Narragansett Bay Commission

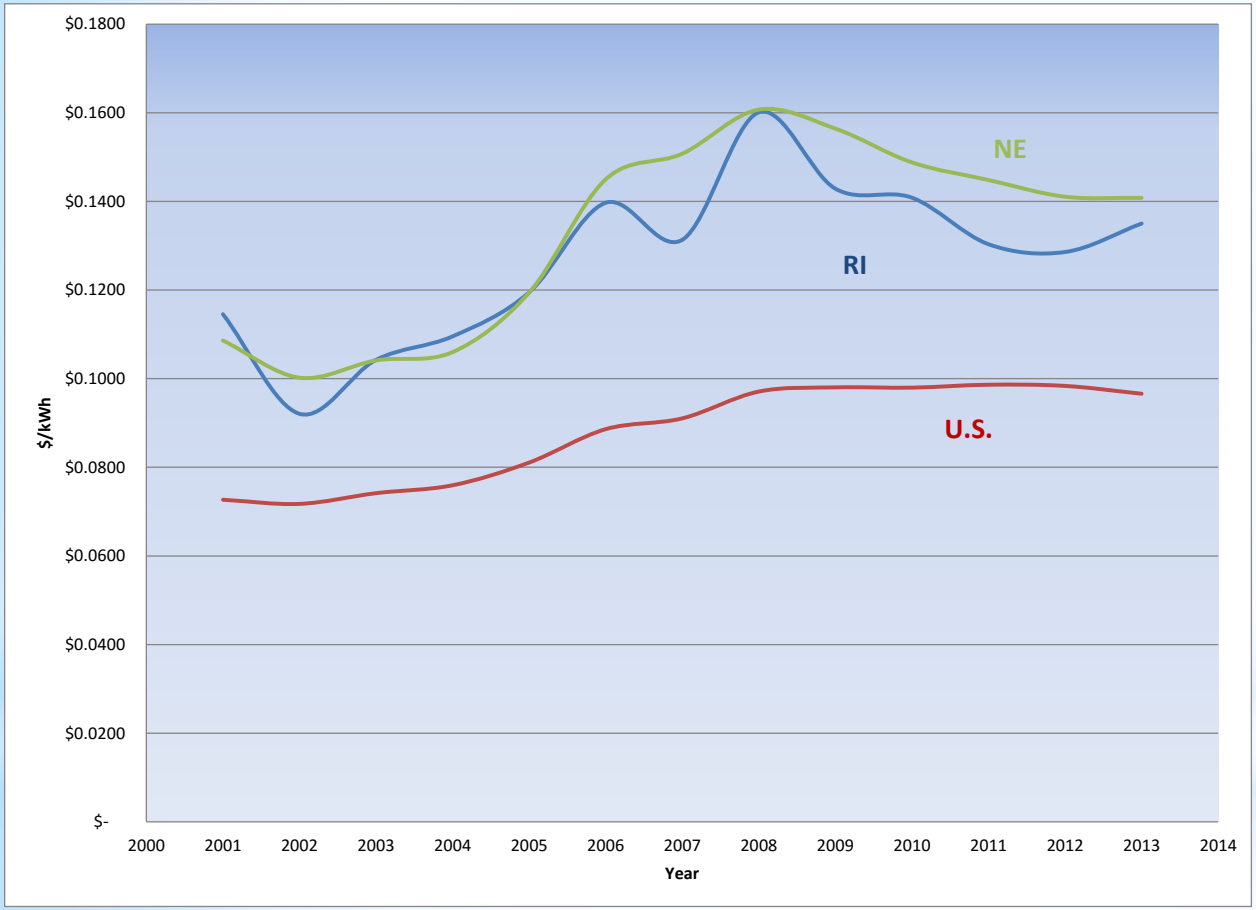
Overview of NBC Energy Programs

Thomas Uva

Director of Environmental Science & Compliance Division

Narragansett Bay Commission

Electricity Costs Comparison



Source: Energy Information Administration - www.eia.doe.gov

- ✓ New England Electric Rates 51% above National average
- ✓ Rhode Island Electric Rates 44% above National average
- ✓ NBC aggressively pursues energy conservation and alternative energy opportunities
- ✓ WWTFs use ~1% of Total US Energy Use
- ✓ NBC is also a Large Energy User!

NBC Energy Programs

- ✓NBC Conducted Comprehensive Energy Evaluations in 2005 with $35,000 EPA Grant
- ✓Performed Feasibility Studies of “Low Hanging Fruit” Alternative Energy Concepts with $50,000 in EDC grants:
  - ✓Wind Energy at Field’s Point
  - ✓Biogas CHP at Bucklin Point
- ✓Routinely Identify On-site Energy Efficiency & Conservation Opportunities at all NBC Facilities
- ✓Continuously Evaluate Energy Usage & Systems - Continuous Improvement!!!

NBC Energy Efficiency Projects

Year	Site	Efficiency Project	kWh
2013	BP	Bucklin Point Lighting Upgrade	124,008
2013	BP	Efficient Blower sand Flexible Aeration	500,000
2013	COB	Lighting upgrade at Corporate Office Building	63,419
2015	FP	FP Bisulfite Storage Building - Heating	227,308
2016	BP	LED Lighting Upgrade	654,852
2016	FP	LED Lighting Upgrade	1,231,226
2016	COB	LED Lighting Upgrade	113,505
2016	IM	LED Lighting Upgrade	34,811
2016	ESPS/TPS	LED Lighting Upgrade	441,243
		Total	3,390,372
		Percent of NBC Use	9.81%

Site	Planned Efficiency Project	kWh
FP	FP Base Blower - VFDs	368,808
BP	BP - Replace Sixty 400 W lamps with LEDs	105,694
ESPS	ESPS - 7,000 cfm Energy Recovery Ventilator	153,433
ESPS	ESPS - Wet Well Energy Recovery	268,593
	Total	896,528

Estimated $373,000/year in Electric Savings!!!
Estimated 1,119 M Tons/Year CO2(e) Reduced

NBC Field's Point WWTF

Field's Point WWTF Operations

- ✓45 MGD Average Daily Flow
- ✓65 MGD Secondary Treatment with Biological Nutrient Removal
- ✓200 MGD Primary
- ✓Chlorination/De-chlorination
- ✓Sludge Gravity Thickeners
- ✓4 Pumping Stations

Field's Point WWTF Energy Use

- ✓1.7 MW Electrical Load
- ✓15,330,000 kWh/year (2016)
- ✓**~$1.75M Annual Expense**

Renewable Opportunities:

- ✓Wind Turbines
- ✓Small Hydro-Electric Projects
- ✓Small Solar Projects

Field's Point Wind Energy

Field's Point Wind Energy Project:

- ✓ **RI's First Wind Farm**
- ✓ 4.5 MW Capacity (3 – 1.5MWTurbines)
- ✓ Operational since October 2012
- ✓ Reduced Facility Electric Use by 45% **(~21% overall reduction for NBC)**
- ✓ **2,579 Metric Tons CO_2 Offset/Year**
- ✓ Generate ~ 7,000,000 kWh/year from wind
- ✓ Save ~$770,000 annually in electricity costs (@ 11 cents/kWh)
- ✓ **$1,459,000** in REC Revenue to date
- ✓ **$ 4,668,000**Total Financial Benefit to date

NBC Bucklin Point WWTF

Bucklin Point WWTF Operations

- ✓24 MGD
- ✓46 MGD Secondary Treatment with Biological Nutrient Removal
- ✓116 MGD Primary
- ✓UV Disinfection
- ✓Anaerobic Digestion
- ✓3 Pumping Stations

Bucklin Point WWTF Energy Use

- ✓1.4 MW Average Demand
- ✓12,618,000 kWh/year (2016)
- ✓~$1.39M Annual Electric Expense

Renewable Opportunities:

- ✓Biogas Reuse Project
- ✓Large Solar Project

NBC Bucklin Point Biogas Combined Heat and Power Energy Project

$25,000 Grant from State of RI - Feasibility Study

- ✓677 kW Combined Heat and Power (CHP) System
- ✓**37%** of Bucklin Point Electricity Demand
- ✓90 % of BP Digester Heat Demand
- ✓250,000 SCFD Biogas Production (60% Methane)
- ✓Estimated Project Cost: $6,440,000
- ✓Estimated Annual Operating Cost: $172,000
- ✓Estimated Annual Electricity Cost Savings (not including REC sales): **$440,000**
- ✓Heat output satisfies digester demand on all but the coldes of winter days
- ✓**1,521 Metric Tons CO_2 Offset/Year**
- ✓Construction On-Going – Completion Spring/Summer 2018

RI Renewable Energy Legislation

Renewable Energy Standard (RIGL Chapter 39-26)

- ✓ Lists RI eligible renewable resources
- ✓ Sets RI renewable energy targets 16.5% by 2019
- ✓ Established RI's Renewable Energy Fund

Distributed Generation Interconnection (RIGL Chapter 39-26.3)

- ✓ On-site or Off-Site Projects
- ✓ Fixed Long Term Rates for Electricity Produced
- ✓ Streamlines interconnection process

Regional Greenhouse Gas Initiative (RIGL 23-82-1)

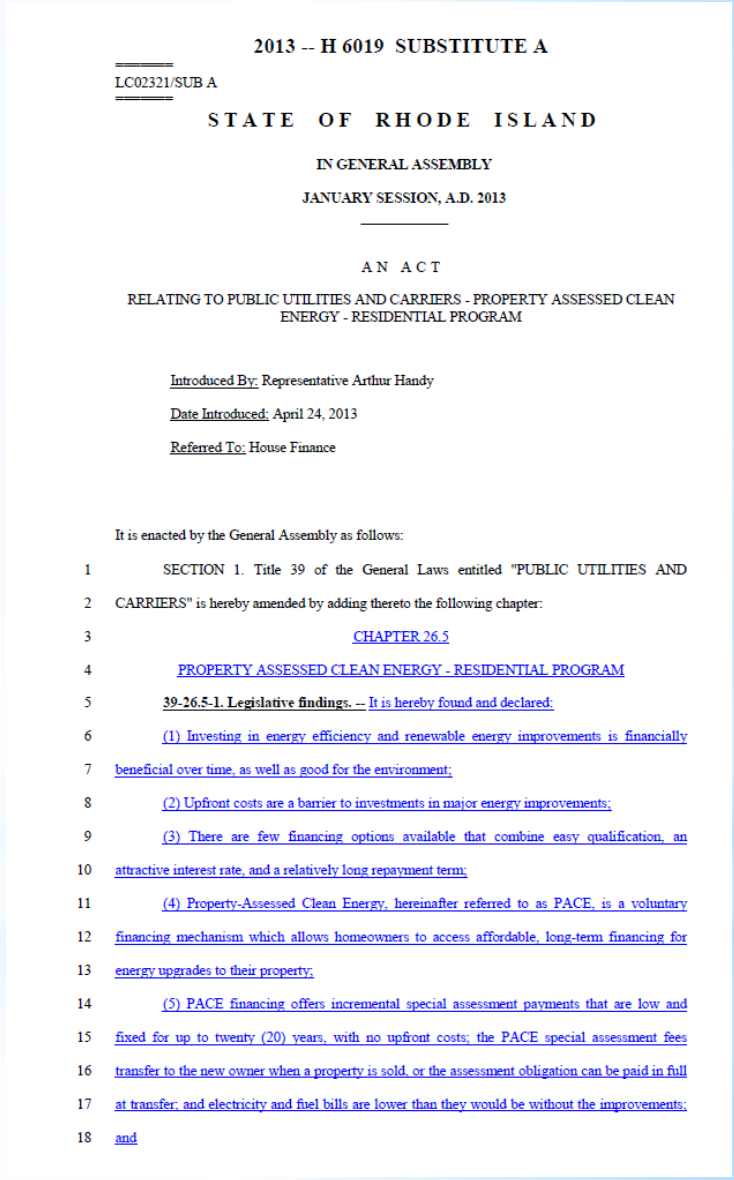
- ✓ Regional GHG cap and trade program
- ✓ Generates income that can be used to fund new energy projects

Renewable Energy Growth Program (RIGL 39-26.6)

- ✓ Provides long term funding through a National Grid Tariff for new installations

Net Metering (RIGL Chapter 39-26.4)

- ✓ Limits nameplate capacity to 5 MW
- ✓ Allows "public entities" like NBC to virtually Net Meter from Off-Site Locations



2013 -- H 6019 SUBSTITUTE A

LC02321/SUB A

STATE OF RHODE ISLAND

IN GENERAL ASSEMBLY

JANUARY SESSION, A.D. 2013

AN ACT

RELATING TO PUBLIC UTILITIES AND CARRIERS - PROPERTY ASSESSED CLEAN ENERGY - RESIDENTIAL PROGRAM

Introduced By: Representative Arthur Handy

Date Introduced: April 24, 2013

Referred To: House Finance

It is enacted by the General Assembly as follows:

SECTION 1. Title 39 of the General Laws entitled "PUBLIC UTILITIES AND CARRIERS" is hereby amended by adding thereto the following chapter:

CHAPTER 26.5

PROPERTY ASSESSED CLEAN ENERGY - RESIDENTIAL PROGRAM

39-26.5-1. Legislative findings. -- It is hereby found and declared:

(1) Investing in energy efficiency and renewable energy improvements is financially beneficial over time, as well as good for the environment;

(2) Upfront costs are a barrier to investments in major energy improvements;

(3) There are few financing options available that combine easy qualification, an attractive interest rate, and a relatively long repayment term;

(4) Property-Assessed Clean Energy, hereinafter referred to as PACE, is a voluntary financing mechanism which allows homeowners to access affordable, long-term financing for energy upgrades to their property;

(5) PACE financing offers incremental special assessment payments that are low and fixed for up to twenty (20) years, with no upfront costs; the PACE special assessment fees transfer to the new owner when a property is sold, or the assessment obligation can be paid in full at transfer; and electricity and fuel bills are lower than they would be without the improvements; and

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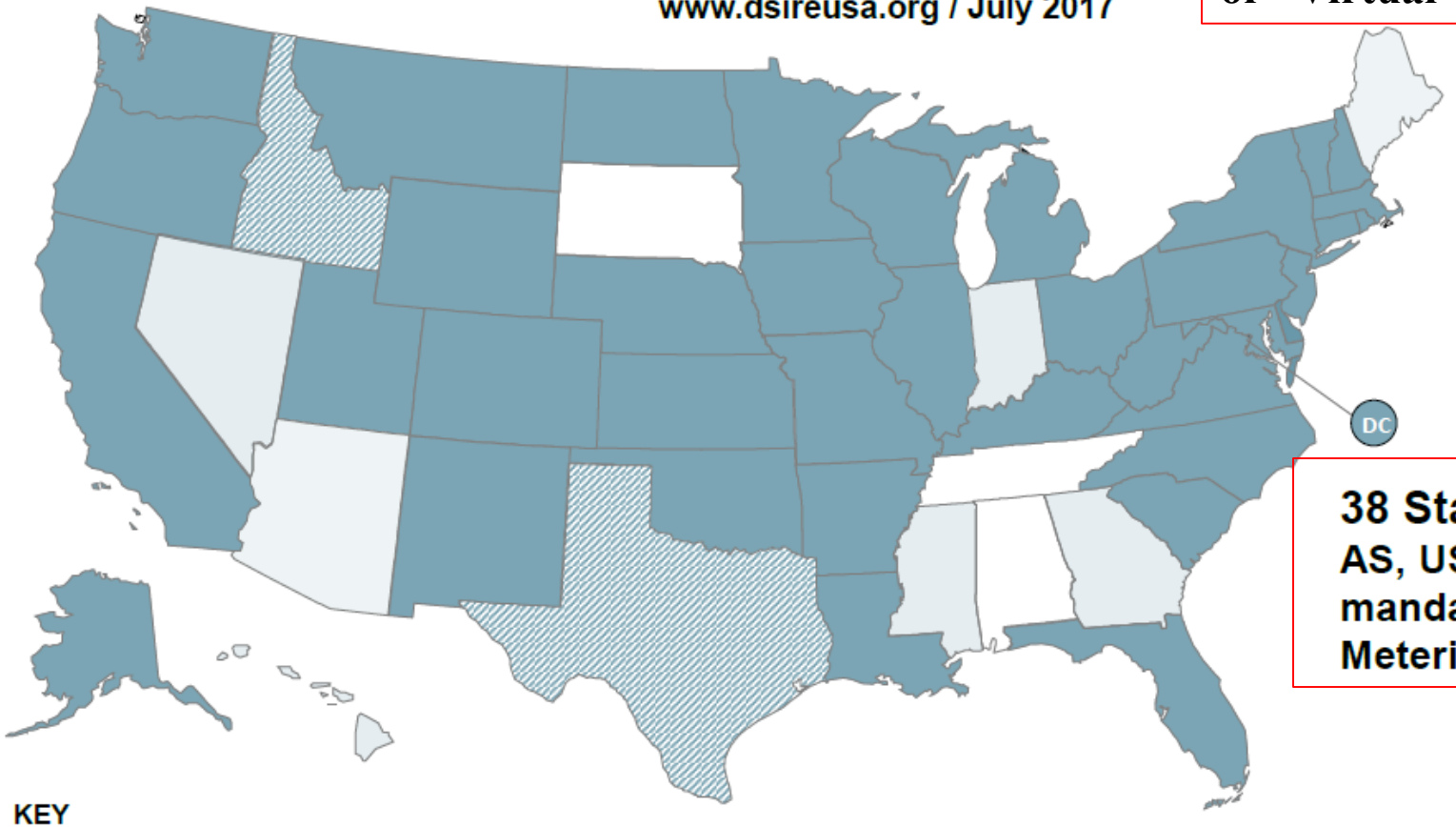
NC CLEAN ENERGY TECHNOLOGY CENTER

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Net Metering

www.dsireusa.org / July 2017

17 States have "Remote" or "Virtual" Net Metering



38 States + DC, AS, USVI, & PR have mandatory Net Metering rules

KEY

- State-developed mandatory rules for certain utilities (38 states + DC+ 3 territories)
- No statewide mandatory rules, but some utilities allow net metering (2 states)
- Statewide distributed generation compensation rules other than net metering (7 states + 1 territory)

U.S. Territories:

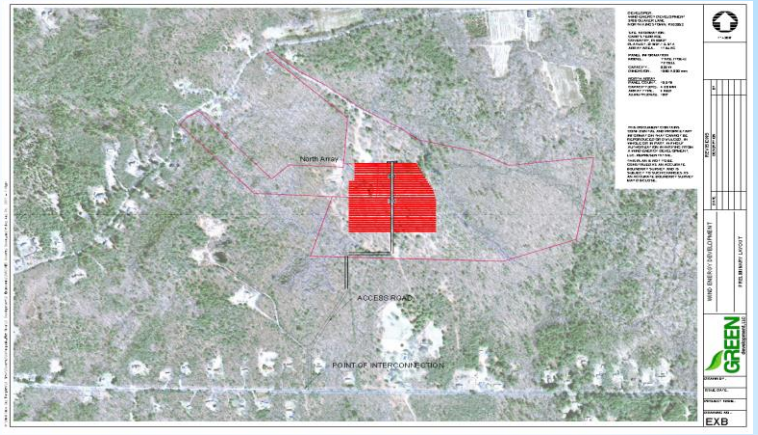
AS PR VI GU

Off-Site Net Metering Projects - Wind

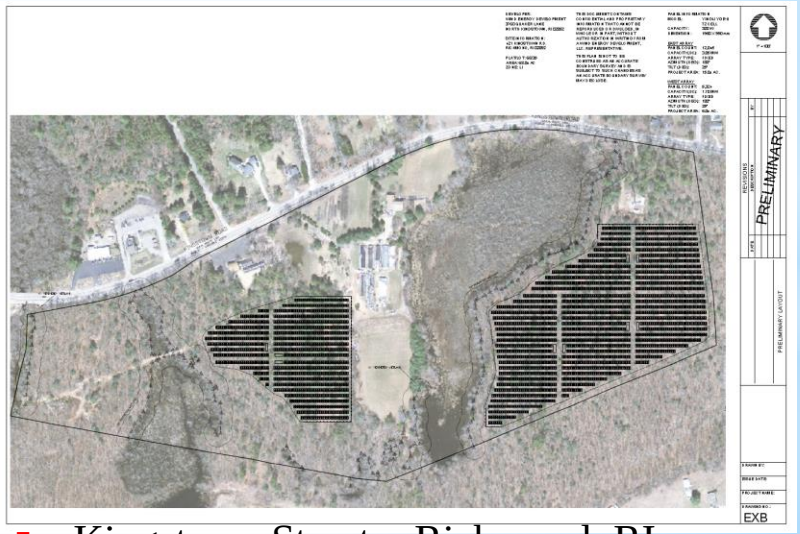
- ✓ **Off-Site (Virtual) Net Metering Passed in RI**
- ✓ Purchased Three 1.5 MW Vensys Wind Turbines
- ✓ Located in Coventry Rhode Island
- ✓ Net Metered to NBC Accounts
- ✓ 9,421,649 kWh/year
- ✓ Became Operational in August 2016
- ✓ **26% of NBC total Electricity Demand**
- ✓ **Wind now Provides 47% of NBC Electricity**
- ✓ **3,071 Metric Tons CO_2 Offset/Year**

Off-Site Net Metering Solar Projects

- ✓ On August 28th, the NBC signed 25 year Net Metering Credit (NMC) agreements for 2 Solar Sites
- ✓ No Up Front Costs!!!
- ✓ NBC will retain all Renewable Energy Credits (RECs)
- ✓ $18.5M financial benefit over 25 yrs
  - ✓ Save $13,082,283 on Electric Costs
  - ✓ $5,404,748 Estimated REC Income
- ✓ Combined 9.83 MW dc/8.4 MW ac
- ✓ Produce 12,875,000 kWh/year
- ✓ 35.46% of NBC Electric Demand
- ✓ Estimated 110,092 Metric tons of CO_2 Offset over 25 years

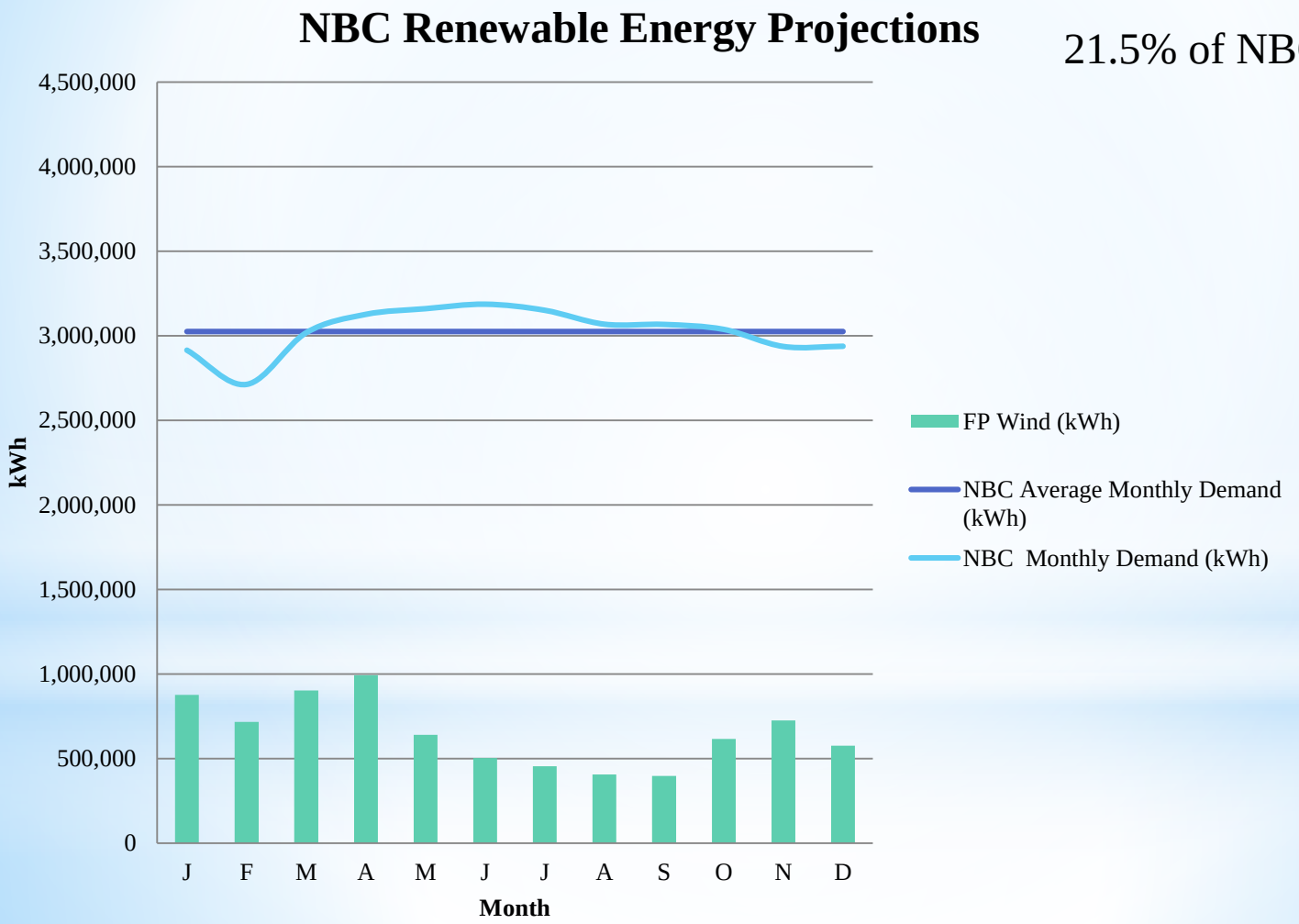


- Carr's Terrace - Coventry, RI
- 3.64 MW ac
- Total Acres: 17.5 Acres



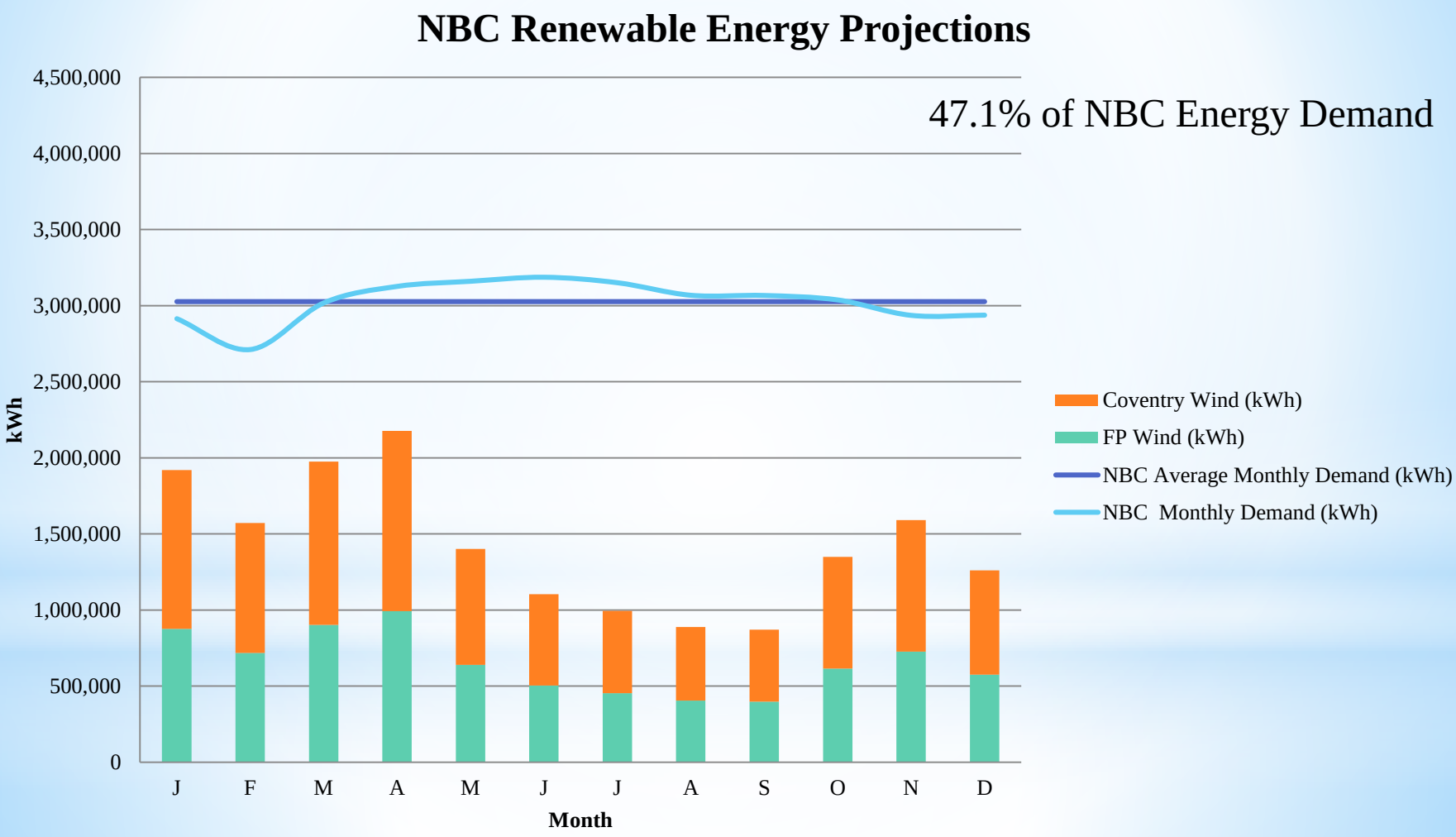
- Kingstown Street – Richmond, RI
- 4.72 MW ac total both sites
- Total Acres: 21Acres

NBC Typical Energy Needs vs Field's Point Wind Energy Production

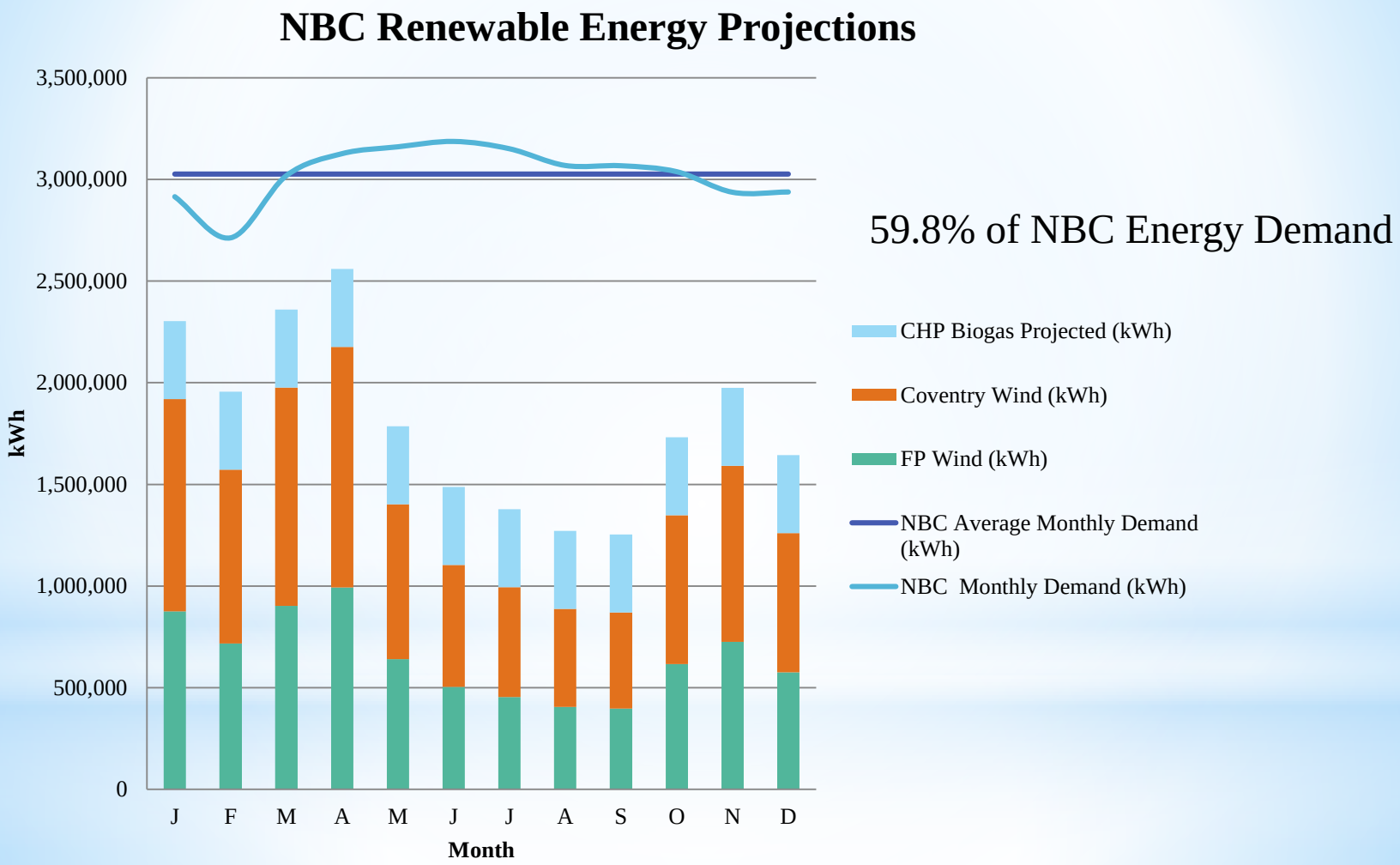


21.5% of NBC Energy Demand

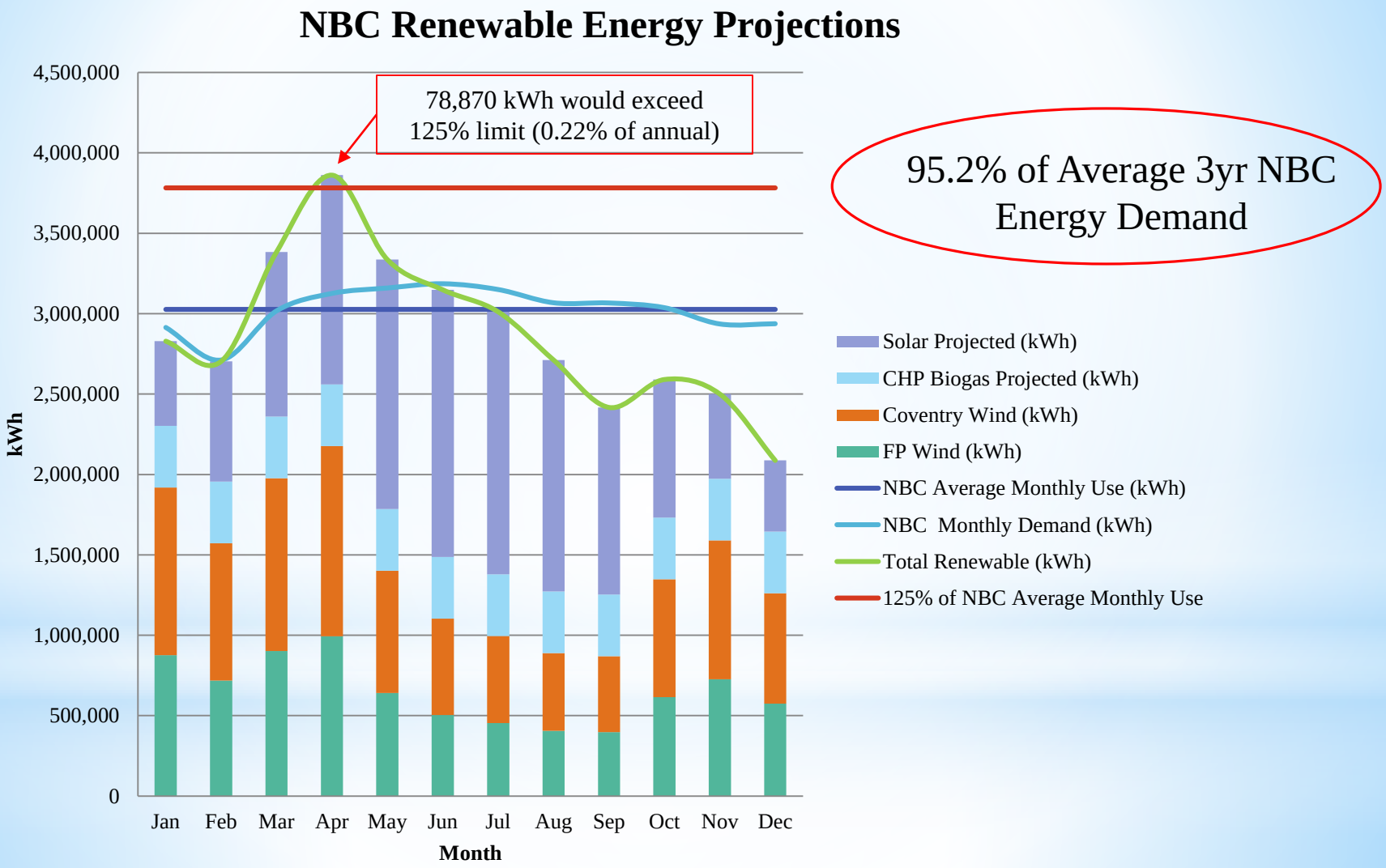
NBC Typical Energy Needs vs Field's Point and Coventry Wind Renewable Energy Projections



NBC Typical Energy Needs vs Field's Point & Coventry Wind & Biogas Renewable Energy Projections



NBC Typical Energy Needs vs FP & Coventry Wind, Biogas and Solar Renewable Energy Projections



Diverse Renewable Energy Portfolio

Estimated Annual Production:
34,580,137 kWh
(95% of NBC Demand)

Off-Site Solar Net Metering Projects

Solar Site	kW DC	kW AC	kWh	Estimated Cumulative % of NBC Demand	COD
Coventry	4,280	3,638	5,495,000	15.13%	3/31/2018
Kingstown 1	1,704	1,448	2,262,000	6.23%	12/31/2017
Kingstown 2	3,854	3,276	5,118,000	14.09%	12/31/2017
Total	9,838	8,362	12,875,000	**35.46%**	

Combined NBC Renewable Energy Projects

NBC Demand (3 year average):	36,312,890	kWh/Year				
Renewable Resource	kWh/year	Cumulative kWh	% of NBC Demand	Cumulative % of NBC Demand	CO_2 Offsets (MT/Year)	Cumulative CO_2 Offsets (MT/Year)
FP Wind	7,806,587	7,806,587	21.50%	21.50%	2,579	2,579
Coventry Wind	9,296,000	17,102,587	25.60%	47.10%	3,071	5,651
BP Biogas	4,602,550	21,705,137	12.67%	59.77%	1,521	7,171
Solar Coventry	5,495,000	27,200,137	15.13%	74.90%	1,816	8,987
Solar Kingstown 1	2,262,000	29,462,137	6.23%	81.13%	747	9,734
Solar Kingstown 2	5,118,000	**34,580,137**	14.09%	**95.23%**	1,691	**11,425**

Historic Energy Use & Projected Renewables

NBC Electricity Use	kWh	Estimated % Renewables
2014	36,822,026	93.91%
2015	35,950,155	96.19%
2016	36,166,489	95.61%
Average	**36,312,890**	**95.23%**

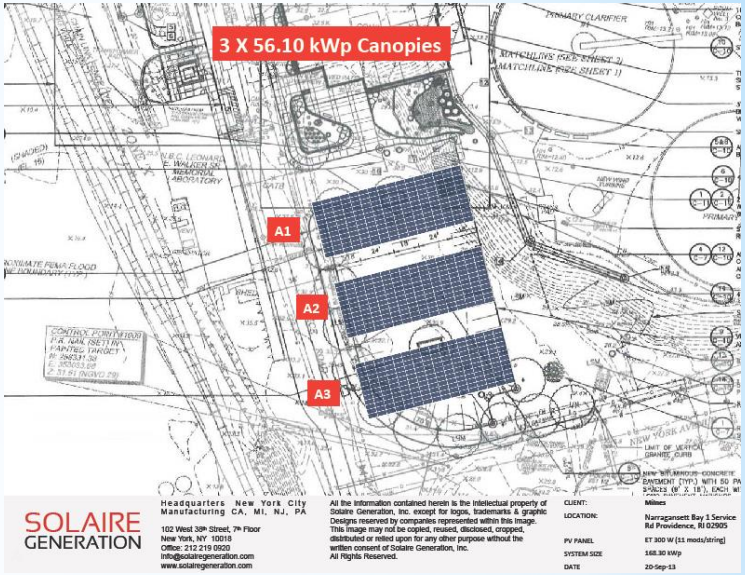
Other Energy Projects Under Investigation:

Hydroelectric Turbine

Typical Siphon Turbine Installation

Estimated Project Values		
Turbine Design Flow (min)	30	MGD
Average Available Head	10.5	Feet
Theoretical Energy	41.2	kW
Turbine Efficiency	72%	
Nameplate Power	29.7	kW
Total Project Cost	$684,237	(Waterline)
Installed Cost	$23,009	per kW
Capacity Factor	96%	
Output	250,656	kWh/yr
Estiamted Net Electric Value	$0.16	per kWh
Annual Savings	$40,105	
Useful Life	20	years
Unsubsidized Payback	17	years

Solar Carports



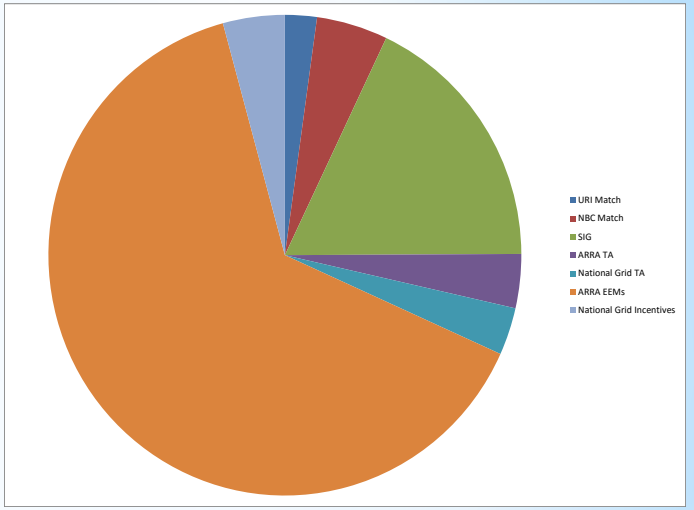
Number of Modules	166	Total
Capacity	49,800 W	$34,860
Percent of Building	30%	of estimated peak
Installed Cost	$3.50	per Watt from NREL
Total Cost		$174,300
Unit Cost Adjustment	0%	
Final Cost		$174,300
Capacity Factor	12%	annual average
Output	52,350	kWh/yr
Avg 15 yr elec Cost	$0.14	per kW
Electric Savings	$7,548	per year
ITC (for eligible entity)	0%	$0
RI Grant	20%	$34,860
Customer Cost		$139,440
RECs Generated	52.3	MWh/yr
Forecasted Rec Value	$40	/MWh
REC Annual Amount	$2,094	per year
Payback Period	14	years

Energy Focused Environmental Management System

Sustainable Energy Management Program for WWTFs

Energy Focused –Environmental Management Systems (EF-EMS)

- ✓NBC Applied for EPA State Innovations Grant in 2008
- ✓$275,000 Grant Award Received
- ✓Leveraged 1.2 M in additional funding
- ✓Project Grew with other Support to $1.54Million
- ✓EPA Energy Management Guidebook for Wastewater and Water Utilities
- ✓Energy Star Portfolio Manager
  - Measure and Benchmark Energy Use Performance
  - Energy Conservation and Efficiency
  - Renewable Energy Opportunity Assessments

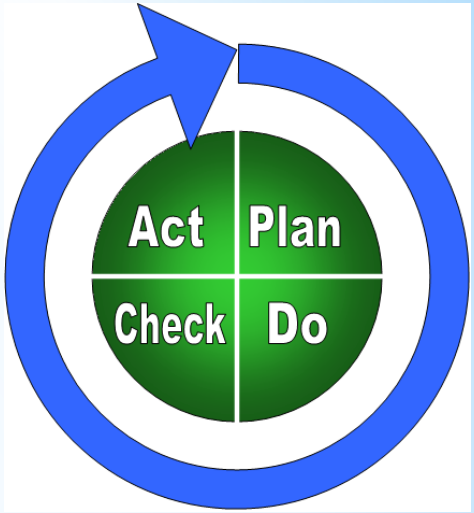


URI Match	$33,512
NBC Match	$75,000
EPA SIG	$275,000
ARRA TA	$55,904
National Grid Energy TA	$49,147
ARRA EEMs	$985,460
National Grid Incent.	$65,000
Total:	$1,539,023

WWTF Sustainability Project Outcomes

Projects Outcomes

- ✓ Energy Assessment of all 19 WWTFs
- ✓ **4,470,000 kWh/year of potential energy savings**
- ✓ **11,000 kWh/year of clean renewable energy opportunities**
- ✓ Heightened energy use awareness
- ✓ Improved energy related communications

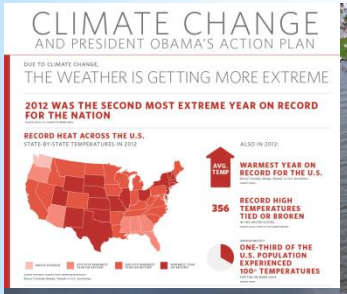


WWTF ID	Population	Electricity kWh	Gas therms	Oil gallons	Energy Mbtu	Flow MGD	Volume MG/Yr	Electric kWh/MG	Heat kBtu/MG	Total kBtu/MG
RI-WWTF-2	1,720	247,300	0	3,000	1,324	0.54	195	1,266	2,150	6,777
RI-WWTF-1	750 / 8500	322,418	0	0	1,100	0.11	38	8,378	0	28,586
RI-WWTF-4	***16,361***	492,600	2,790	1,900	2,288	0.70	255	1,932	2,137	8,973
RI-WWTF-3	6,000	496,534	0	2,000	2,014	0.54	196	2,532	1,428	10,269
RI-WWTF-5	8,000	750,700	0	7,158	3,707	0.84	306	2,453	3,274	12,111
RI-WWTF-8	13,000	979,874	0	9,427	4,852	2.01	734	1,335	1,798	6,609
RI-WWTF-6	2,500	1,051,878	20,350	0	5,624	1.08	393	2,676	5,177	14,307
RI-WWTF-7	8,000	1,095,268	0	16,018	6,300	1.90	694	1,579	3,234	9,084
RI-WWTF-9	25,396	1,277,575	0	17,500	7,159	2.89	1,056	1,210	2,321	6,782
RI-WWTF-10	16,900	1,431,124	10,569	1,112	6,118	3.65	1,333	1,073	909	4,588
RI-WWTF-19	10,000	2,234,168	0	4,800	8,391	2.70	986	2,267	682	8,514
RI-WWTF-15	38,385	2,703,613	23,758	0	11,601	11.83	4,318	626	550	2,687
RI-WWTF-13	47,935	2,776,279	48,531	0	14,326	7.42	2,710	1,025	1,791	5,286
RI-WWTF-11	28,000	3,159,000	27,469	0	13,525	5.01	1,829	1,727	1,502	7,395
RI-WWTF-12	30,000	4,776,225	0	19,411	19,402	6.45	2,354	2,029	1,154	8,242
RI-WWTF-16	77,000	7,874,578	58,735	0	32,742	13.92	5,079	1,550	1,156	6,446
RI-WWTF-14	52,200	8,716,754	4,195	3,085	30,655	33.14	12,097	721	70	2,534
RI-WWTF-18	208,743	10,486,807	74,004	0	43,181	48.67	17,765	590	417	2,431
RI-WWTF-17	119,809	12,507,940	39,883	0	46,665	21.75	7,938	1,576	502	5,879
	709,949	63,380,636	310,284	85,411	260,973		60,276	1,052	713	4,330

- ✓ Annual Electric savings of 7 - 9% from all POTWs attained depending on how data is normalized

Climate Change Legislation & Regulations

- ✓ Many new Regulations & Legislation being proposed & enacted annually to address Climate Change
- ✓ Regulations & Goals Vary Widely
- ✓ WWTFs will eventually have to meet Greenhouse Gas Reduction Targets



Various GHG Reduction Targets

(H 7904):

- ✓ 25% below 1990 levels by 2025
- ✓ 50% below 1990 levels by 2035
- ✓ 85% below 1990 levels by 2050

(S 7952A) 10% below 1990 levels by 2020

- ✓ 45% below 1990 levels by 2035
- ✓ 80% below 1990 levels by 2050

Renewable Energy Portfolio Standard

- ✓ Obtain 38.5% electricity from renewable resources by 2035

RIDEM

- ✓ CO_2 Budget Trading Program – RGGI participation

Regional Greenhouse Gas Initiative (RGGI)

- ✓ Cap and reduce power sector CO_2 emissions
- ✓ 10% Reduction by 2018

RI Climate Change Council

- ✓ Develop strategies to reduce RI GHG emissions (below 1990 levels):
- ✓ 10% by 2020,
- ✓ 45% by 2035, and
- ✓ 80% by 2050

Off-Site (Virtual) Net Metering

EPA Mandatory Reporting of GHGs 40 CFR 98 (2010)

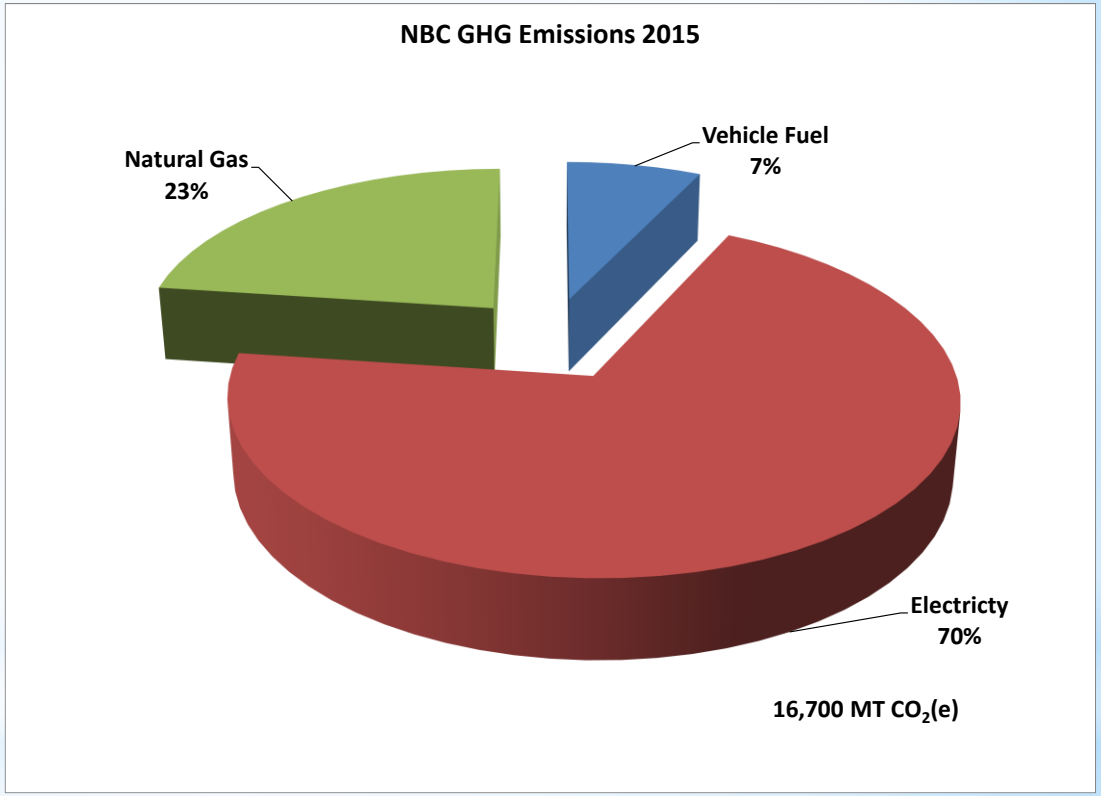
List Categories Regulated

- Listed Source (Table A–3) Category
  - ✓ Specifies Industry Types Regulated
  - ✓ WWTFs were listed in Proposed Regs, but deleted – **Thank You NACWA!!!**
- Listed Source (Table A–4)
  - ✓ Emits 25,000 metric tons CO_2e or more per year
- Not a Listed Source Category but:
  - ✓ 45% below 1990 levels by 2035
  - ✓ Has stationary fuel combustion units with 30 mmBTU/hr nameplate capacity or greater, and
  - ✓ Emits 25,000 metric tons CO_2 equivalents or more per year in combined emissions from all stationary fuel combustion sources

✓ ***NBC is Well Below the 25,000 metric ton cut-off***

✓ ***NBC is NOT Regulated YET!!!***

✓ ***But we are being Proactive and Preparing for Future Regulation!!!***



GHG Emissions in Red are not Reportable under present regulations

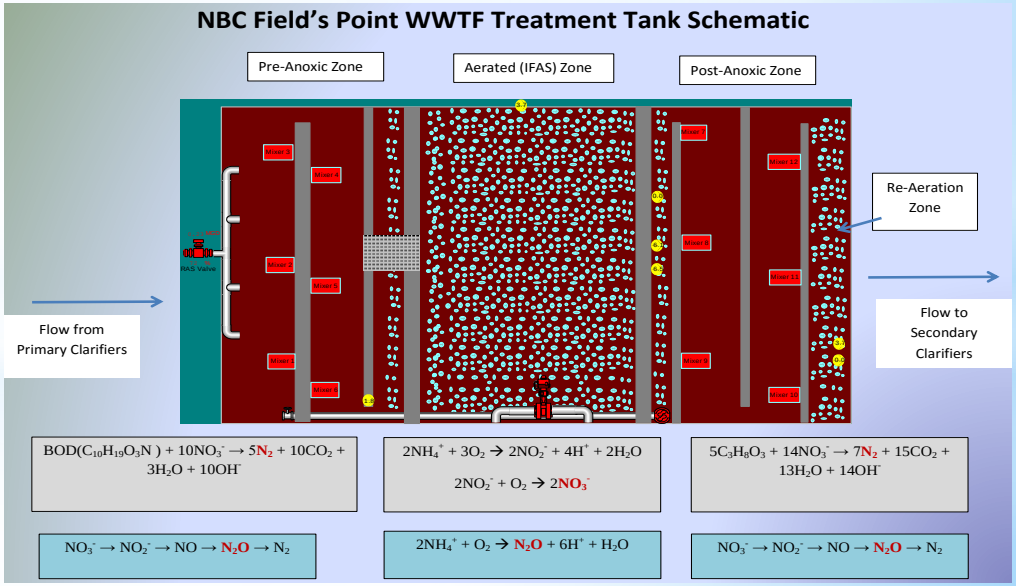
GHG Emissions Analysis of Treatment Processes

Floating chamber placed on water surface to measure GHG concentrations

GHG analyzer that uses cavity ring down spectrometry to measure the ppm concentrations of GHGs: CO_2, N_2O and CH_4

Preliminary Findings:

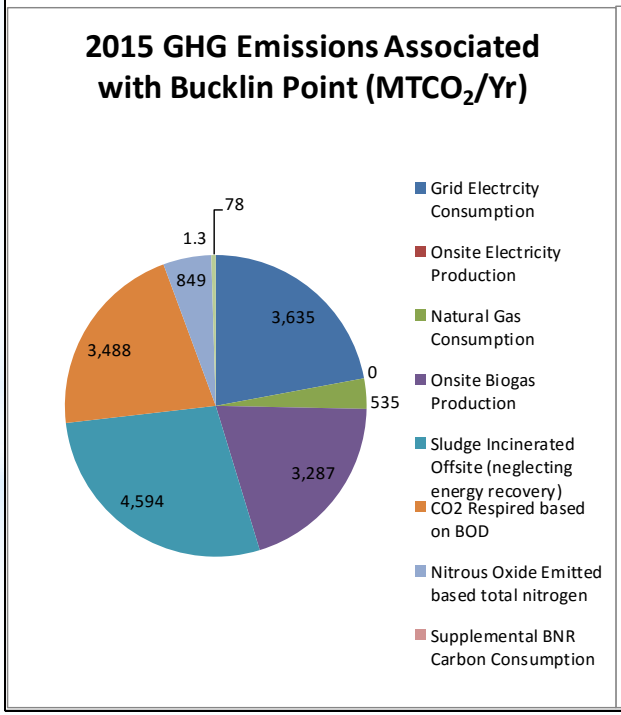
- ✓ % of TKN emitted as N_2O is lower than literature values
- ✓ Grams of CH_4 m^{-2} d^{-1} and g CO_2 m^{-2} d^{-1} can vary from reference values and vary widely depending on process operating parameters

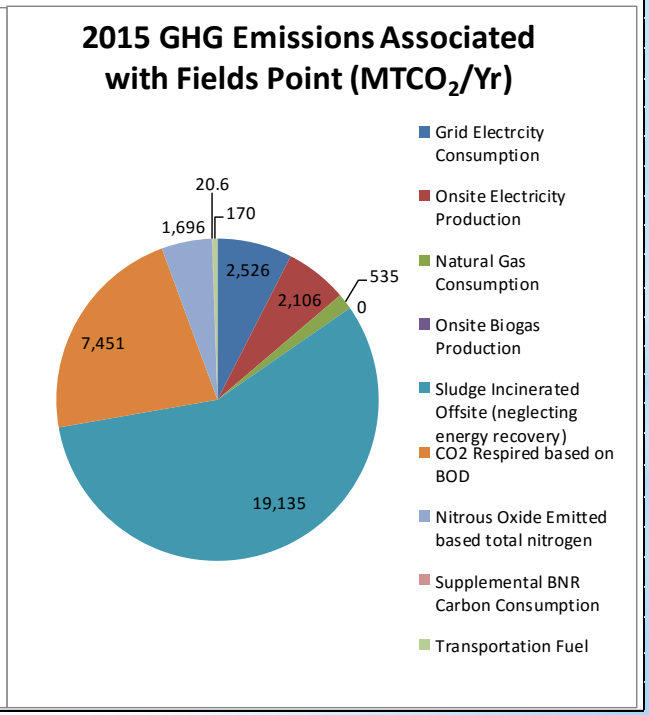


Carbon Footprint of NBC Facilities

- ✓ Emission values are estimates based on plant data and published emission factors
- ✓ Off-site sludge incineration (teal colored wedge) is the largest portion (47%) of NBC GHG emissions
- ✓ Note that sludge incineration is a ***beneficial reuse*** because the incinerator uses an off-gas energy recovery turbine
- ✓ BNR BOD removal (orange colored wedge) is the second largest contributor (22%) of emissions

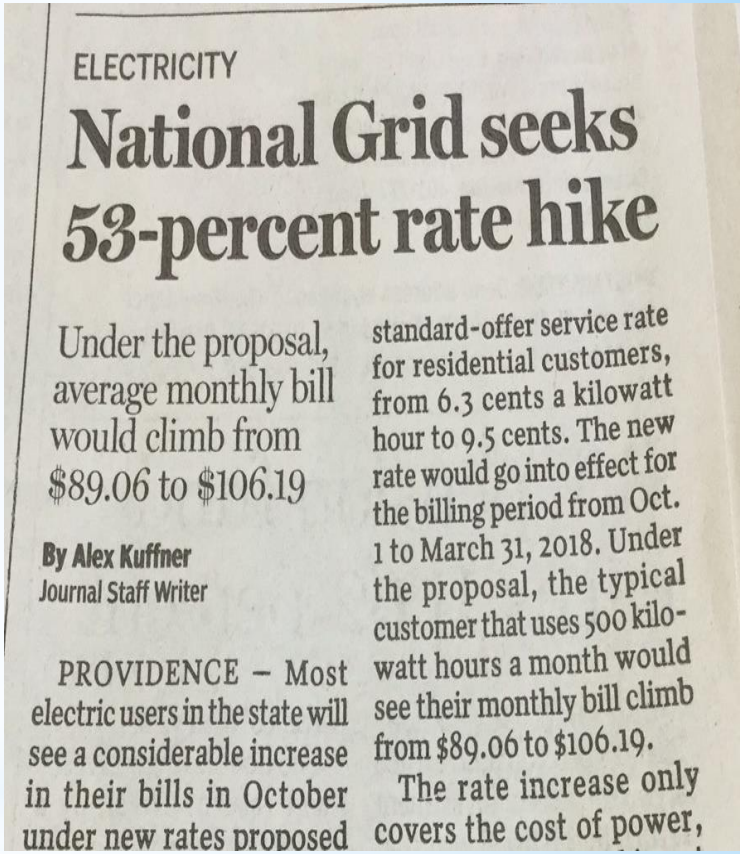
				CO_2 Emission ($Mt_{eq.}$/yr)	
Greenhouse Gas Emission Source	**Bucklin Point WWTF**	**Fields Point WWTF**	**Units**	**Bucklin Point WWTF**	**Fields Point WWTF**
Grid Electrcity Consumption	12,458,000	8,658,845	kWh/yr	3,635	2,526
Onsite Electricity Production	0	7,217,000	kWh/yr	0	2,106
Natural Gas Consumption	109,502	100,947	Therms/yr	535	535
Onsite Biogas Production	115,414,532	0	SCF/Yr	3,287	0
Sludge Incinerated Offsite (neglecting energy recovery)	2,125	7,761	DTY shipped offsite	4,594	19,135
CO_2 Respired based on BOD	3,402	7,265	TPY BOD removed by BNR	3,488	7,451
Nitrous Oxide Emitted based total nitrogen	790	1,578	TPY Influent TN	849	1,696
Supplemental BNR Carbon Consumption	810	12,480	GPY MicroC used	1.3	20.6
Transportation Fuel	8,728	19,042	GPY Gasoline Purchased	78	170
WWTF = Wastewater Treatment Facility			Totals	16,468	33,639





Conclusions & Recommendations

- ✓ Be Proactive and be prepared to increased regulation to reduce CO_2 emissions
- ✓ Continually monitor your electric usage and costs and continually assess conservation opportunities
- ✓ Have open communications with your local Electric Utility
  - Investigate incentives from your Electric Utility and take advantage of them
- ✓ Monitor Local Legislation and actively pursue favorable legislation
- ✓ Seek out small grants to perform feasibility studies for renewable energy projects
- ✓ Educate your directors and board about feasibility study findings and financial and environmental benefits
- ✓ Communicate proposed Renewable Projects to the public to avoid potential issues
- ✓ Continue to "Chip Away" to complete small projects and go after "Low Hanging Fruit" specific to your site on your goal to energy independence



ELECTRICITY

National Grid seeks 53-percent rate hike

Under the proposal, average monthly bill would climb from $89.06 to $106.19

By Alex Kuffner
Journal Staff Writer

PROVIDENCE – Most electric users in the state will see a considerable increase in their bills in October under new rates proposed standard-offer service rate for residential customers, from 6.3 cents a kilowatt hour to 9.5 cents. The new rate would go into effect for the billing period from Oct. 1 to March 31, 2018. Under the proposal, the typical customer that uses 500 kilowatt hours a month would see their monthly bill climb from $89.06 to $106.19.

The rate increase only covers the cost of power,

Any Questions?

Special Thanks to our NBC Energy Team:

Jim McCaughey *- Environmental, Safety & Technical Assistance Manager*
Barry Wenskowicz *– Environmental Sustainability Engineer*

And to our NBC Teams in ***Engineering, Operations, Construction, Finance & Legal*** *that also assisted on these important project!!!*

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