direct-employment numbers from renewable energies are clearer. In 2012, the wind industry said it employed about 81,000, the solar industry employed about 119,000, and geothermal energy may have employed about 20,000. The Hydropower Association estimates the sector employs between 200,000 and 300,000 people today.

Not only are those numbers quite modest, but in broad terms they haven't increased much since 2008, before the recent strong growth in renewables. In 2008, the wind industry said it employed about 85,000 people. So while installed wind capacity more than doubled, wind employment shrank. Solar employment stood at about 93,000 in 2010. Two years—and a ninefold increase in solar power—later, solar employment had increased just 28%.

The contrast between the promise and the reality of green jobs becomes even clearer when compared with other energy sectors. Coal, for example, is shrinking as a share of the U.S. electricity mix. Nevertheless, total coal-sector employment of about 150,000 is the highest since the mid-1990s.

And, by far, the biggest jobs story in the energy patch has come from the oil and gas boom. According to a fresh study by energy consultancy IHS Cera, unconventional oil and gas production—hydraulic fracturing, or fracking, for natural gas and tight oil—accounted for about 360,000 direct jobs.

Mr. Johnson is a reporter in The Wall Street Journal's Washington bureau. Email: keith.johnson@wsj.com.

Corrections & Amplifications
An earlier version of this article had two myths No. 3 and no Myth No. 4. The numbering has been corrected.

The Boston Globe

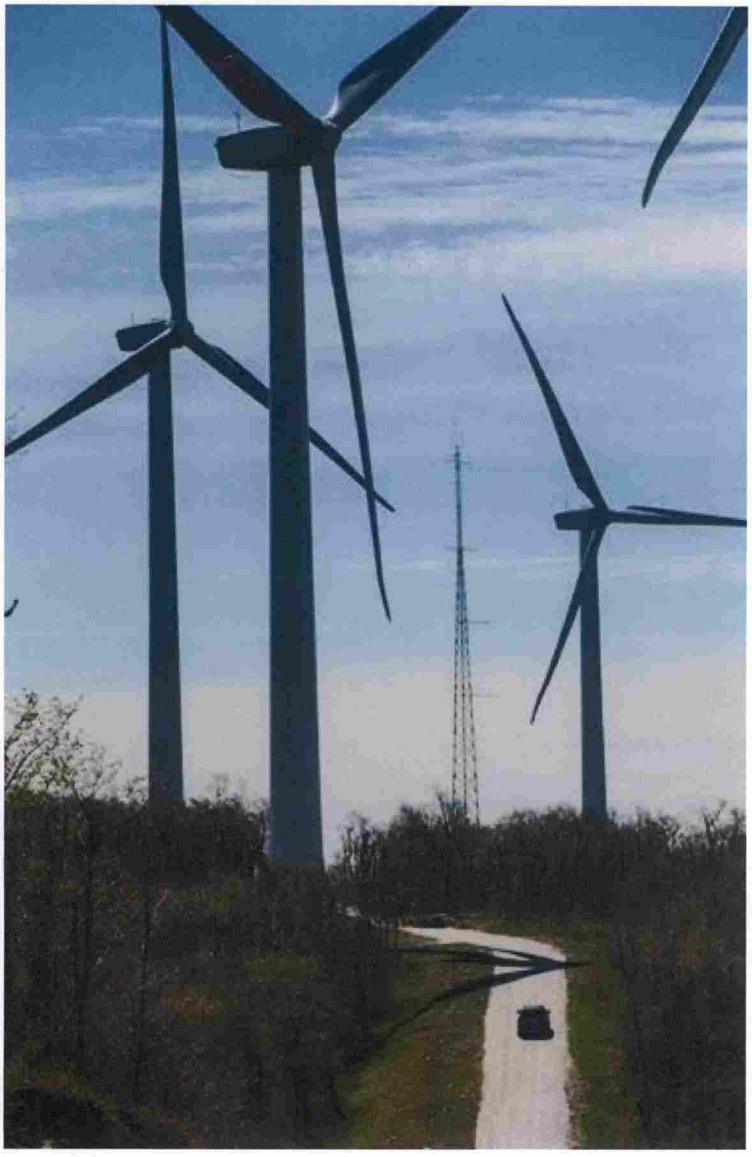
Wind power now competitive with conventional sources

Contracts would bring savings

By Erin Ailworth

GLOBE STAFF

SEPTEMBER 23, 2013



GLOBE FILE

Wind turbines at Hoosac Wind Farm.

The state's biggest utilities, in a milestone for New England's wind power industry, have signed long-term contracts to buy wind-generated electricity at prices below the costs of most conventional sources, such as coal and nuclear plants.

The contracts, filed jointly Friday with the Department of Public Utilities, represent the largest renewable energy purchase to be considered by state regulators at one time. If approved, the contracts would eventually save customers between 75 cents and $1 a month, utilities estimated.

"This proves that competitively priced renewable power exists and we can get it, and Massachusetts can benefit from it," said Robert Rio, a spokesman for Associated Industries of Massachusetts, a trade group that represents some of the state's biggest electricity users.

The utilities — National Grid, Northeast Utilities, and Unitil Corp. — would buy 565 megawatts of electricity from six wind farms in Maine and New Hampshire, enough to power an estimated 170,000 homes.

The projects, in various stages of permitting or development, are expected to begin operations between 2014 and 2016.

John Howat, senior energy analyst at the Boston-based National Consumer Law Center, said he needed to review the details before he could provide a thorough assessment of the contracts. But his initial reaction to the price — on average, less than 8 cents per kilowatt hour? "Wow."

"It seems like there's something for environmental and consumer advocates here to be happy about," he said.

PROJECTED PRICE OF ELECTRICITY BY SOURCE

CENTS PER KILOWATT HOUR

Mass. wind power contracts
Average price until end of contract

Less than 8

SOURCE: The utilities

Total system projected average cost for 2018

Natural gas
6.71

Wind
8.66

Hydro
9.03

Conventional coal
10.01

Nuclear
10.84

Solar
14.43

Wind – offshore
22.15

SOURCE: US Energy Information Administration

GLOBE STAFF

The agreements forecast further growth for the wind industry as the willingness of utilities to make long-term commitments makes it easier for developers to obtain financing for more wind farms. That, in turn, would probably lead to new conflicts in rural areas, where large-scale industrial wind farms are typically sited.

Such projects have sparked fierce opposition from residents who complain about noise, health problems, and damage to pristine landscapes.

"People are really concerned about it, and that's not going to go away," said Lisa Linowes, executive director of the Wind Action Group, a New Hampshire-based advocacy organization that opposes industrial wind projects.

Wind has become a larger part of the energy mix as a result of government policies requiring utilities to acquire power from renewable sources such as wind and solar. Massachusetts, for example, requires utilities to get 15 percent of their power from renewable sources by 2020.

Such policies have created markets for wind, leading to more competition, better technology, larger projects, and ultimately lower prices.

Over the life of the 15- to 20-year contracts, utilities would pay an average price of less than 8 cents per kilowatt hour, compared with projected prices of about 10 cents for coal, 11 cents for nuclear, and 14 cents for solar.

National Grid, Unitil, and Northeast Utilities sought the wind-generated electricity because of new provisions in the state's Green Communities Act, which mandate that utilities acquire a set amount of renewable energy through long-term, competitively bid contracts. Wind, the utilities said, was the best deal, especially after combining their purchasing power to obtain a large amount of energy at cheaper prices than they each might have negotiated separately.

Another big wind generating project, Cape Wind in Nantucket Sound, will have an estimated generating capacity of 468 megawatts, about 100 megawatts less than the new purchase — but because the wind offshore is more powerful, the Nantucket Sound facility will probably end up serving more homes.

Cape Wind has signed contracts to sell roughly three- quarters of its power to NStar and National Grid for 18.7 cents per kilowatt hour — compared with the 8 cent average in the new purchase.

A forecast by the US Department of Energy indicates that the average cost of wind power would be lower than most other sources in the next few years. Only electricity generated by natural gas would have a lower wholesale price, just under 7 cents per kilowatt hour, according to the forecast.

Even hydropower, at about 9 cents per kilowatt hour, would cost more.

"Not only are we getting clean energy," said Ronald Gerwatowski, National Grid's senior vice president for regulation and pricing, "it's below market."

Northeast Utilities, National Grid, and Unitil are seeking an expedited review by state regulators so the wind farms can qualify for federal production tax credits before the incentives expire at the end of year. The tax credit is a factor in the prices.

If approved, Northeast Utilities' Massachusetts subsidiaries, NStar and Western Massachusetts Electric Co. would buy 53.1 percent of the power, National Grid, 45.9 percent, and Unitil, which has just a fraction of the customers of the other utilities, 1 percent.

The Massachusetts utilities filed their contracts the same day that Connecticut's governor, Dannel P. Malloy, said two of his state's utilities, Connecticut Light and Power, another Northeast Utilities subsidiary, and United Illuminating Co., had signed long-term contracts to buy 250 megawatts of electricity from a Maine wind farm and 20 megawatts of solar power, also at an average of less than 8 cents per kilowatt hour.

Combined, the wind contracts in Massachusetts and Connecticut are contributing to "a huge explosion" of growth for the sector in the Northeast, said Emily Williams, senior policy analyst for the American Wind Energy Association, an industry group.

State Energy and Environmental Affairs Secretary Richard K. Sullivan Jr., said the contracts will boost Massachusetts' efforts to use renewable energy.

"It's improving our energy security, it's great for our environmental policy," Sullivan said. "We're going to be able to bring down the price of power using competitively bid renewable energy."

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