



Subsidies to a Wind Farm in Nantucket Sound

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May 2006

1. Introduction and Summary

In November 2001, Cape Wind Associates, filed an application with the U.S. Army Corps of Engineers for permission to construct the nation's first offshore wind farm in Nantucket Sound. The project would consist of 130 wind turbines, each approximately 420 feet tall, arrayed over a 24 square mile area of the Sound known as Horseshoe Shoals. The wind farm would be sited five miles off the coast, in federal Outer Continental Shelf (OCS) waters. From there, undersea cables would transmit power through state waters to an onshore distribution grid. The project, according to Cape Wind, would have an installed nameplate capacity of approximately 468 megawatts (MW) of electricity.

Our estimates show that Cape Wind would receive revenue equivalent to 13.26 cents per kWh of electricity produced, gross of taxes; the present value of this revenue (in 2008, when serious construction would begin, but using 2006 prices for current comparability with other projects) is \$1,527 million, which is more than adequate to cover the financial cost of building and operating the wind farm. The developer can expect to net \$139 million – equivalent to a 25% return on equity – although this figure is subject to considerable uncertainty because the project faces a number of significant risks.

The project would only be privately profitable because of the subsidies it can expect to receive. It would receive a “gross subsidy” (subsidy before taxes) of \$731 million (in present value terms in 2008, using the prices of 2006), consisting of

- (i) the Federal Production Tax Credit, which would contribute \$180 million to revenue in present value terms;
- (ii) the sales of Massachusetts “green credits”, worth a total of \$487 million in present value terms; and
- (iii) accelerated depreciation of investment costs, which would allow the firm to defer payment of Federal income tax, worth \$65 million.

The project would pay taxes, which can be offset against the gross subsidy to arrive at the “net subsidy.” The taxes amount to \$151 million in present value terms. They consist of:

- (i) Massachusetts corporate income tax of \$20 million;
- (ii) Federal corporate income tax of \$131 million (computed on the assumption of no favorable treatment of depreciation); and
- (iii) Local property tax of less than \$1 million.

Table 1: Breakdown of Subsidies		
	Present Value in 2008 (\$million in 2006 prices)	Levelized Revenue per kWh (cents/kWh)
Total Revenue	1,527	13.26
<i>of which:</i>		
Revenue from sales of electricity	860	7.47
Gross subsidies	731	6.35
<i>of which:</i>		
Federal Production Tax Credits (PTCs)	180	1.56
Massachusetts “green credits”	487	4.22
Accelerated depreciation (Federal)	65	0.56
Gross taxes	151	1.31
<i>of which:</i>		
Massachusetts income tax	20	0.17
Federal income tax (normal depreciation)	131	1.13
Local property tax	<1	0.00
Memo:		
Net subsidy (= gross subsidies – gross taxes)	581	5.04
<i>Notes:</i> Total revenue does not adjust for accounts receivable, which would reduce levelized revenue by 0.09 cents per kWh. Totals may differ from sum of reported components because of rounding errors. Federal income tax payments, net of the effects of accelerated depreciation, would be \$66 million.		

Subtracting the present value of the taxes (\$151 million) from the gross subsidy (\$731 million), we arrive at a net subsidy of \$581 million. These effects are summarized in Table 1, and the year-by-year details are shown in Table 2 (on pages 7 and 8). The remainder of this note describes the nature of the subsidies, explains how we calculated their size, and discusses the precision of the estimates. It is not the purpose of this note to judge whether the subsidies are too large or too small; this issue has been addressed elsewhere.¹

The subsidies are, however, an important element in Cape Wind’s decision to undertake the project. The gross subsidy represents 48% of total revenue and the net subsidy (i.e. after subtracting tax payments) 38%.

2. The Federal Renewable Energy Production Tax Credit

New producers of energy from renewable sources, including wind, are eligible for a Federal Production Tax Credit (PTC). The PTC applies to projects that begin to produce electricity before the end of 2007, although judging from recent experience, Congress will almost certainly extend the expiration date further into the future. The PTC was set at 1.9 cents per kilowatt hour (kWh) in 2005; it applies to the first ten

¹ See Jonathan Haughton, Douglas Giuffre, John Barrett and David Tuerck, *An Economic Analysis of a Wind Farm in Nantucket Sound*, Beacon Hill Institute at Suffolk University, Boston, May 2004.

years of production, and is indexed to inflation. It is a tax credit, and so can only be used to reduce corporation income tax due to the Federal government. Although Cape Wind is unlikely to earn taxable income in the first few years of operation (even without the PTC), and at first sight might not be able to make use of the PTC, this problem could be avoided if Cape Wind were to sell its wind farm operation to a profit-making enterprise that could take advantage of the production tax credits.

To compute the tax credit, we first estimate the amount of electricity that the wind farm will produce, based on the available information on wind speeds in Nantucket sound and the technical specifications (such as height and rotor length) of the windmills. We assume that the wind farm would come into operation in October, 2009 and that output in 2010, the first full year of operation, would be 1,399 million kWh (see row (15) in Table 2). Our estimate shows that the PTC would be worth \$31 million in 2010; the present value of the credit, as of 2008 (but in 2006 prices) and using a 10% discount rate, would be \$180 million, equivalent to a “levelized cost” of 1.56 cents/kWh over the full life of the project.

3. *Massachusetts Renewable Energy Portfolio Standards*

Massachusetts has put in place a Renewable Energy Portfolio Standard (RPS) law. Starting in 2003, a proportion of the electricity sold in the Commonwealth must come from new renewable generating sources; the proportion was set at 1% of the total in 2003, and is set to rise by half a percentage point annually until 2009. Estimates of the retail sales of electricity, and the RPS proportions and amounts, are shown in Table 3. Utilities can satisfy the RPS requirement by producing energy from new renewable sources or by buying “green credits” from a certified provider; if this is not sufficient, they may make an “alternative compliance payment” (ACP), which effectively puts a ceiling on the cost of complying with the RPS standard. The current ACP is 5.513 cents per kWh.

Table 3.			
Actual and Project Renewable Portfolio Standard Annual Compliance Obligations, 2003-2009			
	Retail Sales of electricity in Massachusetts, millions of kWh	RPS % obligation	RPS obligation in millions of kWh
2003	49,834	1.0	498
2004	50,063	1.5	751
2005	50,726*	2.0	1,015
2006	51,376*	2.5	1,284
2007	52,034*	3.0	1,561
2008	52,700*	3.5	1,845
2009	53,375*	4.0	2,135

Source: Commonwealth of Massachusetts, Office of Consumer Affairs and Business Regulation, Division of Energy Resources. *Renewable Energy Portfolio Standard: Annual RPS Compliance Report for 2004. January 9, 2006.*
Note: * Projected

Power from the Nantucket wind farm would be certified as new renewable power, so the question becomes one of what price Cape Wind could expect to receive by selling its green credits.

Grace and Cory have projected the price of green credits through 2012. Writing in 2002, they anticipated that the price would be about 2.3 cents/kWh in 2006 (in the prices of 2000), 2.5 cents in 2009 and 2.6 cents in 2010, but they also argued that there is considerable uncertainty about these numbers, especially as “green” energy supplies can come from neighboring states (including New York) and are subject to regulatory changes there that could lead to wide swings in the amount delivered to Massachusetts consumers. Their figures are summarized in Table 4. What is striking is that the actual figure for 2006 is larger than their high estimate. In other words, they overestimated the short-term ability of suppliers to develop new renewable sources of electricity.

Table 4. Estimate Cost of Massachusetts “Green Credits” According to Grace and Cory			
	2006	2009	2012
In 2002 prices			
Low estimate	0.58	0.10	0.10
Middle “best” estimate	2.30	2.50	2.60
High estimate	4.11	3.78	4.53
In current prices			
Low estimate	0.69	0.13	0.14
Middle “best” estimate	2.74	3.25	3.69
High estimate	4.89	4.91	6.44
Actual	5.51		
Consumer Price Index	106.8	116.7	127.5
<i>Sources:</i> Robert Grace and Karlynn Cory, “Massachusetts RPS: 2002 Cost Analysis Update – Sensitivity Analysis,” Sustainable Energy Advantage and LaCapra Associates (2002): Slide 10, for numbers in constant prices. Figure for actual price is from same source as Table 3. Consumer price index was set at 100.0 in 2004, and took on a value of 89.7 in 2000.			

However, the Cape Wind project is large; its output alone – about 1,400 million kWh annually – would more than suffice to satisfy the entire RPS requirement for Massachusetts in 2006, and if it were to come on stream it would certainly push down the price of green credits. There are also indications that some sizeable “new renewable” projects are due to come on stream over the coming two to three years, so the price of green credits will probably fall below the ACP ceiling by 2009.² Our expectations about the price of green credits are set out in row (5) of Table 2; these are in line with the middle projections of Grace and Cory, delayed by two years because the Cape Wind project would not come on line until 2009 at the earliest (instead of 2007, as some had anticipated). Thus we expect the price of green credits to fall

² See Commonwealth of Massachusetts, Office of Consumer Affairs and Business Regulation, Division of Energy Resources. *Renewable Energy Portfolio Standard: Annual RPS Compliance Report for 2004. January 9, 2006.*

to 3.45 cents/kWh in 2011 and then to remain at about that level in real terms, because once the price premium on electricity reaches this point there are a number of attractive options for producing “green” electricity (e.g. biomass, landfill methane, etc.).³ This would generate revenue for Cape Wind of \$59 million in 2010, and at least \$48 million annually thereafter. The present value of all income to Cape Wind from sales of green credits (as of 2008, in 2006 prices, and assuming a nominal discount rate of 10%) would be \$487 million, or an average of 4.22 cents/kWh.

4. *Accelerated Depreciation*

Under section 168, part (e), subsection (3)(b) of the Internal Revenue Code, wind farms are allowed to write off their investment costs over five years instead of the usual twenty years or more that would otherwise apply. This accelerated depreciation allowance allows the project’s owner to write the cost of the project off against tax prematurely. This has the effect of deferring tax payments; meanwhile the owner has the use of the funds, and this represents a benefit to the owner.

To measure the benefit we computed the difference between taxable income with, and without, the accelerated depreciation; the net increase in taxable income is shown in row (9) of Table 2 and the net reduction in taxes in row (10). Cape Wind would pay \$206 million less in income taxes prior to 2013, but would pay more tax – roughly \$20 million extra annually – thereafter. The present value of the benefit of the accelerated depreciation in 2008 (in 2006 prices), again assuming a 10% discount rate, is \$65 million, equivalent to 0.56 cents/kWh over the lifetime of the project.

5. *Tax Payments and Net Subsidies*

Cape Wind would also pay corporation income tax to Massachusetts (at 9.5% of taxable income) and to the Federal government (at 35% of taxable income). The precise computations of tax payable are sensitive to the assumptions that are made about cash flows, but our best estimates are shown in rows (11) through (13) in Table 2. The present value of tax payments amount to \$20 million for Massachusetts income tax and \$66 million for Federal income tax, with negligible amounts of property tax. These calculations do not include any provision for royalty payments. It should also be noted that these tax payments already take accelerated depreciation into account; in the absence of accelerated depreciation they would be \$65 million higher.

³ Robert Grace and Karlynn Cory, “Massachusetts RPS: 2002 Cost Analysis Update – Sensitivity Analysis,” Sustainable Energy Advantage and LaCapra Associates (2002): Slide 10.

It is possible to define the “net subsidy” as the present value of subsidies received less taxes paid. This comes to \$581 million, equivalent to 5.04 cents/kWh.

Table 2: Subsidies and Tax Payments by Year, 2004-2033

Operating Cashflows	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Production Tax Credit														
(1) Total Eligible Generation (millions of kWh)	-	-	-	451	1,399	1,387	1,381	1,364	1,352	1,341	1,334	1,317	1,305	879
(2) Production Tax Credit, nominal cents/kWh	1.96	2.02	2.08	2.14	2.20	2.27	2.34	2.41	2.48	2.55	2.63	2.71	2.79	2.87
(3) Production Tax Credit, \$m	-	-	-	10	31	31	32	33	34	34	35	36	36	25
Massachusetts Green Credit														
(4) Total Generation (millions of kWh)	-	-	-	451	1,399	1,387	1,381	1,364	1,352	1,341	1,334	1,317	1,305	1,294
(5) Green credit price, nominal cents/kWh	5.51	5.68	5.85	5.05	4.25	3.45	3.60	3.76	3.92	4.04	4.16	4.28	4.41	4.54
(6) Green credit, total, \$m	-	-	-	23	59	48	50	51	53	54	55	56	58	59
Accelerated Depreciation														
(7) Five-year accelerated depreciation, \$m	-	-	-	205	328	197	118	118	59	-	-	-	-	-
(8) Twenty-year normal depreciation, \$m	-	-	-	42	83	79	39	72	69	65	62	63	65	67
(9) Net increase in taxable income, \$m	-	-	-	163	244	117	79	46	(10)	(65)	(62)	(63)	(65)	(67)
(10) Net reduction in taxes, \$m	-	-	-	52	77	37	25	15	(3)	(21)	(20)	(20)	(21)	(21)
Taxes														
(11) Massachusetts income tax, \$m	(0)	(0)	(0)	(17)	(23)	(11)	(3)	(3)	4	10	10	11	11	12
(12) Federal income tax, \$m	(0)	(0)	(1)	(57)	(76)	(37)	(10)	(9)	12	32	34	36	38	39
(13) Property tax, \$m	-	-	-	0	0	0	0	0	0	0	0	0	0	0
(14) Subsidies net of taxes	0	0	1	106	189	128	95	95	71	46	46	46	45	33
(15) Total Generation (millions of kWh)	-	-	-	451	1,399	1,387	1,381	1,364	1,352	1,341	1,334	1,317	1,305	1,294
(16) Average ex-factory price, nominal cents/kWh	5.38	5.46	5.62	5.82	5.97	6.15	6.41	6.59	6.84	7.11	7.37	7.56	7.82	8.02
(17) Sales revenue, \$m	-	-	-	27	86	88	91	93	96	98	101	103	105	107
(18) Revenue from sales and MA green credits, \$m	-	-	-	50	146	136	141	144	149	152	157	159	163	166
(19) Revenue: sales, MA credits, Federal PTC, \$m	-	-	-	59	177	167	173	177	182	187	192	195	199	191
(20) Net Operating Income \$m	-	-	-	50	146	136	141	144	149	152	157	159	163	166
(21) Net Income Before Tax, \$m	(0)	(0)	(2)	(179)	(239)	(118)	(32)	(28)	38	102	108	113	119	124
(22) Pre-Tax Cash Flow, \$m	(4)	(3)	(203)	(289)	75	57	62	67	74	80	79	81	90	88
(23) Final cash flow (to equity), \$m	(4)	(2)	(202)	(206)	204	137	107	111	92	73	70	70	77	63
(24) Memo: Consumer Price Index (100 in 2004)	106.76	109.96	113.26	116.66	120.16	123.76	127.47	131.30	135.24	139.29	143.47	147.78	152.21	156.78

Operating Cashflows	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Production Tax Credit														
(1) Total Eligible Generation (millions of kWh)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
(2) Production Tax Credit, nominal cents/kWh	2.96	3.05	3.14	3.23	3.33	3.43	3.53	3.64	3.75	3.86	3.98	4.10	4.22	4.35
(3) Production Tax Credit, \$m	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Massachusetts Green Credit														
(4) Total Generation (millions of kWh)	1,326	1,348	1,336	1,324	1,318	1,338	1,364	1,352	1,346	1,329	1,317	1,344	1,376	1,359
(5) Green credit price, nominal cents/kWh	4.68	4.82	4.96	5.11	5.27	5.42	5.59	5.75	5.93	6.10	6.29	6.48	6.67	6.87
(6) Green credit, total, \$m	62	65	66	68	69	73	76	78	80	81	83	87	92	93
Accelerated Depreciation														
(7) Five-year accelerated depreciation, \$m	-	-	-	-	-	-	-	-	-	-	-	-	-	-
(8) Twenty-year normal depreciation, \$m	69	71	73	75	78	80	82	85	87	45	-	-	-	-
(9) Net increase in taxable income, \$m	(69)	(71)	(73)	(75)	(78)	(80)	(82)	(85)	(87)	(45)	-	-	-	-
(10) Net reduction in taxes, \$m	(22)	(23)	(23)	(24)	(25)	(25)	(26)	(27)	(28)	(14)	-	-	-	-
Taxes														
(11) Massachusetts income tax, \$m	9	14	15	15	16	13	19	19	20	20	20	17	23	23
(12) Federal income tax, \$m	29	47	49	51	54	44	62	64	65	67	68	58	76	77
(13) Property tax, \$m	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(14) Subsidies net of taxes	24	4	3	2	(1)	15	(5)	(5)	(5)	(6)	(6)	12	(7)	(7)
(15) Total Generation (millions of kWh)	1,326	1,348	1,336	1,324	1,318	1,338	1,364	1,352	1,346	1,329	1,317	1,344	1,376	1,359
(16) Average ex-factory price, nominal cents/kWh	8.29	8.58	8.83	9.04	9.39	9.68	9.97	10.27	10.58	10.90	11.22	11.56	11.91	12.26
(17) Sales revenue, \$m	113	119	122	124	128	134	140	143	147	150	153	160	169	172
(18) Revenue from sales and MA green credits, \$m	175	184	188	191	197	206	217	221	227	231	235	247	261	266
(19) Revenue: sales, MA credits, Federal PTC, \$m	175	184	188	191	197	206	217	221	227	231	235	247	261	266
(20) Net Operating Income \$m	175	184	188	191	197	206	217	221	227	231	235	247	261	266
(21) Net Income Before Tax, \$m	92	147	154	160	170	139	197	201	207	210	215	183	240	244
(22) Pre-Tax Cash Flow, \$m	52	107	109	108	118	86	196	201	206	210	215	182	238	244
(23) Final cash flow (to equity), \$m	15	47	46	42	48	29	115	118	121	123	126	107	140	143
(24) Memo: Consumer Price Index (100 in 2004)	161.48	166.32	171.31	176.45	181.75	187.20	192.81	198.60	204.56	210.69	217.01	223.52	230.23	237.14

Note: Federal income tax liabilities here are computed on the assumption that accelerated depreciation is applied.