Initial Results

Eight Distribution Planning Opportunities

Discussion Document
Distribution Planning Working Group
Massachusetts Distributed Generation Collaborative
October 19, 2005

NAVIGANT CONSULTING

Agenda

I. Introduction

II. Preliminary Conclusions

III. Status Quo/Customer Ownership

IV. Active Case/Utility Ownership

V. Active Case/Customer Ownership

VI. Next Steps

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The major purpose of the analysis of the eight opportunities is to test the DG/Distribution Planning hypothesis.

- Hypothesis: "DG contributes value to distribution planning and meets customer needs"
- There are three conditions that must be met for the hypothesis to be correct
  - There must be enough DG **capacity** to meet the distribution system shortfall (forecasted load – 2005 distribution system capacity).
  - The DG r**eliability** must meet distribution planning needs
  - The **economics** for DG customers/owners and utilities must be favorable.

Our analysis will consider a status quo and active scenarios for each of the eight DG and distribution planning opportunities.

Status Quo

DG grows without tight integration with distribution planning

Customer Ownership

Status Quo Analysis – Include only DG values that can be captured today

Assumptions

- DG penetrates the customer base on the eight distribution planning opportunity areas based on the savings that DG will provide customers.
- Current customer incentives are included in economic analysis.
- DG penetration is based on customer payback.
- No new incentives (e.g. value of distribution deferral).

Active

DG is tightly integrated with distribution and is relied upon to meet demand

Customer Ownership

Distribution Deferral Value Included

Customer Case - Similar to passive analysis but will also include distribution deferral payment and customer recruitment.

Other values included

- Customer case – add additional values and associated costs

Utility Ownership

Distribution Deferral Value Included

Utility ownership and control of DG

Other values included

- Utility case – add additional values and associated costs

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Without an active program DG is not likely to meet the capacity shortfalls.

	Status Quo		Active			
	Customer Ownership		Utility Ownership		Customer Ownership	
	Ability of DG to meet shortfall	Length of deferral	Ability of DG to meet shortfall	Length of deferral	Ability of DG to meet shortfall	Length of deferral
NGRID Norwell	◒	1 yr	●	7 yr	◒	2 yr
NGRID Worcester	○	N/A	●	10 yr	○	N/A
FG&E Lunenberg	◒	1 yr	●	9 yr	◒	2 yr
FG&E Leominster	Not tested	N/A	●	10 yr	○	N/A
NSTAR Woburn	○	N/A	●	10 yr	○	N/A
NSTAR Framingham	●	10 years	●	9 yr	●	10 yr
WMECO Circuit	◒	1 yr	●	7 yr	◒	3 yr
WMECO Substation	◒	1 yr	●	7 yr	◒	1 yr

● **DG alone meets capacity requirements**

◒ **DG is part of a portfolio that meets capacity requirements**

○ **DG does not meet capacity requirements**

DG could provide adequate reliability in some cases.

- Status Quo/Customer Ownership – DG doesn't meet the reliability requirements in most cases since it will not provide enough capacity.
- Active/Customer Ownership – Under certain circumstances, DG could meet the reliability requirements if there is enough diversity of resources and other resources (energy efficiency and demand response) are used to firm DG capacity.
- Active/Utility Ownership – The analysis assumed that the utilities would add enough DG capacity to meet their needs for reliability.

In some cases DG provide positive NPVs for utilities.

Customer Ownership

Status Quo and Active Utility DG Ownership

- Customer Perspective – An underlying assumption for the analysis is that a customer will not install DG unless it meets their requirements for savings.
- Utility Perspective – The impact on utility economics has not been evaluated.

Active – Utility Ownership*

Opportunity	NPV
NGRID Norwell	- $1,325,000
NGRID Worcester	- $802,000
FG&E Lunenberg	- $867,000
FG&E Leominster	$90,000
NSTAR Woburn	- $38,000
NSTAR Framingham	-$432,000
WMECO Substation	$1,111,000
WMECO Circuit	- $522,000

***Results have not been optimized, NPVs may improve**

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Preliminary Conclusions

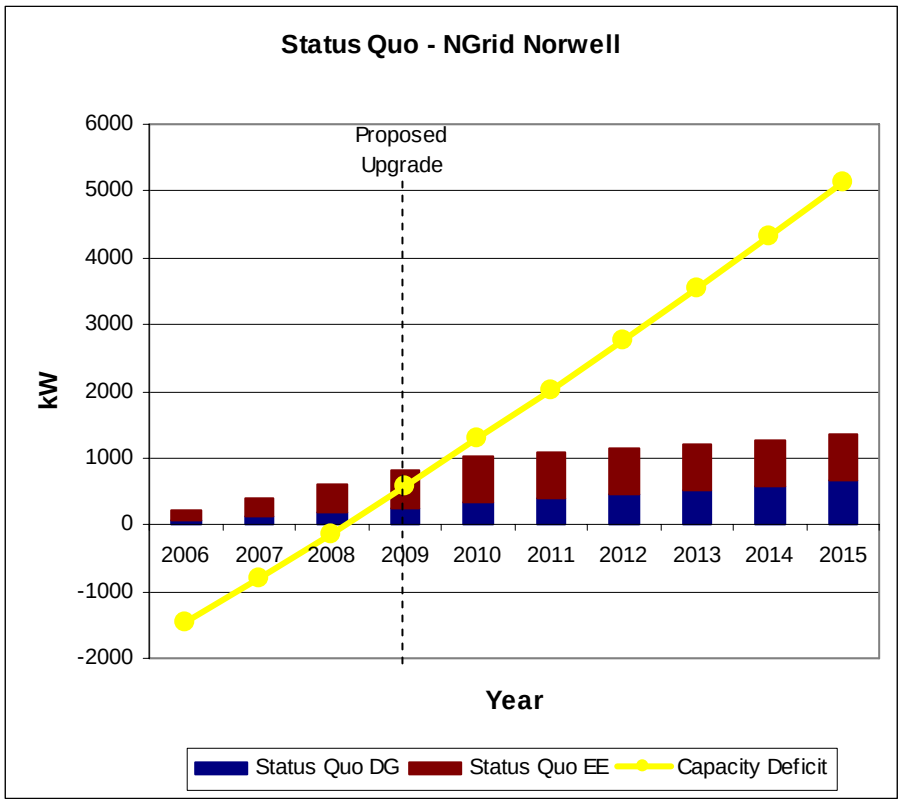
- In most cases, DG alone is not enough to meet the capacity shortfalls. Energy efficiency combined with DG can meet shortfalls in some cases; however, the deferral period is short.
- Small recip engines are the most attractive technologies; PV can beat recip engines in some cases.
- Characteristics of a good opportunity for DG in distribution planning:
  - System near capacity, but need is still several years out
  - Large customers with thermal demand
  - Slow growth
  - Shortfall is small relative to the load

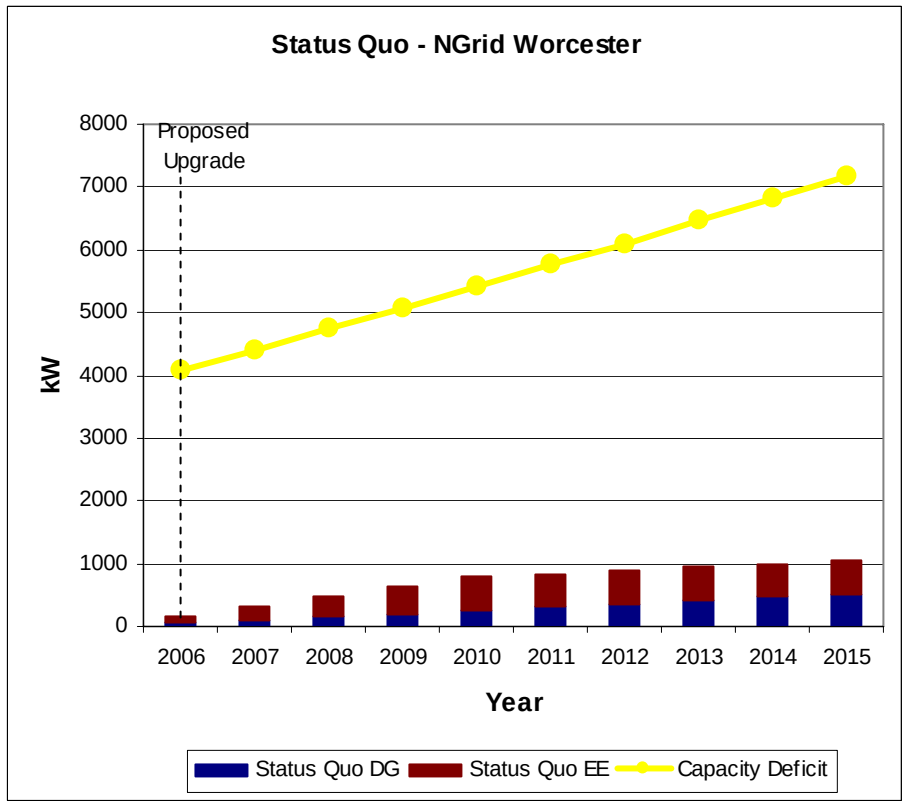
Assumptions

- Distributed Generation
  - Customer maximum demand and annual energy use are provided by the electric distribution companies
  - Electric and gas prices for Jan 1, 2005 to Dec 31, 2005 (For some utilities the Nov & Dec cost of gas and electric generation are estimated)
  - DG performance parameters, installation and operating costs as provided in the NREL report, Gas-Fired Distributed Energy Resource Technology Characterizations, October 2003
  - Cumulative market penetration determined from the curve -- Average of Kastovich and ADL
  - Linear market adoption, with 100% occurring in year 10

- Energy Efficiency
  - The amount of energy efficiency that can be achieved is 10% of all customers' maximum demand
  - The payback for all customers is 5 years
  - Cumulative market penetration determined from the curve -- Average of Kastovich and ADL
  - Linear market adoption, with 100% occurring in year 5

In the Norwell Opportunity, DG and Energy Efficiency could provide a one-yr deferral.





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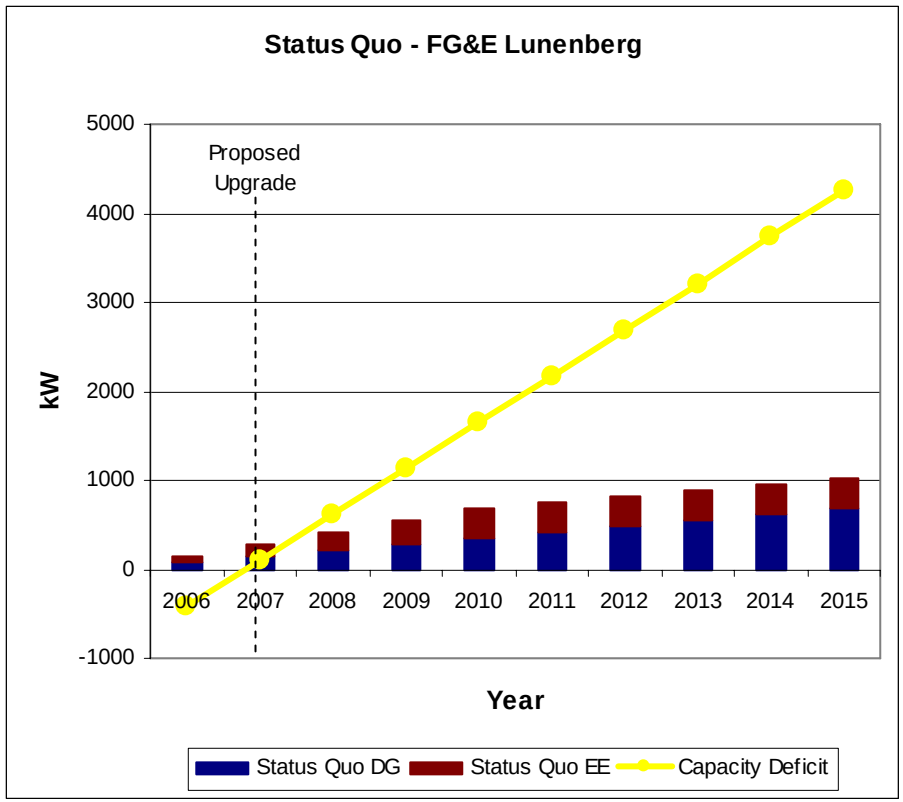
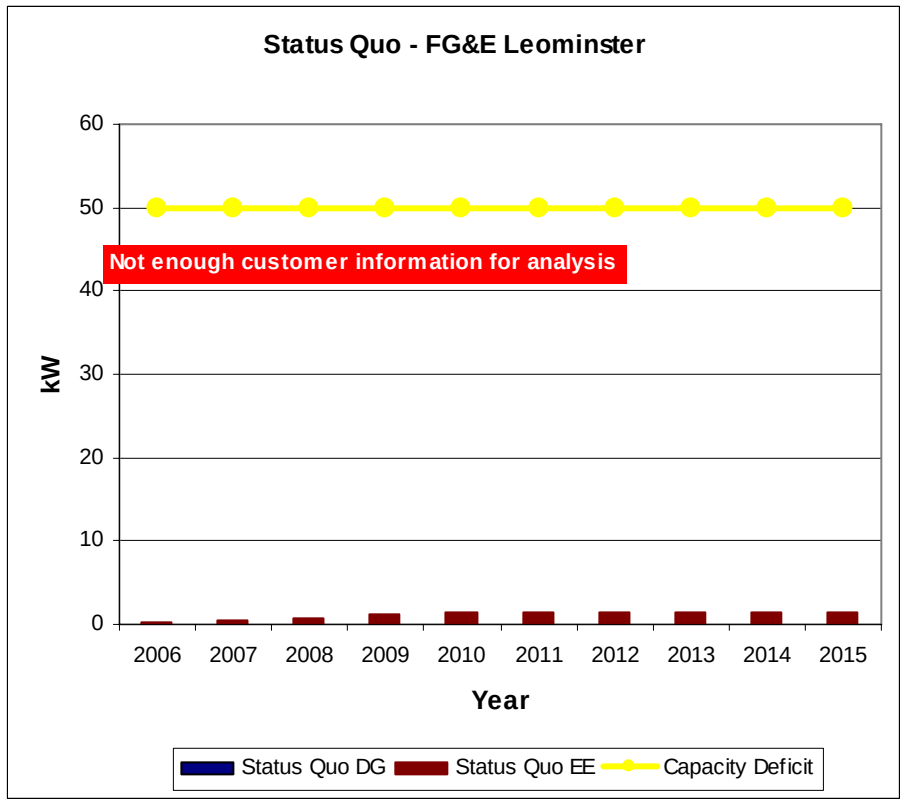
In the Lunenberg Opportunity, DG and Energy Efficiency could provide a one-yr deferral.





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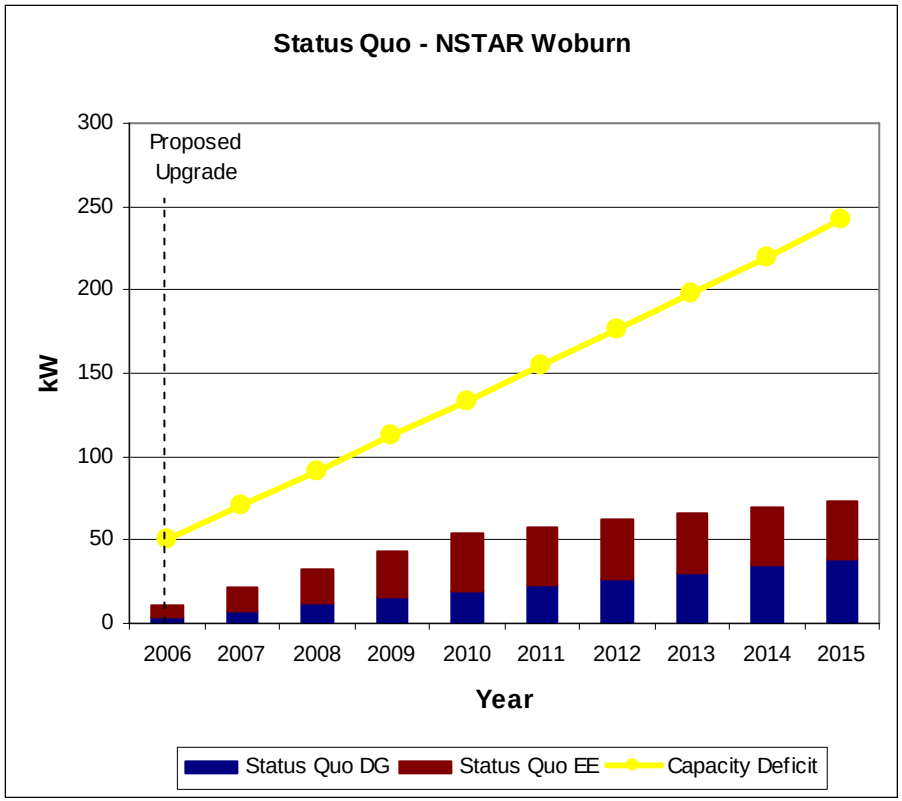
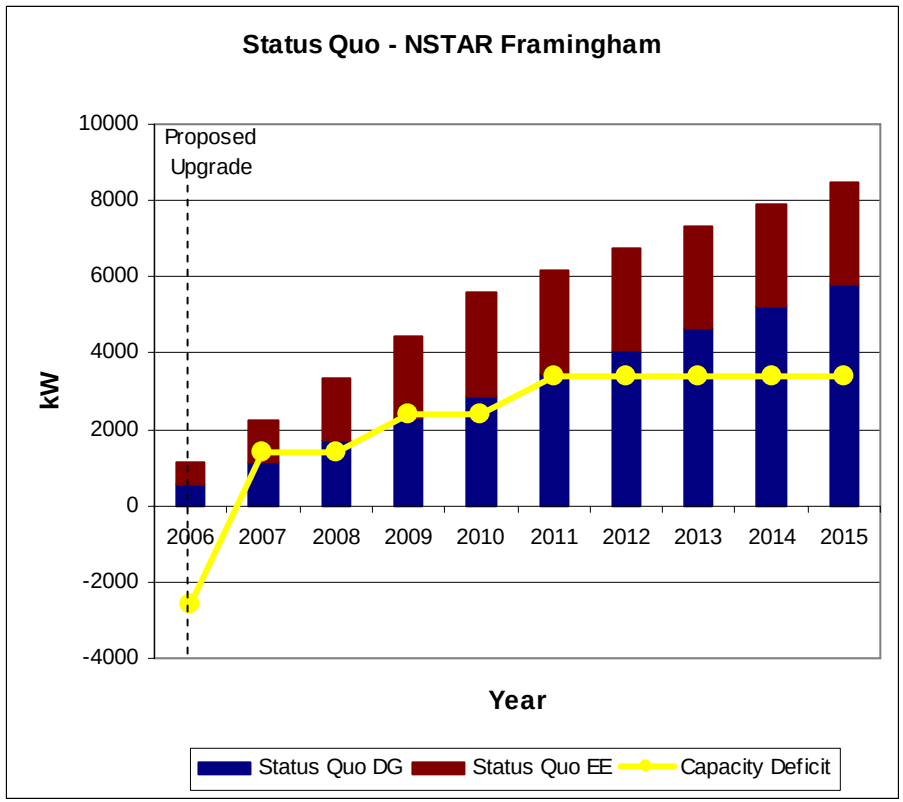
For the Framingham Opportunity, DG alone may meet the capacity shortfall.





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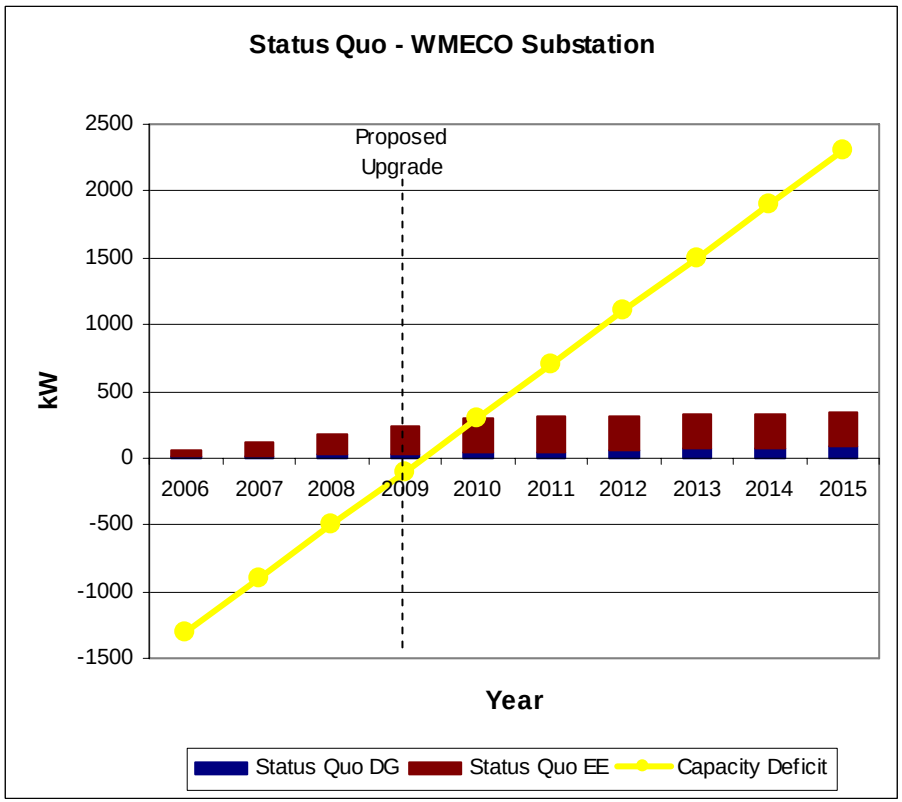
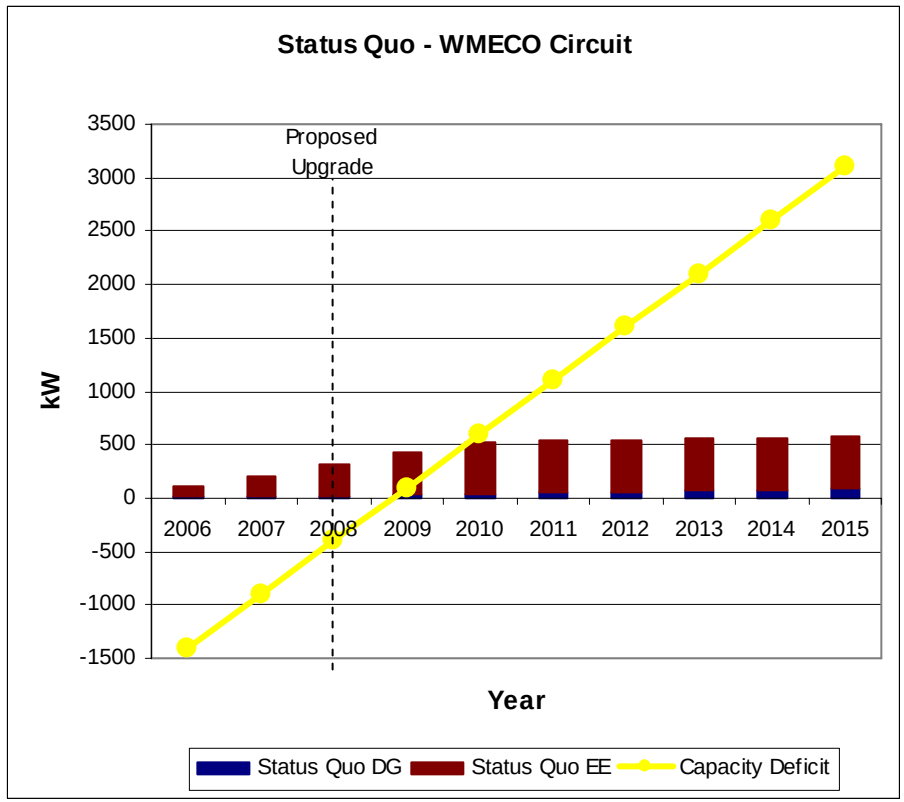
In the WMECO opportunities, DG and Energy Efficiency could provide one-yr deferrals.





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The DG opportunity may be understated, since the analysis doesn't address growth and is limited to the 2004 customer loads.

Targeted Customer Load as a Percentage of Forecasted Load

Year	NGRID NORWELL	NGRID WORCESTER	FG&E LUNENBERG	FG&E LEOMINSTER	NSTAR WOBURN	NSTAR FRAMINGHAM	WMECO SUBSTATION	WMECO CIRCUIT
2006	96%	78%	69%	100%	58%	84%	39%	87%
2007	93%	77%	67%	100%	58%	81%	38%	85%
2008	91%	76%	65%	100%	57%	81%	38%	83%
2009	89%	75%	63%	100%	57%	81%	37%	81%
2010	87%	74%	61%	100%	56%	81%	37%	79%
2011	85%	73%	59%	100%	55%	80%	37%	77%
2012	83%	72%	57%	100%	55%	80%	36%	75%
2013	81%	71%	56%	100%	54%	80%	36%	74%
2014	79%	70%	54%	100%	54%	80%	35%	72%
2015	77%	69%	53%	100%	53%	80%	35%	71%
2016	75%	68%	51%	100%	53%	80%	35%	69%
2017	73%	67%	50%	100%	52%	79%	34%	67%
2018	71%	66%	48%	100%	52%	79%	34%	66%
2019	69%	65%	47%	100%	51%	78%	33%	64%
2020	68%	64%	46%	100%	51%	78%	33%	63%
2021	66%	64%	44%	100%	50%	77%	33%	61%
2022	64%	63%	43%	100%	50%	77%	32%	60%
2023	63%	62%	42%	100%	49%	77%	32%	59%
2024	61%	61%	41%	100%	49%	76%	32%	57%
2025	60%	60%	40%	100%	48%	76%	31%	56%

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Preliminary Conclusions

- In most cases, DG was not an economic solution
- Despite the higher capital costs, several smaller units are more attractive than one large unit in meeting reliability requirements.
- The characteristics of the best opportunities
  - Shortfall is small relative to the forecasted load
  - High cost distribution solution relative to the need
- Deferral value per kW is much higher in the earlier years
- The amount of DG needed to meet the reliability threshold is significantly higher than the shortfall.
- The number of hours that DG needs to run is short (most cases capacity factor = 1%-3%)
- The results of this analysis have not been optimized.
  - For example, improving diversity by using smaller units could improve NPV, since fewer MWs are required to meet the reliability limits.

Assumptions

1) Utility Model

- Utilities are allowed to own small, distributed generation
- DG can be moved when it no longer can meet reliability criteria (i.e., T&D Solution is implemented)
- Last year of NPV analysis is 2015 (to coincide with prior utility economic case studies) – Note that shorter (or longer) timeframes could alter results
- Discount rate based on utility weighted cost of capital
- Have assumed sufficient DG must be installed to meet a peak load reliability threshold of 0.999
- We assume the existing system is 100% reliable in setting the 0.999 threshold
- DG only operates when loads exceed equipment ratings
- Most utility ownership cases include installation of diesels w/o emission control systems (Range: $400 - $600/kW)
- DG units operate independently – a forced outage of one unit does not influence the likelihood of an outage of other units
- The utility can receive capacity and energy benefits for DG based on market rates
- Used the same load profile (LDC) and load factor for all cases
- Revenue requirements model used to calculate NPV
- DG costs include cost of capital (rate base), working capital, depreciation, property taxes, state and federal taxes, fuel and O&M
- DG asset life and depreciation schedule set at approximately 35 years; depreciation is straight-line
- Property taxes assumed to be 2% for all cases

2) Customer and Deferral Savings Model

- Use revenue requirements model to estimate value of deferral
- T&D deferral values include cost of capital (rate base), working capital, depreciation, property taxes, state and federal taxes, O&M and demand and energy losses
- Discount rate based on utility weighted cost of capital
- Losses are estimated at 6% (average)
- Distribution O&M based on percent of initial installation cost (1.5% assumed)
- T&D asset life and depreciation schedule set at approximately 30 years; depreciation is straight-line
- Property taxes assumed to be 2% for all cases
- Same reliability model and criteria used for customer ownership options

The deferral savings are calculated using a revenue requirements approach.

WMECO Substation Opportunity

DISCOUNTED CASH FLOW ANALYSIS
REVENUE REQUIREMENTS APPROACH (DECLINING BALANCE)

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Deferred Capacity										
T&D Plant Balance	$ -	$ -	$ -	$ 2,300,000	$ 2,300,000	$ 2,300,000	$ 2,300,000	$ 2,300,000	$ 2,300,000	$ 2,300,000
Working Capital	$ -	$ -	$ -	$ 287,500	$ 287,500	$ 287,500	$ 287,500	$ 287,500	$ 287,500	$ 287,500
Less Accumulated Depreciation	$ -	$ -	$ -	$ (40,250)	$ (120,750)	$ (201,250)	$ (281,750)	$ (362,250)	$ (442,750)	$ (523,250)
ADIT	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Net Rate Base	**$ -**	**$ -**	**$ -**	**$ 2,547,250**	**$ 2,466,750**	**$ 2,386,250**	**$ 2,305,750**	**$ 2,225,250**	**$ 2,144,750**	**$ 2,064,250**
Operating Savings										
Fuel & Purch Power	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Open Access Transmission	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Operation & Maintenance	$ -	$ -	$ -	$ 37,699	$ 38,830	$ 39,995	$ 41,195	$ 42,431	$ 43,704	$ 45,015
Depreciation	$ -	$ -	$ -	$ 80,500	$ 80,500	$ 80,500	$ 80,500	$ 80,500	$ 80,500	$ 80,500
Property Taxes	$ -	$ -	$ -	$ 46,000	$ 46,000	$ 46,000	$ 46,000	$ 46,000	$ 46,000	$ 46,000
Avoided Losses	$ -	$ -	$ -	$ 1,654	$ 3,392	$ 3,510	$ 5,406	$ 5,569	$ 7,636	$ 7,865
Net Deductions	**$ -**	**$ -**	**$ -**	**$ 165,853**	**$ 168,722**	**$ 170,005**	**$ 173,101**	**$ 174,499**	**$ 177,839**	**$ 179,380**
Debt and Return on Equity										
Interest on Debt	$ -	$ -	$ -	$ 79,067	$ 76,568	$ 74,069	$ 71,570	$ 69,072	$ 66,573	$ 64,074
Return on Equity	$ -	$ -	$ -	$ 118,600	$ 114,852	$ 111,104	$ 107,356	$ 103,608	$ 99,860	$ 96,111
State & Federal Taxes	$ -	$ -	$ -	$ 70,555	$ 68,325	$ 66,095	$ 63,866	$ 61,636	$ 59,406	$ 57,176
Net Savings - Cost of Capital	**$ -**	**$ -**	**$ -**	**$ 268,221**	**$ 259,745**	**$ 251,268**	**$ 242,792**	**$ 234,315**	**$ 225,839**	**$ 217,362**
Net Savings After Taxes	**$ -**	**$ -**	**$ -**	**$ 434,074**	**$ 428,467**	**$ 421,273**	**$ 415,893**	**$ 408,815**	**$ 403,678**	**$ 396,742**

Net Present Value	**$ 1,751,060**

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Explain how cost module works

WMECO Substation Opportunity

DISCOUNTED CASH FLOW ANALYSIS
REVENUE REQUIREMENTS APPROACH (DECLINING BALANCE)

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
DG Capacity Cost										
DG Plant Balance	$ -	$ -	$ -	$ 583,495	$ 1,202,525	$ 1,202,525	$ 1,859,254	$ 1,859,254	$ 2,555,977	$ 2,555,977
Working Capital	$ -	$ -	$ -	$ 72,937	$ 150,316	$ 150,316	$ 232,407	$ 232,407	$ 319,497	$ 319,497
Less Accumulated Depreciation	$ -	$ -	$ -	$ (26,257)	$ (53,048)	$ (89,123)	$ (135,050)	$ (190,828)	$ (257,056)	$ (333,735)
ADIT	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Net Rate Base	**$ -**	**$ -**	**$ -**	**$ 630,175**	**$ 1,299,793**	**$ 1,263,717**	**$ 1,956,610**	**$ 1,900,833**	**$ 2,618,418**	**$ 2,541,739**
Operating Costs										
Fuel	$ -	$ -	$ -	$ 289	$ 232	$ 382	$ 394	$ 406	$ 418	$ 430
Operation & Maintenance	$ -	$ -	$ -	$ 41	$ 33	$ 54	$ 56	$ 57	$ 59	$ 61
Depreciation	$ -	$ -	$ -	$ 17,505	$ 36,076	$ 36,076	$ 55,778	$ 55,778	$ 76,679	$ 76,679
Property Taxes	$ -	$ -	$ -	$ 11,670	$ 24,050	$ 24,050	$ 37,185	$ 37,185	$ 51,120	$ 51,120
Operating Costs	**$ -**	**$ -**	**$ -**	**$ 29,505**	**$ 60,391**	**$ 60,563**	**$ 93,412**	**$ 93,426**	**$ 128,276**	**$ 128,290**
Operating Savings										
Capacity	$ -	$ -	$ -	$ 27,318	$ 56,275	$ 57,964	$ 89,554	$ 92,241	$ 126,677	$ 130,477
Energy	$ -	$ -	$ -	$ 244	$ 261	$ 538	$ 554	$ 570	$ 587	$ 605
Avoided Losses	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Lost Revenues (Credit)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Operating Savings	**$ -**	**$ -**	**$ -**	**$ 27,562**	**$ 56,536**	**$ 58,501**	**$ 90,108**	**$ 92,811**	**$ 127,264**	**$ 131,082**
Debt Cost and Return on Equity										
Interest on Debt	$ -	$ -	$ -	$ 19,561	$ 40,346	$ 39,226	$ 60,733	$ 59,002	$ 81,276	$ 78,896
Return on Equity	$ -	$ -	$ -	$ 29,341	$ 60,518	$ 58,839	$ 91,100	$ 88,503	$ 121,914	$ 118,343
State & Federal Taxes	$ -	$ -	$ -	$ 17,455	$ 36,002	$ 35,003	$ 54,195	$ 52,650	$ 72,526	$ 70,402
Net Equity	**$ -**	**$ -**	**$ -**	**$ 66,356**	**$ 136,866**	**$ 133,067**	**$ 206,028**	**$ 200,155**	**$ 275,715**	**$ 267,641**
Net Cost	**$ -**	**$ -**	**$ -**	**$ 68,299**	**$ 140,721**	**$ 135,129**	**$ 209,332**	**$ 200,769**	**$ 276,727**	**$ 264,849**

Net Present Value	**$ 734,938**

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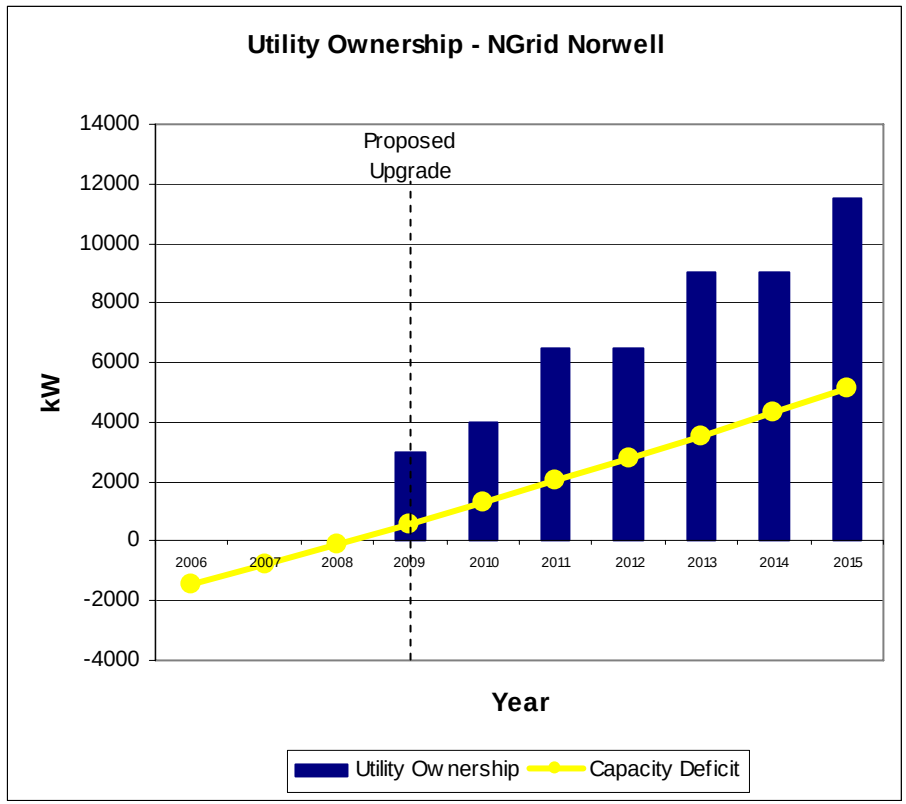
In the Norwell opportunity, 6 MW of DG would be added over a 7-yr period to meet the capacity shortfall and reliability requirements.

CASE ASSUMPTIONS & DATA:

Utility Selected	**NGRID**
Case No.	**5**
Ownership	**Utility**
Number of DG Units	**6.0**
First Year Annual Peak Load (MW)	**26.53**
Existing System Rating	**28**
Cost of T&D Solution	**$900,000**
Max DG Capacity Added (kW)	**11500**
Number of Units Installed	**6**
Start Year for Deferral	**2009**
Start Year	**2006**
Last Year DG Solution is Viable	**2015**
Inflation Rate	**3.0%**
Generation Cost Escalation	**3.0%**
Market Value of Capacity	**Base**
Market Value of Energy	**Base**
Fuel Cost ($/MMBTU)	**$8.0**
Fuel Cost Escalator	**3.0%**
Cost of Capital	**0.080**
Load Factor	**55.0%**
Distribution O&M as a % of Cap Cost	**1.5%**
Lost Revenues?	**No**
Avoided Losses	**6.0%**



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The Norwell Opportunity would have a negative NPV.

CASE DESCRIPTION: **NGRID Norwell**

Year	DG Cap. Added	DG Capital Cost	DG Annual Cost	Deferral Savings	Savings/(Cost)
2006	0.0	$ -	$ -	$ -	$ -
2007	0.0	$ -	$ -	$ -	$ -
2008	0.0	$ -	$ -	$ -	$ -
2009	3000.0	$ 1,884,954	$ 239,436	$ 177,375	$ (62,061)
2010	1000.0	$ 450,204	$ 279,512	$ 176,251	$ (103,261)
2011	2500.0	$ 1,738,911	$ 492,162	$ 177,890	$ (314,272)
2012	0.0	$ -	$ 472,743	$ 175,392	$ (297,352)
2013	2500.0	$ 1,844,811	$ 688,880	$ 177,648	$ (511,232)
2014	0.0	$ -	$ 657,595	$ 175,698	$ (481,897)
2015	2500.0	$ 1,957,160	$ 871,616	$ 179,078	$ (692,538)
2016	0.0	$ -	$ -	$ -	$ -
2017	0.0	$ -	$ -	$ -	$ -
2018	0.0	$ -	$ -	$ -	$ -
2019	0.0	$ -	$ -	$ -	$ -
2020	0.0	$ -	$ -	$ -	$ -
2021	0.0	$ -	$ -	$ -	$ -
2022	0.0	$ -	$ -	$ -	$ -
2023	0.0	$ -	$ -	$ -	$ -
2024	0.0	$ -	$ -	$ -	$ -
2025	0.0	$ -	$ -	$ -	$ -
TOTAL	**11500.0**	**$ 7,876,039**	**$ 3,701,944**	**$ 1,239,331**	**$ (2,462,613)**

NET PRESENT VALUE:	**($2,057,079)**	**$731,587**	**($1,325,491)**

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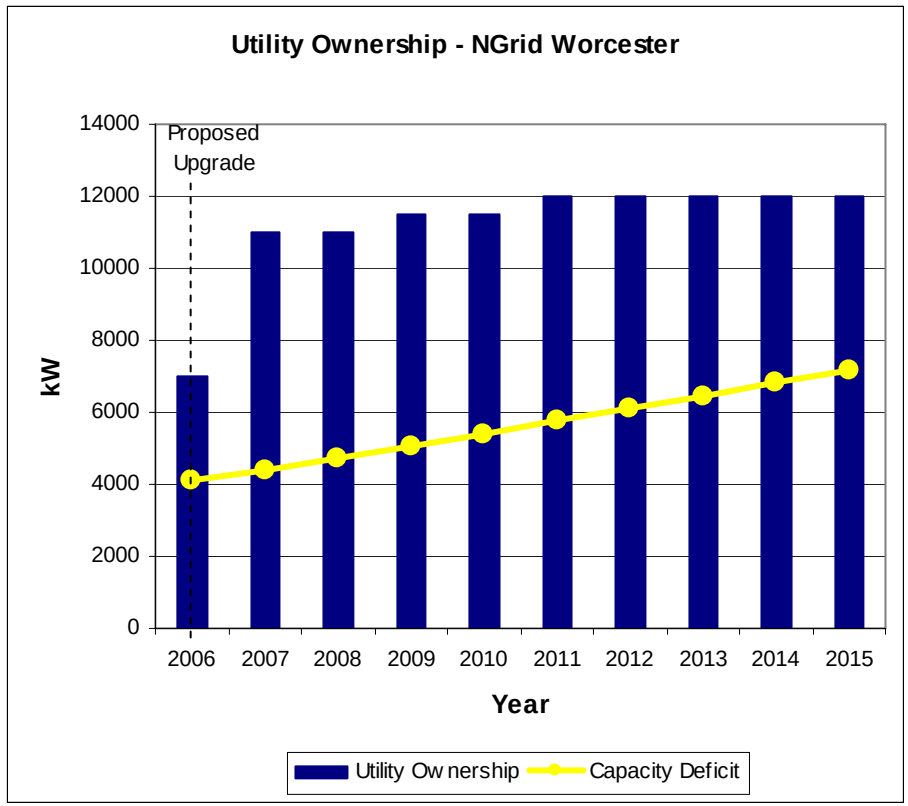
In the Worcester opportunity, 12 MW of DG would be added over a 10-year period to meet the shortfall and reliability requirements.

CASE ASSUMPTIONS & DATA:

Utility Selected	**NGRID**
Case No.	**6**
Ownership	**Utility**
Number of DG Units	**8.0**
First Year Annual Peak Load (MW)	**23.18**
Existing System Rating	**19.1**
Cost of T&D Solution	**$2,100,000**
Max DG Capacity Added (kW)	**12000**
Number of Units Installed	**8**
Start Year for Deferral	**2006**
Start Year	**2006**
Last Year DG Solution is Viable	**2011**
Inflation Rate	**3.0%**
Generation Cost Escalation	**3.0%**
Market Value of Capacity	**Base**
Market Value of Energy	**Base**
Fuel Cost ($/MMBTU)	**$8.0**
Fuel Cost Escalator	**3.0%**
Cost of Capital	**0.080**
Load Factor	**55.0%**
Distribution O&M as a % of Cap Cost	**1.5%**
Lost Revenues?	**No**
Avoided Losses	**6.0%**



NAVIGANT CONSULTING

The Worcester Opportunity would have a negative NPV.

CASE DESCRIPTION: **NGRID Worcester**

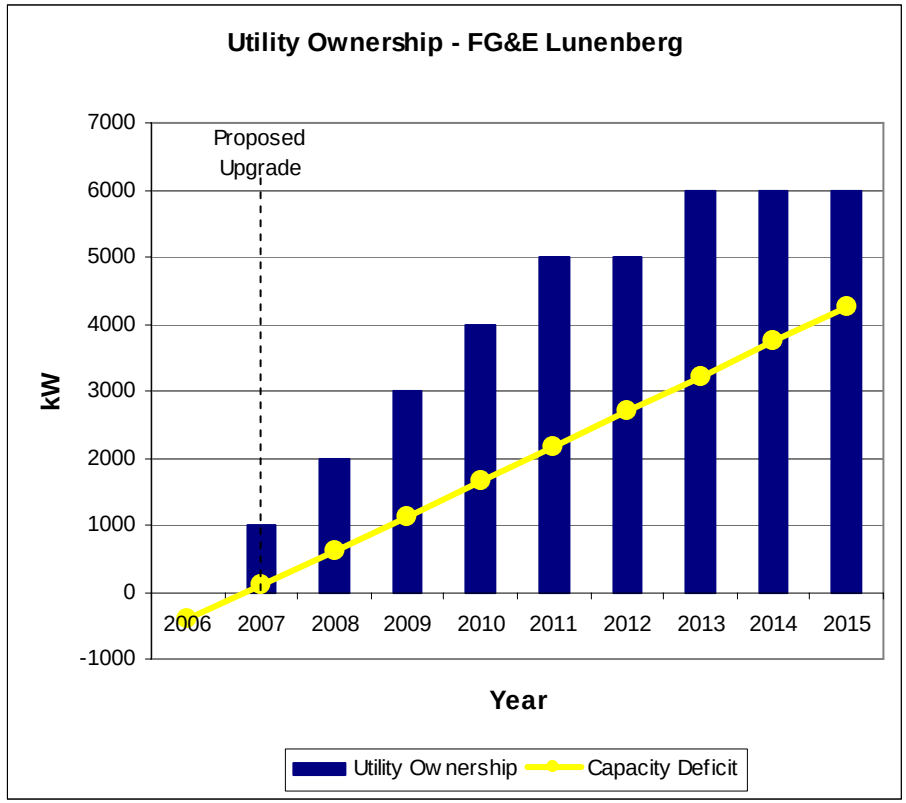
Year	DG Cap. Added	DG Capital Cost	DG Annual Cost	Deferral Savings	Savings/(Cost)
2006	7000.0	$ 3,500,000	$ 412,746	$ 411,659	$ (1,086)
2007	4000.0	$ 2,266,000	$ 666,534	$ 411,750	$ (254,785)
2008	0.0	$ -	$ 631,965	$ 406,026	$ (225,939)
2009	500.0	$ 245,864	$ 622,696	$ 401,319	$ (221,377)
2010	0.0	$ -	$ 583,383	$ 395,994	$ (187,388)
2011	500.0	$ 260,837	$ 570,591	$ 391,728	$ (178,864)
2012	0.0	$ -	$ -	$ -	$ -
2013	0.0	$ -	$ -	$ -	$ -
2014	0.0	$ -	$ -	$ -	$ -
2015	0.0	$ -	$ -	$ -	$ -
2016	0.0	$ -	$ -	$ -	$ -
2017	0.0	$ -	$ -	$ -	$ -
2018	0.0	$ -	$ -	$ -	$ -
2019	0.0	$ -	$ -	$ -	$ -
2020	0.0	$ -	$ -	$ -	$ -
2021	0.0	$ -	$ -	$ -	$ -
2022	0.0	$ -	$ -	$ -	$ -
2023	0.0	$ -	$ -	$ -	$ -
2024	0.0	$ -	$ -	$ -	$ -
2025	0.0	$ -	$ -	$ -	$ -
TOTAL	**12000.0**	**$ 6,272,700**	**$ 3,487,915**	**$ 2,418,476**	**$ (1,069,439)**

NET PRESENT VALUE:	**($2,669,602)**	**$1,867,835**	**($801,767)**

In the Lunenberg Opportunity, 6 MW of DG would be added to meet the capacity shortfall and reliability requirements.

CASE ASSUMPTIONS & DATA:

Utility Selected	**FG&E**
Case No.	**3**
Ownership	**Utility**
Number of DG Units	**6.0**
First Year Annual Peak Load (MW)	**15.56**
Existing System Rating	**15.98**
Cost of T&D Solution	**$603,000**
Max DG Capacity Added (kW)	**6000**
Number of Units Installed	**6**
Start Year for Deferral	**2007**
Start Year	**2006**
Last Year DG Solution is Viable	**2015**
Inflation Rate	**3.0%**
Generation Cost Escalation	**3.0%**
Market Value of Capacity	**Base**
Market Value of Energy	**Base**
Fuel Cost ($/MMBTU)	**$8.0**
Fuel Cost Escalator	**3.0%**
Cost of Capital	**0.085**
Load Factor	**55.0%**
Distribution O&M as a % of Cap Cost	**1.5%**
Lost Revenues?	**No**
Avoided Losses	**6.0%**



NAVIGANT CONSULTING

The Lunenberg Opportunity would have a negative NPV.

CASE DESCRIPTION: **FG&E Lunenberg**

Year	DG Cap. Added	DG Capital Cost	DG Annual Cost	Deferral Savings	Savings/(Cost)
2006	0.0	$ -	$ -	$ -	$ -
2007	1000.0	$ 566,500	$ 75,105	$ 121,053	$ 45,949
2008	1000.0	$ 583,495	$ 149,767	$ 120,543	$ (29,224)
2009	1000.0	$ 601,000	$ 224,051	$ 120,161	$ (103,889)
2010	1000.0	$ 619,030	$ 297,408	$ 119,935	$ (177,473)
2011	1000.0	$ 637,601	$ 369,428	$ 119,923	$ (249,506)
2012	0.0	$ -	$ 353,488	$ 118,442	$ (235,045)
2013	1000.0	$ 676,431	$ 423,003	$ 119,145	$ (303,858)
2014	0.0	$ -	$ 398,643	$ 118,504	$ (280,139)
2015	0.0	$ -	$ 371,721	$ 118,328	$ (253,393)
2016	0.0	$ -	$ -	$ -	$ -
2017	0.0	$ -	$ -	$ -	$ -
2018	0.0	$ -	$ -	$ -	$ -
2019	0.0	$ -	$ -	$ -	$ -
2020	0.0	$ -	$ -	$ -	$ -
2021	0.0	$ -	$ -	$ -	$ -
2022	0.0	$ -	$ -	$ -	$ -
2023	0.0	$ -	$ -	$ -	$ -
2024	0.0	$ -	$ -	$ -	$ -
2025	0.0	$ -	$ -	$ -	$ -
TOTAL	**6000.0**	**$ 3,684,056**	**$ 2,662,613**	**$ 1,076,035**	**$ (1,586,578)**

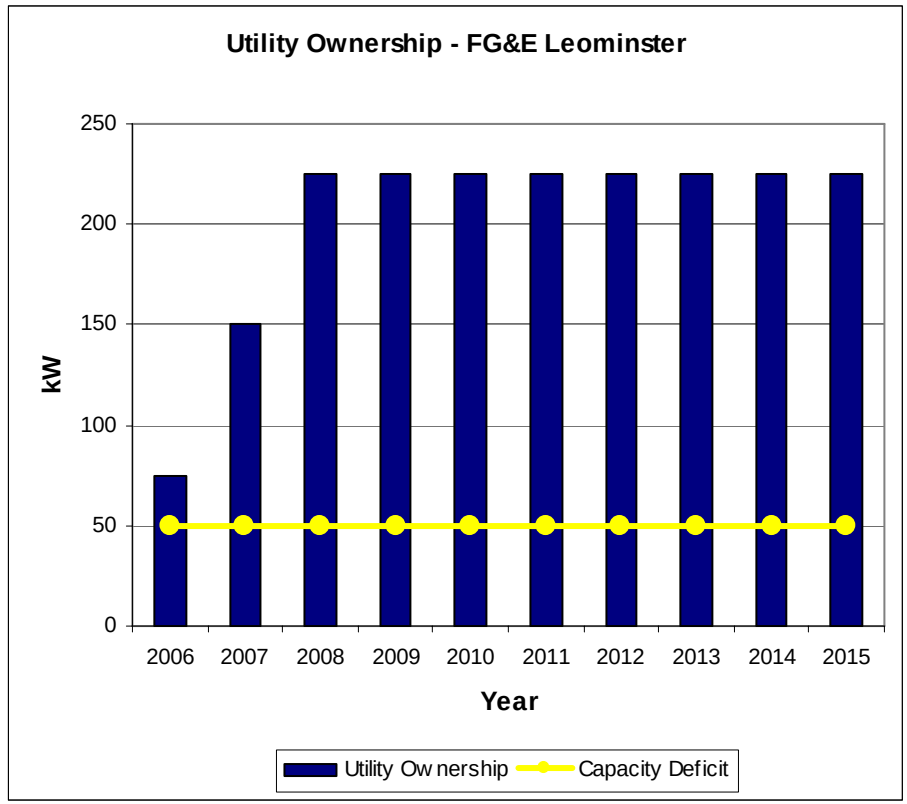
NET PRESENT VALUE:	**($1,542,597)**	**$675,326**	**($867,271)**

NAVIGANT CONSULTING

In the Leominster Opportunity, 225 kW of DG would be added to meet the capacity shortfall and reliability requirements.

CASE ASSUMPTIONS & DATA:

Utility Selected	**FG&E**
Case No.	**4**
Ownership	**Utility**
Number of DG Units	**3.0**
First Year Annual Peak Load (MW)	**0.05**
Existing System Rating	**0.001**
Cost of T&D Solution	**$250,000**
Max DG Capacity Added (kW)	**225**
Number of Units Installed	**3**
Start Year for Deferral	**2006**
Start Year	**2006**
Last Year DG Solution is Viable	**2015**
Inflation Rate	**3.0%**
Generation Cost Escalation	**3.0%**
Market Value of Capacity	**Base**
Market Value of Energy	**Base**
Fuel Cost ($/MMBTU)	**$8.0**
Fuel Cost Escalator	**3.0%**
Cost of Capital	**0.085**
Load Factor	**55.0%**
Distribution O&M as a % of Cap Cost	**1.5%**
Lost Revenues?	**No**
Avoided Losses	**6.0%**



NAVIGANT CONSULTING

The Leominster Opportunity would have a positive NPV.

CASE DESCRIPTION: **FG&E Leominster**

Year	DG Cap. Added	DG Capital Cost	DG Annual Cost	Deferral Savings	Savings/(Cost)
2006	75.0	$ 67,500	$ 18,008	$ 50,566	$ 32,558
2007	75.0	$ 69,525	$ 29,213	$ 49,924	$ 20,711
2008	75.0	$ 71,611	$ 39,735	$ 49,203	$ 9,467
2009	0.0	$ -	$ 39,112	$ 48,360	$ 9,247
2010	0.0	$ -	$ 38,492	$ 47,521	$ 9,029
2011	0.0	$ -	$ 37,876	$ 46,688	$ 8,813
2012	0.0	$ -	$ 37,262	$ 45,861	$ 8,599
2013	0.0	$ -	$ 36,651	$ 45,038	$ 8,387
2014	0.0	$ -	$ 36,044	$ 44,222	$ 8,177
2015	0.0	$ -	$ 35,441	$ 43,411	$ 7,970
2016	0.0	$ -	$ -	$ -	$ -
2017	0.0	$ -	$ -	$ -	$ -
2018	0.0	$ -	$ -	$ -	$ -
2019	0.0	$ -	$ -	$ -	$ -
2020	0.0	$ -	$ -	$ -	$ -
2021	0.0	$ -	$ -	$ -	$ -
2022	0.0	$ -	$ -	$ -	$ -
2023	0.0	$ -	$ -	$ -	$ -
2024	0.0	$ -	$ -	$ -	$ -
2025	0.0	$ -	$ -	$ -	$ -
TOTAL	**225.0**	**$ 208,636**	**$ 347,834**	**$ 470,793**	**$ 122,959**

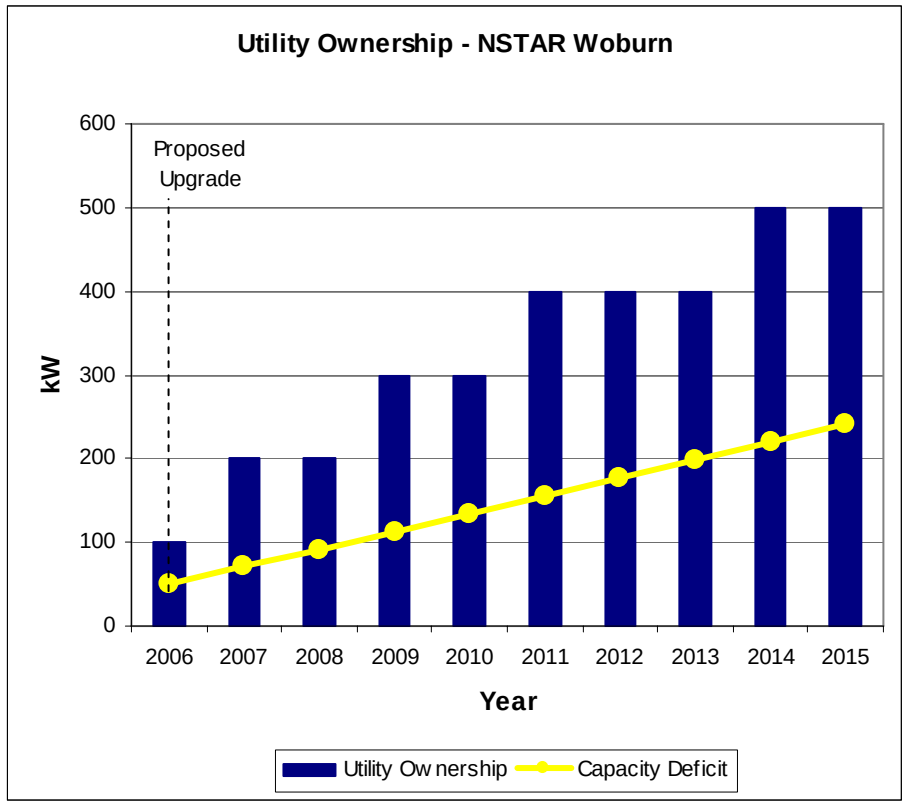
NET PRESENT VALUE:	**($222,664)**	**$312,429**	**$89,765**

NAVIGANT CONSULTING

In the Woburn Opportunity, 500 kW of DG would be added to meet the capacity shortfall and reliability requirements.

CASE ASSUMPTIONS & DATA:

Utility Selected	**NSTAR**
Case No.	**7**
Ownership	**Utility**
Number of DG Units	**5.0**
First Year Annual Peak Load (MW)	**2.05**
Existing System Rating	**2**
Cost of T&D Solution	**$60,000**
Max DG Capacity Added (kW)	**500**
Number of Units Installed	**5**
Start Year for Deferral	**2006**
Start Year	**2006**
Last Year DG Solution is Viable	**2015**
Inflation Rate	**3.0%**
Generation Cost Escalation	**3.0%**
Market Value of Capacity	**Base**
Market Value of Energy	**Base**
Fuel Cost ($/MMBTU)	**$8.0**
Fuel Cost Escalator	**3.0%**
Cost of Capital	**0.078**
Load Factor	**55.0%**
Distribution O&M as a % of Cap Cost	**1.5%**
Lost Revenues?	**No**
Avoided Losses	**6.0%**



NAVIGANT CONSULTING

The Woburn Opportunity would have a negative NPV.

CASE DESCRIPTION: **NSTAR Woburn**

Year	DG Cap. Added	DG Capital Cost	DG Annual Cost	Deferral Savings	Savings/(Cost)
2006	100.0	$ 50,000	$ 5,890	$ 11,402	$ 5,511
2007	100.0	$ 51,500	$ 11,723	$ 11,365	$ (358)
2008	0.0	$ -	$ 11,247	$ 11,180	$ (67)
2009	100.0	$ 54,636	$ 17,203	$ 11,160	$ (6,042)
2010	0.0	$ -	$ 16,464	$ 10,983	$ (5,480)
2011	100.0	$ 57,964	$ 22,515	$ 10,982	$ (11,533)
2012	0.0	$ -	$ 21,479	$ 10,815	$ (10,664)
2013	0.0	$ -	$ 20,429	$ 10,650	$ (9,779)
2014	100.0	$ 63,339	$ 26,770	$ 10,678	$ (16,092)
2015	0.0	$ -	$ 25,370	$ 10,526	$ (14,843)
2016	0.0	$ -	$ -	$ -	$ -
2017	0.0	$ -	$ -	$ -	$ -
2018	0.0	$ -	$ -	$ -	$ -
2019	0.0	$ -	$ -	$ -	$ -
2020	0.0	$ -	$ -	$ -	$ -
2021	0.0	$ -	$ -	$ -	$ -
2022	0.0	$ -	$ -	$ -	$ -
2023	0.0	$ -	$ -	$ -	$ -
2024	0.0	$ -	$ -	$ -	$ -
2025	0.0	$ -	$ -	$ -	$ -
TOTAL	**500.0**	**$ 277,439**	**$ 179,088**	**$ 109,742**	**$ (69,346)**

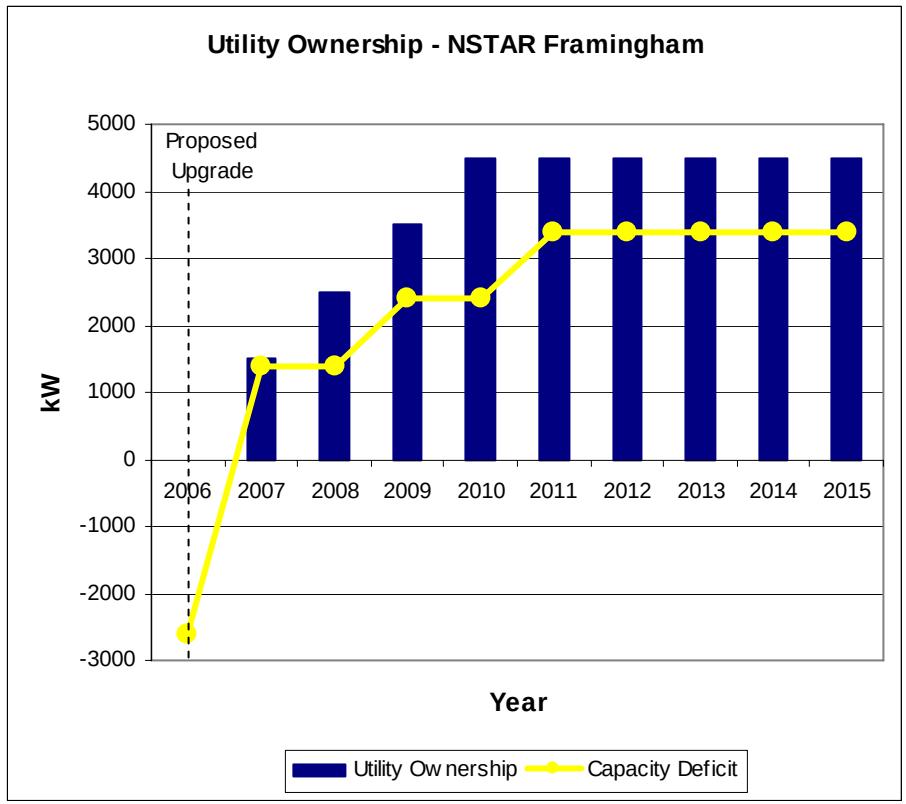
NET PRESENT VALUE:	**($112,287)**	**$74,652**	**($37,634)**

NAVIGANT CONSULTING

In the Framingham Opportunity, 4.5 MW of DG would be added to meet the capacity shortfall and reliability requirements.

CASE ASSUMPTIONS & DATA:

Utility Selected	**NSTAR**
Case No.	**8**
Ownership	**Utility**
Number of DG Units	**4.0**
First Year Annual Peak Load (MW)	**119.00**
Existing System Rating	**121.6**
Cost of T&D Solution	**$530,000**
Max DG Capacity Added (kW)	**4500**
Number of Units Installed	**4**
Start Year for Deferral	**2006**
Start Year	**2006**
Last Year DG Solution is Viable	**2015**
Inflation Rate	**3.0%**
Generation Cost Escalation	**3.0%**
Market Value of Capacity	**Base**
Market Value of Energy	**Base**
Fuel Cost ($/MMBTU)	**$8.0**
Fuel Cost Escalator	**3.0%**
Cost of Capital	**0.078**
Load Factor	**55.0%**
Distribution O&M as a % of Cap Cost	**1.5%**
Lost Revenues?	**No**
Avoided Losses	**6.0%**



NAVIGANT CONSULTING

The Framingham Opportunity would have a negative NPV.

CASE DESCRIPTION: **NSTAR Framingham**

Year	DG Cap. Added	DG Capital Cost	DG Annual Cost	Deferral Savings	Savings/(Cost)
2006	0.0	$ -	$ -	$ 99,385	$ 99,385
2007	1500.0	$ 927,000	$ 116,929	$ 99,979	$ (16,950)
2008	1000.0	$ 424,360	$ 157,496	$ 99,918	$ (57,578)
2009	1000.0	$ 437,091	$ 197,241	$ 99,969	$ (97,272)
2010	1000.0	$ 450,204	$ 236,015	$ 100,123	$ (135,892)
2011	0.0	$ -	$ 225,056	$ 98,667	$ (126,390)
2012	0.0	$ -	$ 214,015	$ 97,211	$ (116,805)
2013	0.0	$ -	$ 202,857	$ 95,770	$ (107,087)
2014	0.0	$ -	$ 191,578	$ 94,345	$ (97,233)
2015	0.0	$ -	$ 180,174	$ 92,936	$ (87,238)
2016	0.0	$ -	$ -	$ -	$ -
2017	0.0	$ -	$ -	$ -	$ -
2018	0.0	$ -	$ -	$ -	$ -
2019	0.0	$ -	$ -	$ -	$ -
2020	0.0	$ -	$ -	$ -	$ -
2021	0.0	$ -	$ -	$ -	$ -
2022	0.0	$ -	$ -	$ -	$ -
2023	0.0	$ -	$ -	$ -	$ -
2024	0.0	$ -	$ -	$ -	$ -
2025	0.0	$ -	$ -	$ -	$ -
TOTAL	**4500.0**	**$ 2,238,654**	**$ 1,721,360**	**$ 978,302**	**$ (743,059)**

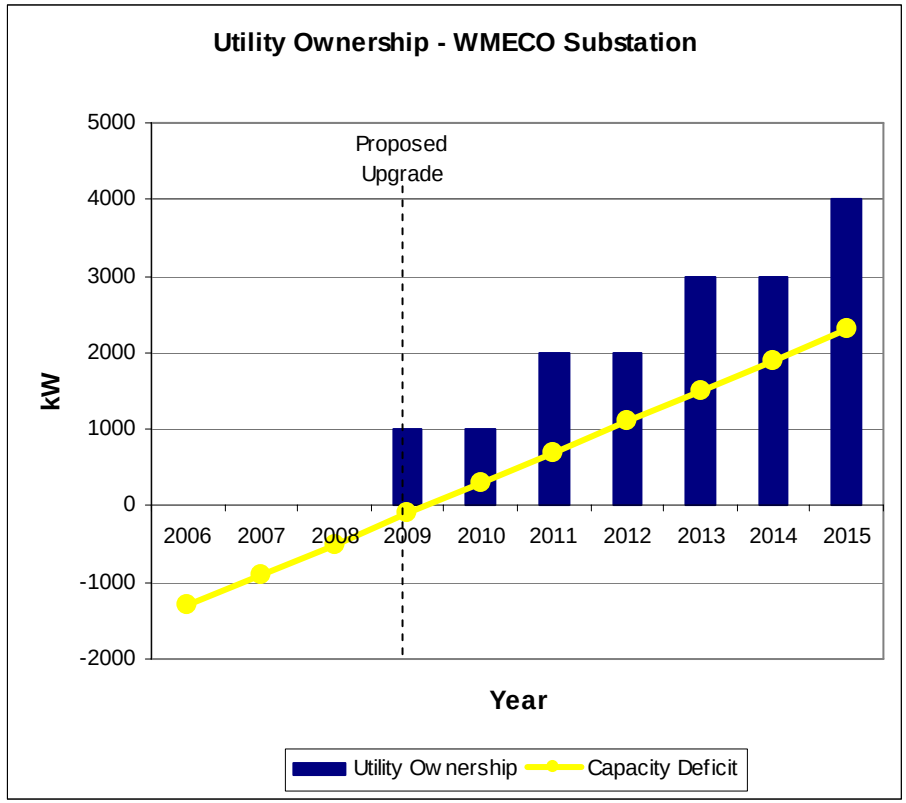
NET PRESENT VALUE:	**($1,096,964)**	**$664,887**	**($432,077)**

NAVIGANT CONSULTING

In the WMECO Substation Opportunity, 4 MW of DG would be added to meet the capacity shortfall and reliability requirements.

CASE ASSUMPTIONS & DATA:

Utility Selected	**WMECO**
Case No.	**2**
Ownership	**Utility**
Number of DG Units	**5.0**
First Year Annual Peak Load (MW)	**34.10**
Existing System Rating	**35.4**
Cost of T&D Solution	**$2,300,000**
Max DG Capacity Added (kW)	**4000**
Number of Units Installed	**5**
Start Year for Deferral	**2009**
Start Year	**2006**
Last Year DG Solution is Viable	**2015**
Inflation Rate	**3.0%**
Generation Cost Escalation	**3.0%**
Market Value of Capacity	**Base**
Market Value of Energy	**Base**
Fuel Cost ($/MMBTU)	**$8.0**
Fuel Cost Escalator	**3.0%**
Cost of Capital	**0.078**
Load Factor	**55.0%**
Distribution O&M as a % of Cap Cost	**1.5%**
Lost Revenues?	**No**
Avoided Losses	**6.0%**



NAVIGANT CONSULTING

The WMECO Substation Opportunity would have a positive NPV.

CASE DESCRIPTION: **WMECO Substation**

Year	DG Cap. Added	DG Capital Cost	DG Annual Cost	Deferral Savings	Savings/(Cost)
2006	0.0	$ -	$ -	$ -	$ -
2007	0.0	$ -	$ -	$ -	$ -
2008	1000.0	$ 583,495	$ -	$ -	$ -
2009	0.0	$ -	$ 68,299	$ 434,074	$ 365,775
2010	1000.0	$ 619,030	$ 140,721	$ 428,467	$ 287,746
2011	0.0	$ -	$ 135,129	$ 421,273	$ 286,144
2012	1000.0	$ 656,729	$ 209,332	$ 415,893	$ 206,560
2013	0.0	$ -	$ 200,769	$ 408,815	$ 208,045
2014	1000.0	$ 696,724	$ 276,727	$ 403,678	$ 126,952
2015	0.0	$ -	$ 264,849	$ 396,742	$ 131,893
2016	0.0	$ -	$ -	$ -	$ -
2017	0.0	$ -	$ -	$ -	$ -
2018	0.0	$ -	$ -	$ -	$ -
2019	0.0	$ -	$ -	$ -	$ -
2020	0.0	$ -	$ -	$ -	$ -
2021	0.0	$ -	$ -	$ -	$ -
2022	0.0	$ -	$ -	$ -	$ -
2023	0.0	$ -	$ -	$ -	$ -
2024	0.0	$ -	$ -	$ -	$ -
2025	0.0	$ -	$ -	$ -	$ -
TOTAL	**4000.0**	**$ 2,555,977**	**$ 1,295,826**	**$ 2,908,942**	**$ 1,613,116**

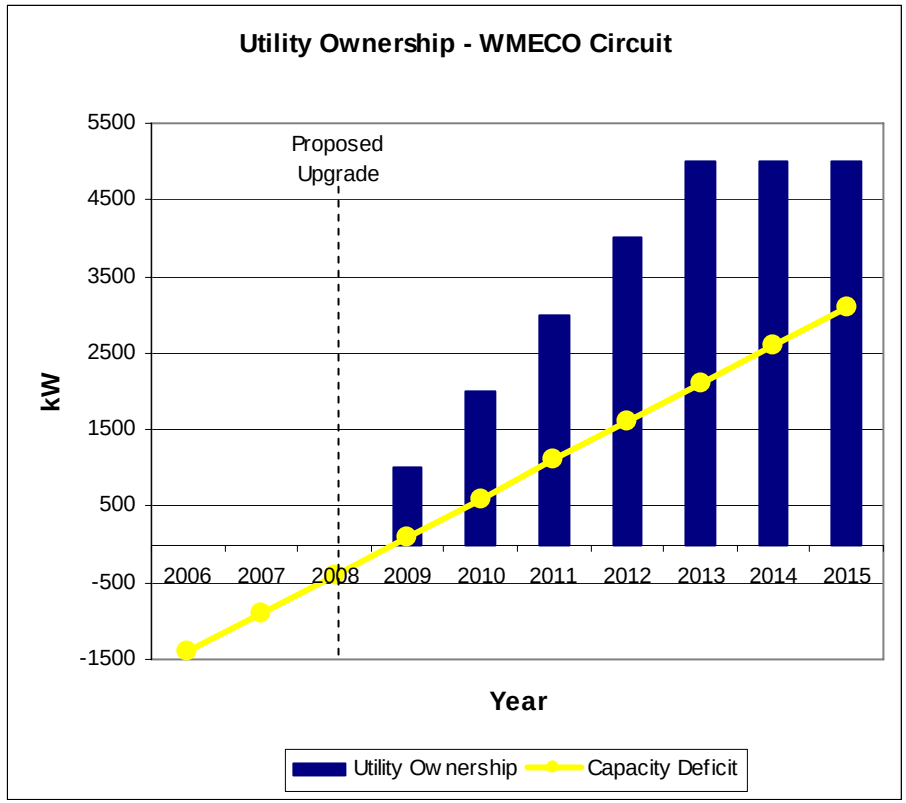
NET PRESENT VALUE:	**($734,938)**	**$1,751,060**	**$1,016,122**

NAVIGANT CONSULTING

In the WMECO Circuit Opportunity, 5 MW of DG would be added to meet the capacity shortfall and reliability requirements.

CASE ASSUMPTIONS & DATA:

Utility Selected	**WMECO**
Case No.	**1**
Ownership	**Utility**
Number of DG Units	**5.0**
First Year Annual Peak Load (MW)	
Existing System Rating	**20.7**
Cost of T&D Solution	**$500,000**
Max DG Capacity Added (kW)	**5000**
Number of Units Installed	**5**
Start Year for Deferral	**2008**
Start Year	**2006**
Last Year DG Solution is Viable	**2015**
Inflation Rate	**3.0%**
Generation Cost Escalation	**3.0%**
Market Value of Capacity	**Base**
Market Value of Energy	**Base**
Fuel Cost ($/MMBTU)	**$8.0**
Fuel Cost Escalator	**3.0%**
Cost of Capital	**0.078**
Load Factor	**55.0%**
Distribution O&M as a % of Cap Cost	**1.5%**
Lost Revenues?	**No**
Avoided Losses	**6.0%**



NAVIGANT CONSULTING

The WMECO Circuit Opportunity would have a negative NPV.

CASE DESCRIPTION: **WMECO Circuit**

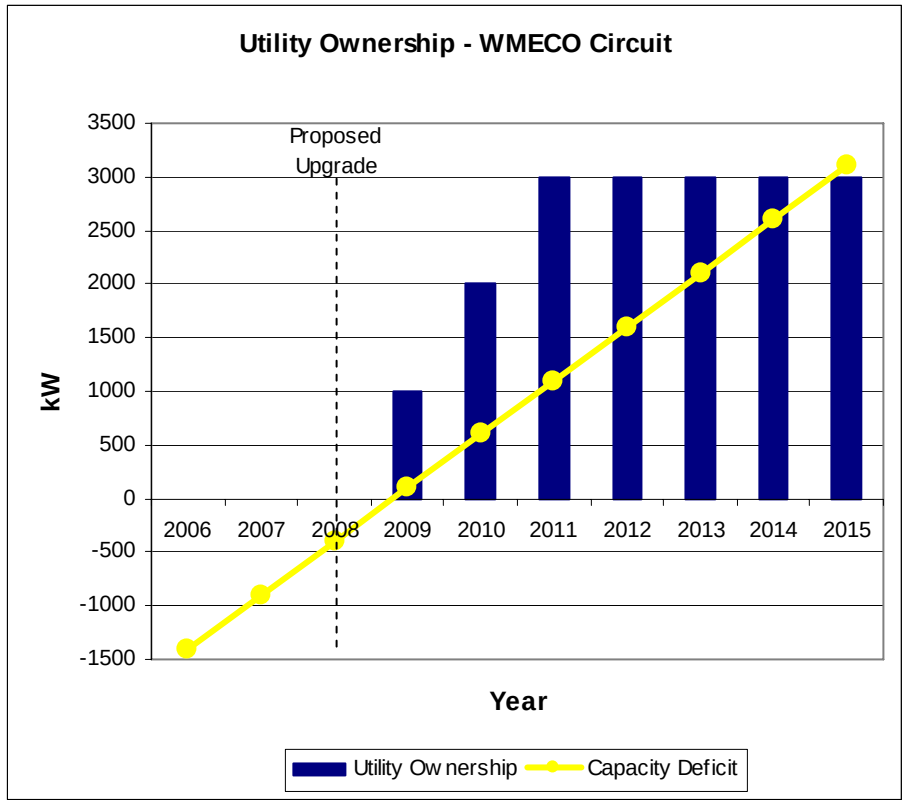
Year	DG Cap. Added	DG Capital Cost	DG Annual Cost	Deferral Savings	Savings/(Cost)
2006	0.0	$ -	$ -	$ -	$ -
2007	0.0	$ -	$ -	$ -	$ -
2008	0.0	$ -	$ -	$ 93,766	$ 93,766
2009	1000.0	$ 601,000	$ 72,980	$ 93,801	$ 20,821
2010	1000.0	$ 619,030	$ 145,460	$ 93,947	$ (51,513)
2011	1000.0	$ 637,601	$ 217,443	$ 94,215	$ (123,227)
2012	1000.0	$ 656,729	$ 288,590	$ 94,626	$ (193,964)
2013	1000.0	$ 676,431	$ 358,705	$ 95,197	$ (263,508)
2014	0.0	$ -	$ 343,513	$ 94,067	$ (249,446)
2015	0.0	$ -	$ 327,774	$ 93,084	$ (234,690)
2016	0.0	$ -	$ -	$ -	$ -
2017	0.0	$ -	$ -	$ -	$ -
2018	0.0	$ -	$ -	$ -	$ -
2019	0.0	$ -	$ -	$ -	$ -
2020	0.0	$ -	$ -	$ -	$ -
2021	0.0	$ -	$ -	$ -	$ -
2022	0.0	$ -	$ -	$ -	$ -
2023	0.0	$ -	$ -	$ -	$ -
2024	0.0	$ -	$ -	$ -	$ -
2025	0.0	$ -	$ -	$ -	$ -
TOTAL	**5000.0**	**$ 3,190,790**	**$ 1,754,465**	**$ 752,704**	**$ (1,001,761)**

NET PRESENT VALUE:	**($991,959)**	**$469,849**	**($522,110)**

Alternatively, by adding fewer DG units, the WMECO Circuit Opportunity would have a shorter deferral period.

CASE ASSUMPTIONS & DATA:

Utility Selected	**WMECO**
Case No.	**1**
Ownership	**Utility**
Number of DG Units	**3.0**
First Year Annual Peak Load (MW)	**19.30**
Existing System Rating	**20.7**
Cost of T&D Solution	**$500,000**
Max DG Capacity Added (kW)	**3000**
Number of Units Installed	**6**
Start Year for Deferral	**2008**
Start Year	**2006**
Last Year DG Solution is Viable	**2011**
Inflation Rate	**3.0%**
Generation Cost Escalation	**3.0%**
Market Value of Capacity	**Base**
Market Value of Energy	**Base**
Fuel Cost ($/MMBTU)	**$8.0**
Fuel Cost Escalator	**3.0%**
Cost of Capital	**0.078**
Load Factor	**55.0%**
Distribution O&M as a % of Cap Cost	**1.5%**
Lost Revenues?	**No**
Avoided Losses	**6.0%**



NAVIGANT CONSULTING

A shorter deferral period would provide a positive NPV.

CASE DESCRIPTION: **WMECO Circuit**

Year	DG Cap. Added	DG Capital Cost	DG Annual Cost	Deferral Savings	Savings/(Cost)
2006	0.0	$ -	$ -	$ -	$ -
2007	0.0	$ -	$ -	$ -	$ -
2008	0.0	$ -	$ -	$ 93,766	$ 93,766
2009	1000.0	$ 437,091	$ 45,625	$ 93,801	$ 48,177
2010	1000.0	$ 450,204	$ 90,425	$ 93,947	$ 3,522
2011	1000.0	$ 463,710	$ 134,363	$ 94,215	$ (40,148)
2012	0.0	$ -	$ -	$ -	$ -
2013	0.0	$ -	$ -	$ -	$ -
2014	0.0	$ -	$ -	$ -	$ -
2015	0.0	$ -	$ -	$ -	$ -
2016	0.0	$ -	$ -	$ -	$ -
2017	0.0	$ -	$ -	$ -	$ -
2018	0.0	$ -	$ -	$ -	$ -
2019	0.0	$ -	$ -	$ -	$ -
2020	0.0	$ -	$ -	$ -	$ -
2021	0.0	$ -	$ -	$ -	$ -
2022	0.0	$ -	$ -	$ -	$ -
2023	0.0	$ -	$ -	$ -	$ -
2024	0.0	$ -	$ -	$ -	$ -
2025	0.0	$ -	$ -	$ -	$ -
TOTAL	**3000.0**	**$ 1,351,004**	**$ 270,413**	**$ 375,729**	**$ 105,317**

NET PRESENT VALUE:	**($181,875)**	**$269,319**	**$87,444**

NAVIGANT CONSULTING

The reliability module calculates the peak load availability for each year.

WMECO Substation

Unit Name	Capacity (kW)	Unit FOR
U-Diesel (500-1000k	1000.00	0.10
U-Diesel (500-1000k	1000.00	0.10
U-Diesel (500-1000k	1000.00	0.10
U-Diesel (500-1000k	1000.00	0.10

Number of DG Units	4

EFFECTIVE DG RELIABILITY:

Total Opportunity Load (MWH)	**203,039**
Unserved Energy (MWH)	**31.0**
Net Availability (Total Load)	**0.99985**
Net Availability (Overload Hrs Only)	**0.93**
Peak Load Availability	**0.92545**

State	Unit 1 Status	Unit 2 Status	Unit 3 Status	Unit 4 Status	Unit 1 Prob	Unit 2 Prob	Unit 3 Prob	Unit 4 Prob	Unit 1 Cap	Unit 2 Cap	Unit 3 Cap	Unit 4 Cap	Total Cap	State Prob
1	ON	ON	ON	ON	0.90	0.90	0.90	0.90	1000.00	1000.00	1000.00	1000.00	4000.00	0.66
2	ON	ON	ON	OFF	0.90	0.90	0.90	0.10	1000.00	1000.00	1000.00	0.00	3000.00	0.07
3	ON	ON	OFF	ON	0.90	0.90	0.10	0.90	1000.00	1000.00	0.00	1000.00	3000.00	0.07
4	ON	ON	OFF	OFF	0.90	0.90	0.10	0.10	1000.00	1000.00	0.00	0.00	2000.00	0.01
5	ON	OFF	ON	ON	0.90	0.10	0.90	0.90	1000.00	0.00	1000.00	1000.00	3000.00	0.07
6	ON	OFF	ON	OFF	0.90	0.10	0.90	0.10	1000.00	0.00	1000.00	0.00	2000.00	0.01
7	ON	OFF	OFF	ON	0.90	0.10	0.10	0.90	1000.00	0.00	0.00	1000.00	2000.00	0.01
8	ON	OFF	OFF	OFF	0.90	0.10	0.10	0.10	1000.00	0.00	0.00	0.00	1000.00	0.00
9	OFF	ON	ON	ON	0.10	0.90	0.90	0.90	0.00	1000.00	1000.00	1000.00	3000.00	0.07
10	OFF	ON	ON	OFF	0.10	0.90	0.90	0.10	0.00	1000.00	1000.00	0.00	2000.00	0.01
11	OFF	ON	OFF	ON	0.10	0.90	0.10	0.90	0.00	1000.00	0.00	1000.00	2000.00	0.01
12	OFF	ON	OFF	OFF	0.10	0.90	0.10	0.10	0.00	1000.00	0.00	0.00	1000.00	0.00
13	OFF	OFF	ON	ON	0.10	0.10	0.90	0.90	0.00	0.00	1000.00	1000.00	2000.00	0.01
14	OFF	OFF	ON	OFF	0.10	0.10	0.90	0.10	0.00	0.00	1000.00	0.00	1000.00	0.00
15	OFF	OFF	OFF	ON	0.10	0.10	0.10	0.90	0.00	0.00	0.00	1000.00	1000.00	0.00
16	OFF	OFF	OFF	OFF	0.10	0.10	0.10	0.10	0.00	0.00	0.00	0.00	0.00	0.00

For the WMECO Substation case enough DG is added to provide >99.9% peak load availability.

Year	Feeder/ Substation Peak Load	Existing Capacity (Rating)	Capacity Deficit (MW)	DG Capacity Added (MW)	Cumulative Capacity Added (MW)	Net Deficit (MW)	Annual Energy (MWHr)	Unserved Energy (MWHr)	Net Availability (Total)	Peak Load Availability	Meets Threshold? (All Hours)	Meets Threshold? (Peak Hour)
2006	34.1	35.4	1.30	0.0000	0.000	1.30	164,294	0.0	1.00000	1.00000	Yes	Yes
2007	34.5	35.4	0.90	0.0000	0.000	0.90	166,221	0.0	1.00000	1.00000	Yes	Yes
2008	34.9	35.4	0.50	1.0000	1.000	1.50	168,148	0.0	1.00000	1.00000	Yes	Yes
2009	35.3	35.4	0.10	0.0000	1.000	1.10	170,075	0.0	1.00000	1.00000	Yes	Yes
2010	35.7	35.4	-0.30	1.0000	2.000	1.70	172,003	0.0	1.00000	0.99992	Yes	Yes
2011	36.1	35.4	-0.70	0.0000	2.000	1.30	173,930	0.0	1.00000	0.99981	Yes	Yes
2012	36.5	35.4	-1.10	1.0000	3.000	1.90	175,857	0.0	1.00000	0.99990	Yes	Yes
2013	36.9	35.4	-1.50	0.0000	3.000	1.50	177,784	0.0	1.00000	0.99959	Yes	Yes
2014	37.3	35.4	-1.90	1.0000	4.000	2.10	179,711	0.0	1.00000	0.99991	Yes	Yes
2015	37.7	35.4	-2.30	0.0000	4.000	1.70	181,639	0.0	1.00000	0.99948	Yes	Yes
2016	38.1	35.4	-2.72	0.0000	4.000	1.28	183,673	0.1	1.00000	0.99891	Yes	No
2017	38.5	35.4	-3.15	0.0000	4.000	0.85	185,730	0.2	1.00000	0.99721	Yes	No
2018	39.0	35.4	-3.58	0.0000	4.000	0.42	187,810	0.5	1.00000	0.99344	Yes	No
2019	39.4	35.4	-4.02	0.0000	4.000	-0.02	189,914	1.0	0.99999	0.98941	Yes	No
2020	39.9	35.4	-4.46	0.0000	4.000	-0.46	192,041	2.2	0.99999	0.97845	Yes	No
2021	40.3	35.4	-4.91	0.0000	4.000	-0.91	194,192	4.2	0.99998	0.96761	Yes	No
2022	40.8	35.4	-5.36	0.0000	4.000	-1.36	196,367	7.7	0.99996	0.95689	Yes	No
2023	41.2	35.4	-5.81	0.0000	4.000	-1.81	198,566	12.7	0.99994	0.94630	Yes	No
2024	41.7	35.4	-6.27	0.0000	4.000	-2.27	200,790	20.4	0.99990	0.93581	Yes	No
2025	42.1	35.4	-6.74	0.0000	4.000	-2.74	203,039	31.0	0.99985	0.92545	Yes	No

Set at >99.9%

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Preliminary Conclusions

- Including incentives makes DG, EE and DR more attractive (e.g. extends deferral 1-3 years).
- An Active/Customer Ownership program is not likely to provide 10-yr deferrals in most cases.
- A program could be developed for a 1-3 year deferral.
- Small recip engines are the most attractive technologies; PV can beat recip engines in some cases.
- Characteristics of a good opportunity for DG in distribution planning:
  - System near capacity, but need is still several years out
  - Large customers with thermal demand
  - Slow growth
  - Shortfall is small relative to the load

Assumptions

- Active Distributed Generation:
  - Same conditions as in Status Quo case, except there is now a one-time incentive payment in year 1 corresponding to
    - Annual deferral savings were determined from the utility DG module
    - The NPV of the savings from 2006 to 2015 was determined for each opportunity
    - This was then divided by the capacity shortfall in 2015 to determine the value of the one-time incentive payment, $/kW
  - Cumulative market penetration determined from the curve -- Average of Kastovich and ADL market penetration curves
  - Linear market adoption, with 100% occurring in year 5

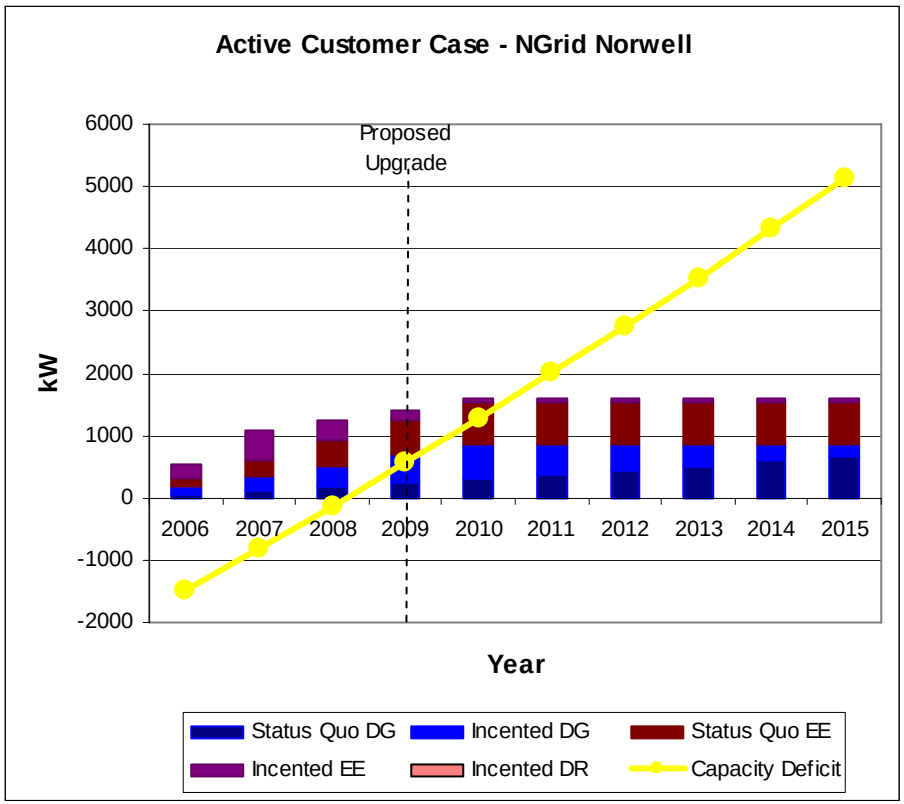
	One-time Incentive Payment ($/kW)
NGRID Norwell	140
NGRID Worcester	350
FG&E Lunenberg	150
FG&E Leominster	6500
NSTAR Woburn	450
NSTAR Framingham	195
WMECO Substation	810
WMECO Circuit	160

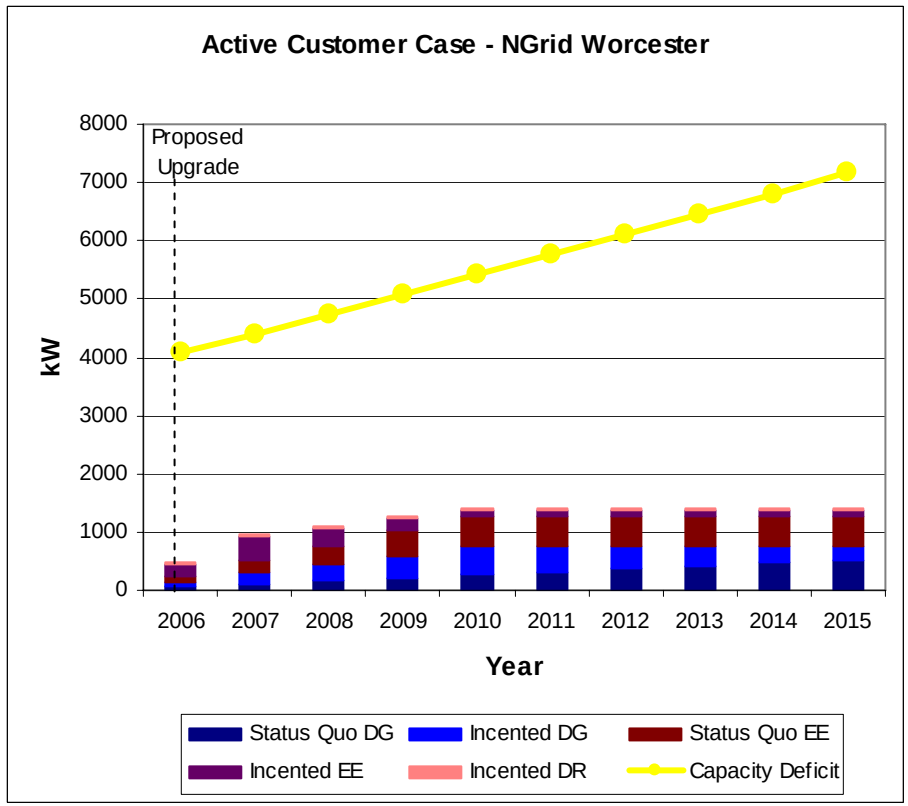
Assumptions (continued)

- Active Energy Efficiency:
  - The amount of energy efficiency that can be achieved is 10% of all customers' maximum demand
  - The payback for customers is adjusted based on the incentive, assumes EE measures to achieve 10% reduction cost $3,000 per kW
  - Cumulative market penetration determined from the curve -- Average of Kastovich and ADL market penetration curves
  - Linear market adoption, with 100% occurring in year 2

- Active Demand Response:
  - Customer reduction must be at least 50 kW (same as Brockton Pilot)
  - The achievable demand response is 5% of a customer's maximum demand
  - Same payback as energy efficiency case
  - Cumulative market penetration determined from the curve -- Average of Kastovich and ADL market penetration curves
  - Linear market adoption, with 100% occurring in year 2

With incentives for DG, DR and EE, the Norwell Opportunity could have a 2-yr deferral.





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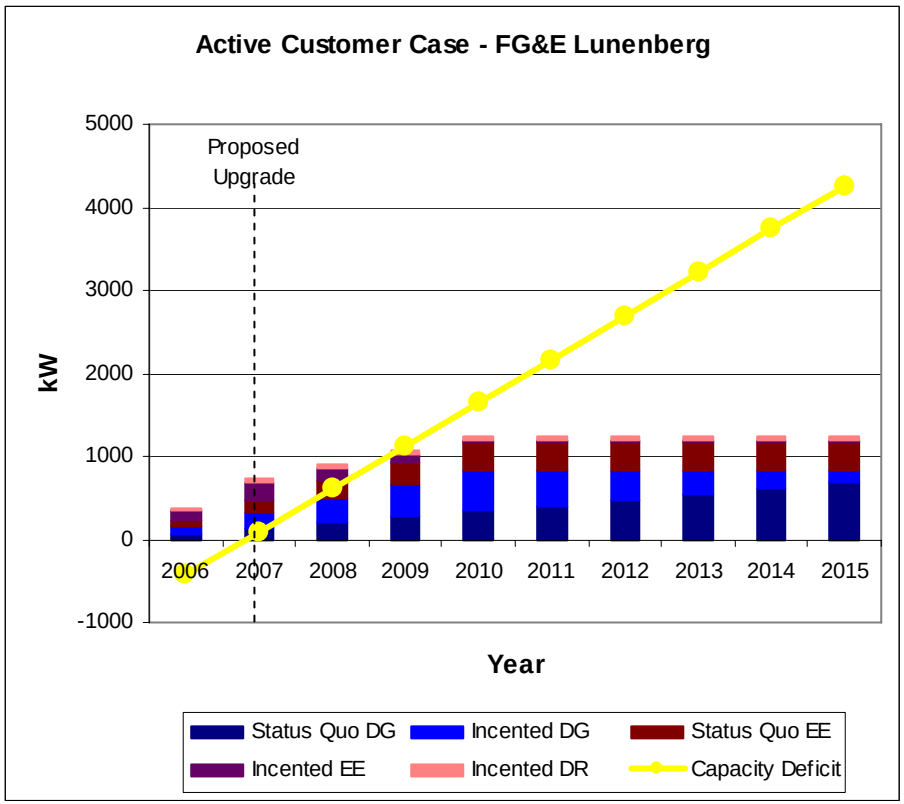
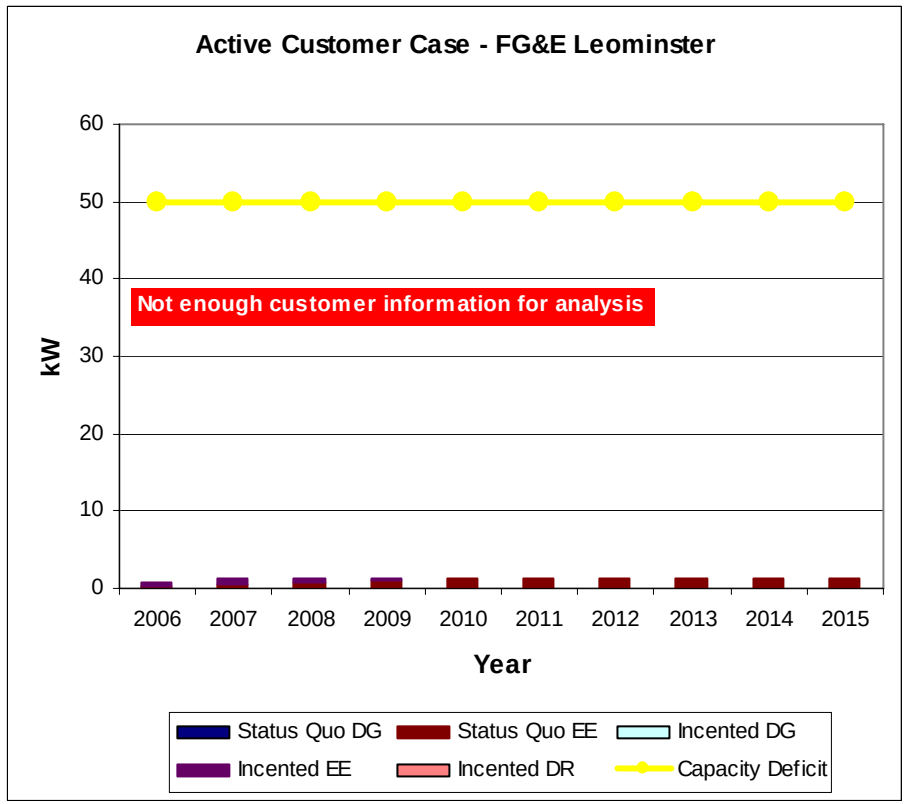
With incentives for DG, DR and EE, the Lunenberg Opportunity could have a 2-yr deferral.





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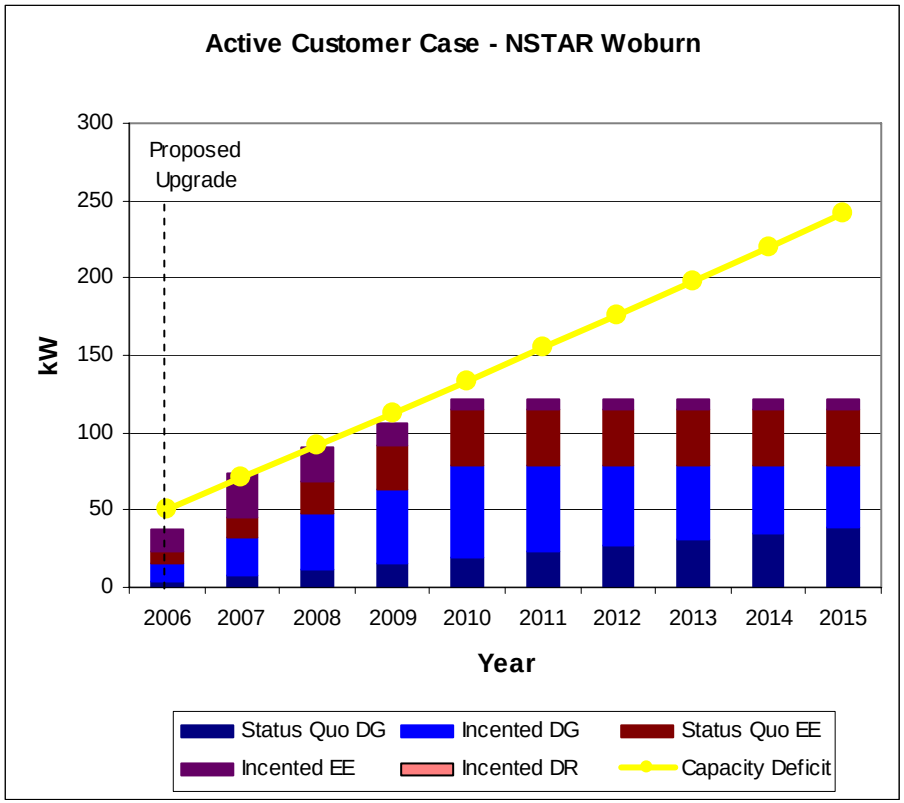
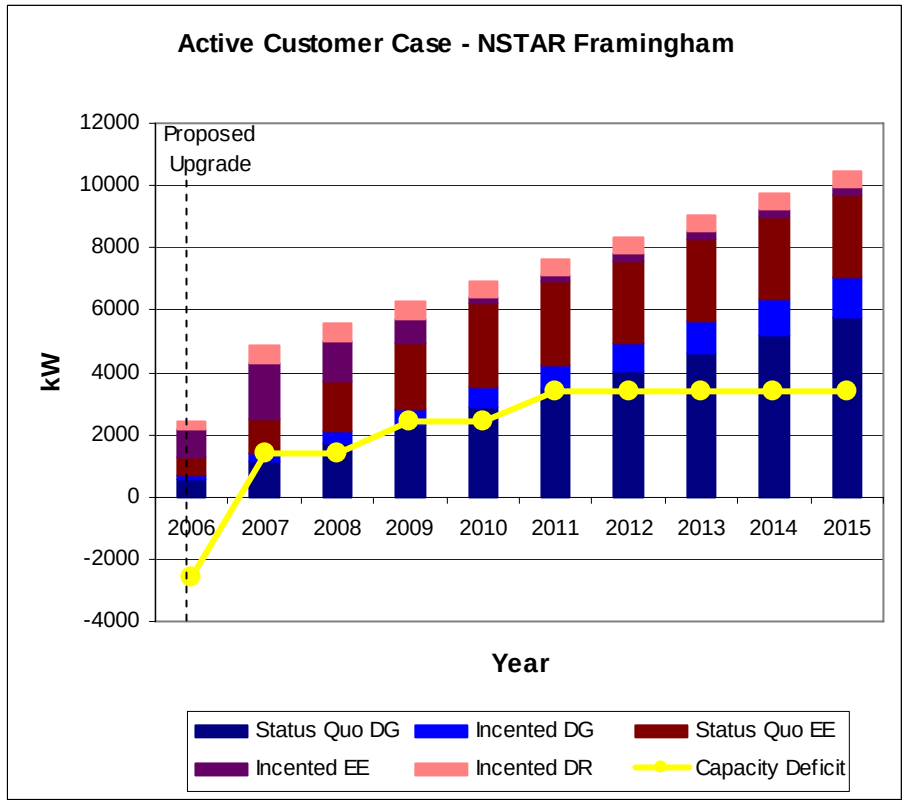
With incentives for DG, the Framingham Opportunity could have a 10-yr deferral.





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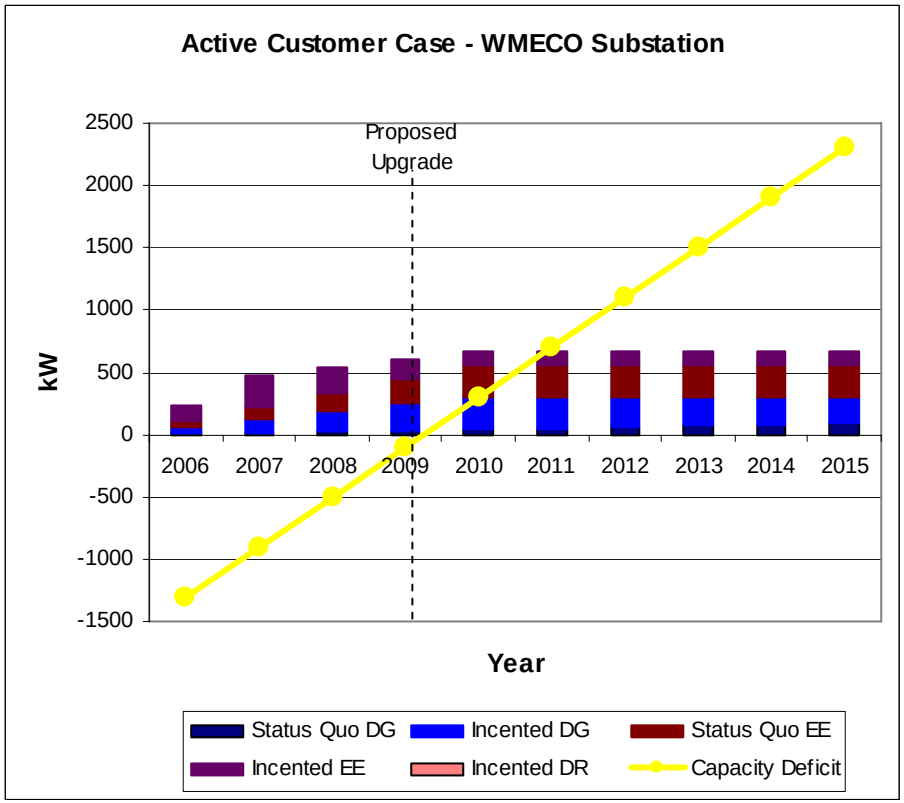
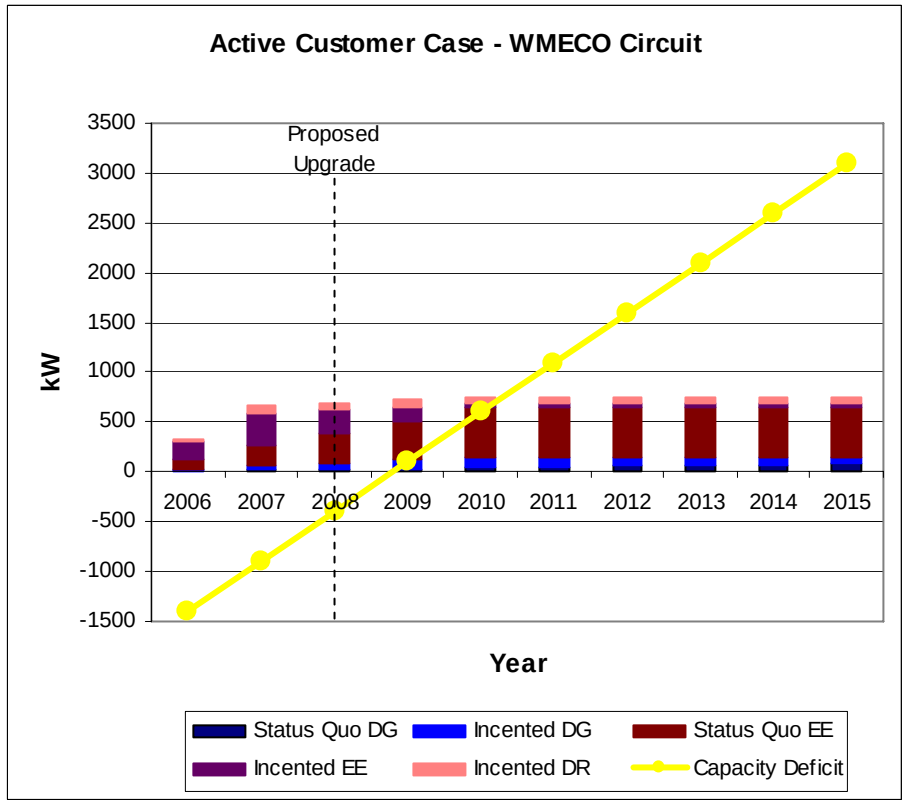
With incentives for DG, DR and EE, the WMECO Opportunities could have 1-3 year deferrals.





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Reliability

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