@SJ_Program
#SustainableStateNJ

Next Generation Sustainable Energy - Emerging Technologies and Practices in Sustainable Energy

2016 NEW JERSEY SUSTAINABLE SUMMIT

PRESENTERS

- *Randall Solomon*
- *Kenny Esser*
- *Gary Fournier*
- *Nancy Quirk*
- *Serpil Guran*
- *Stephen Marks*
- *Michael Winka*

New Jersey's Energy Master Plan

Michael Winka
Sr. Policy Advisor

Sustainable Jersey
June 15, 2016

The 2011 EMP

5 overarching goals:

Drive Down the Cost of Energy For All Customers

Promote a Diverse Portfolio of New, Clean, In-State Generation

Reward Energy Efficiency and Energy Conservation/ Reduce Peak Demand

Capitalize on Emerging Technologies for Transportation and Power Production

Maintain Support for the Renewable Energy Portfolio Standard

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The 2011 EMP

Plan for Action – 31 policy recommendations in 4 general sections

- Expand In-State Electricity Resources
- Cost Effective Renewable Resources
- Promote Cost Effective Conservation and Energy Efficiency
- Support the Development of Innovative Energy Technologies

http://www.nj.gov/emp/

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Is New Jersey a High Energy Cost State ???

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Drive Down the Cost of **All Energy** For All Customers

Residential **Electricity** Price

4^{th} → 10^{th} + $200 - $300

Residential **Natural Gas** Price

17^{th} → 46^{th} - $ 200 - $300

Gasoline Price → 46^{th} - $ 200 - $300

The average New Jersey energy customer spends $200 to $300 less per year for electricity, natural gas and gasoline than the average US energy customer.
Overall 3% decrease in residential electricity cost (Max 8% decrease) – Dec 2015

This is all driven by low natural gas cost

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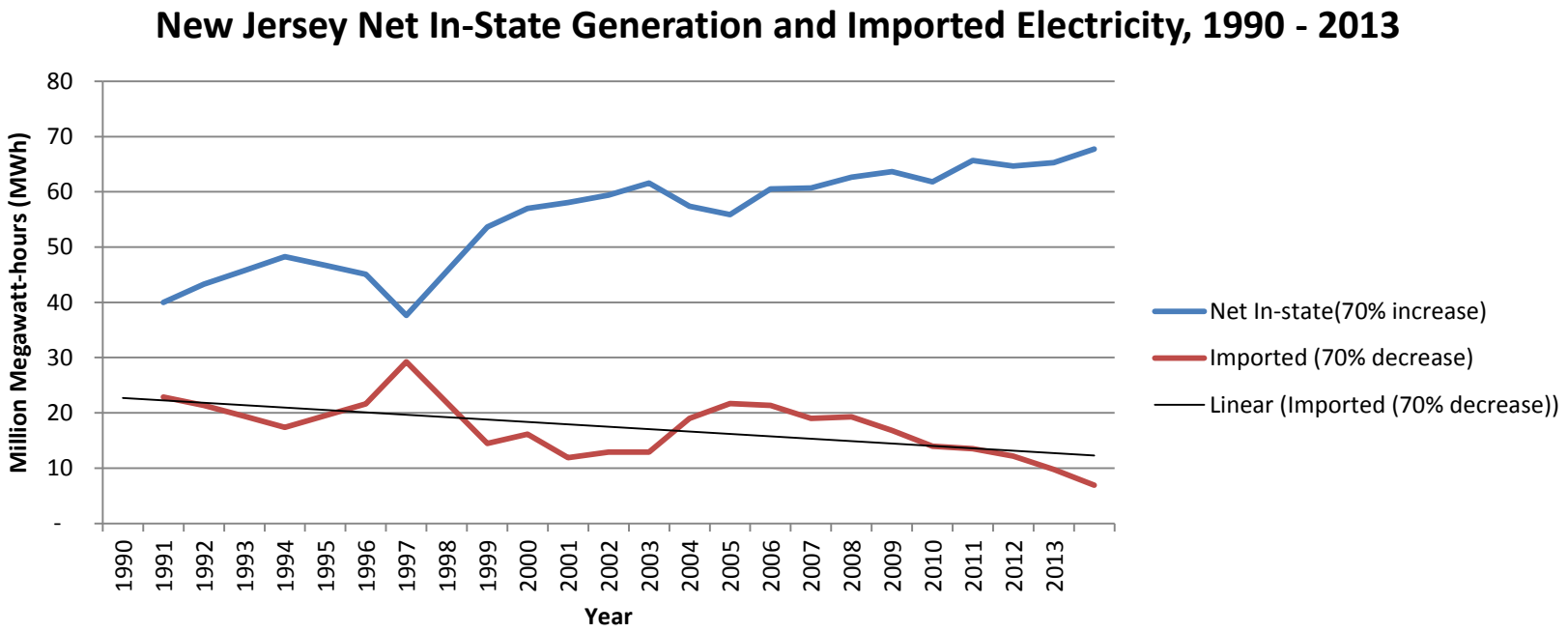

BPU has approved over $1.93 billion for natural gas utility infrastructure upgrades and mitigation projects.

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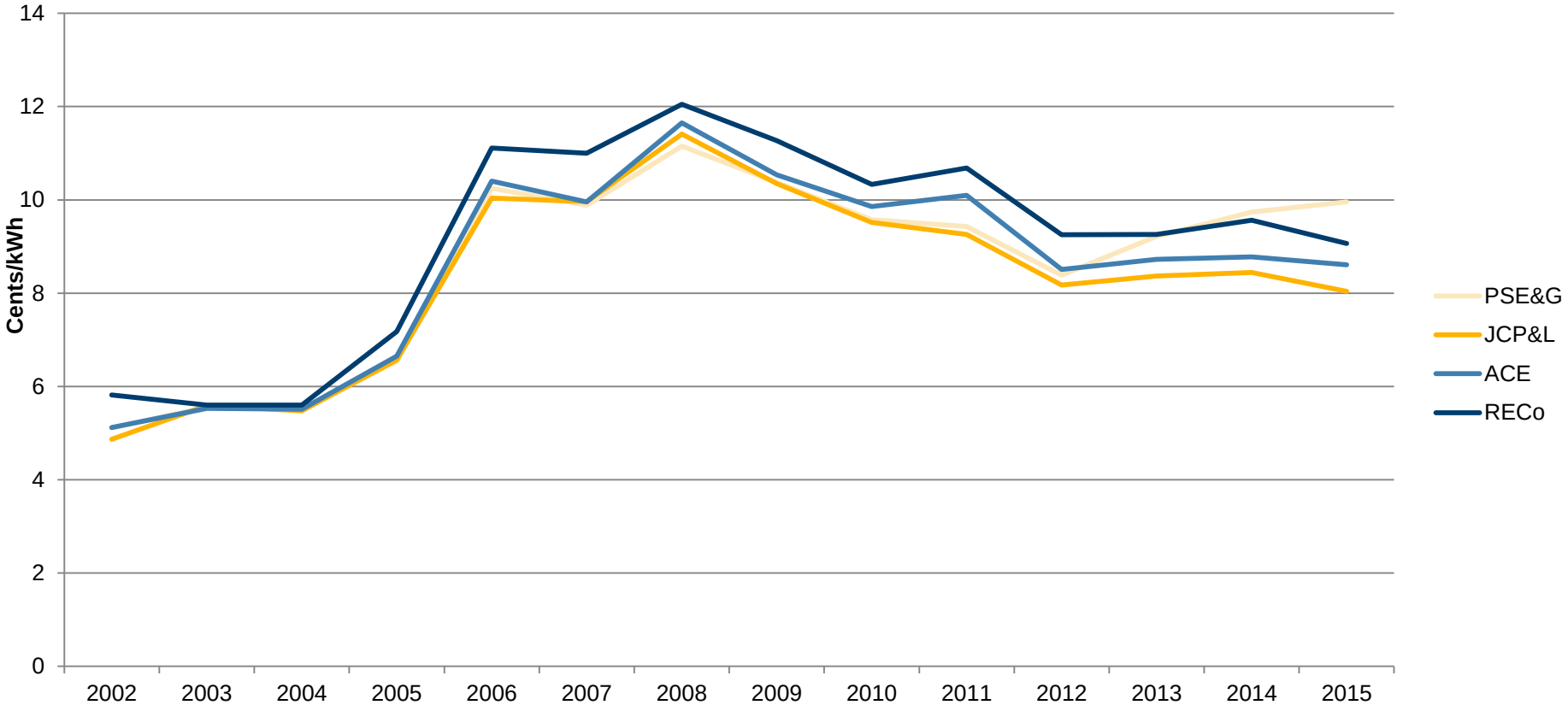
Annual BGS Auction Price - FP 2002 - 2015



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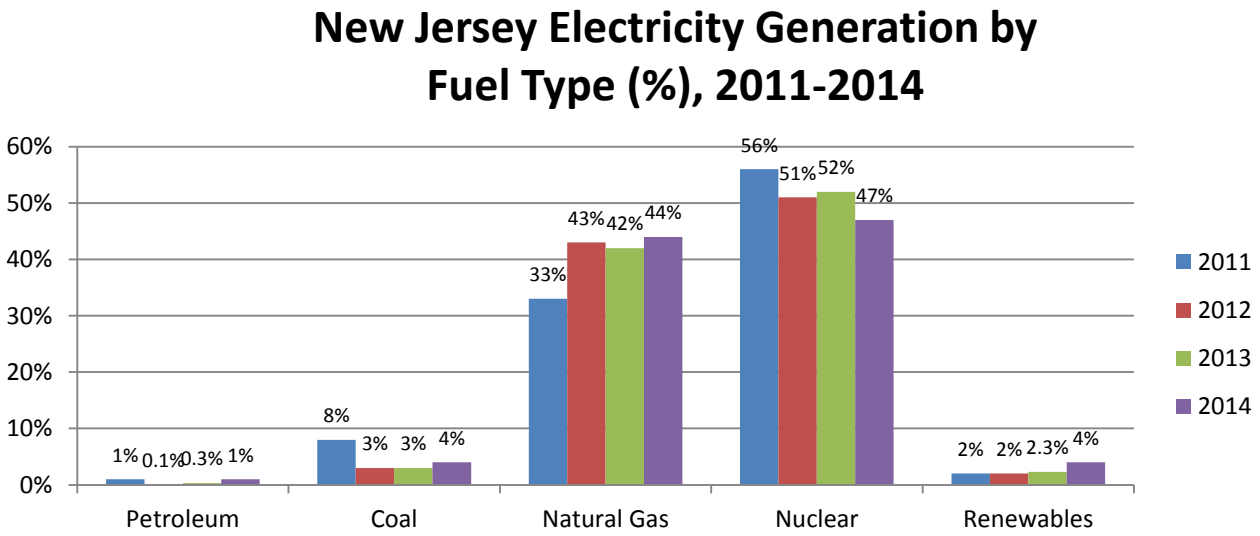
Promote a Diverse Portfolio of New, Clean, In-State Generation



93% of total electricity from ‘Clean” Sources – 96% of in-state generation
2,000 + megawatts (MW) of new CCNG (3,000 permit requests)
100 MW CHP
1,300 MW of DG including CHP, fuels cells, biomass, LF gas, wind and solar
Oyster Creek 654 MW closing – PJM’s latest RTIP neutral
Despite the current economics - remain committed to the objective assessment (Dec 2015)

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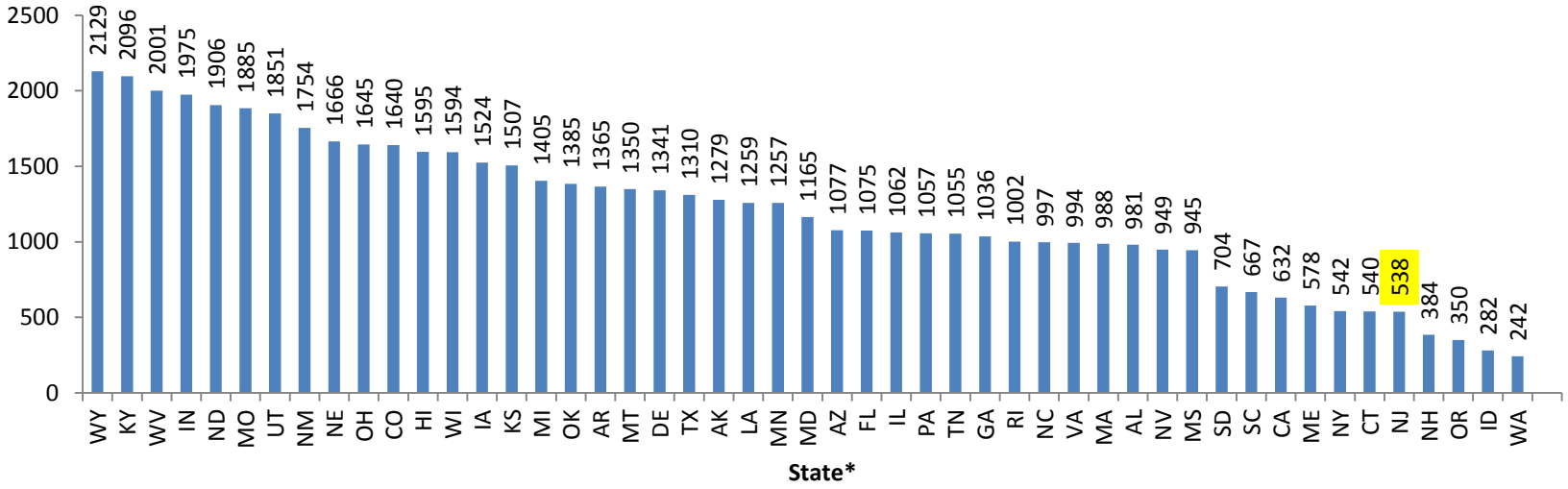
All Sources CO_2 Emission Rate (lb/MWh), 2013
NJ in-state generators



New Jersey's SO_2 emissions 3rd lowest
NOx and CO_2 6th lowest
In 13-state PJM region New Jersey ranks the lowest
NJ is the 22nd largest generator of electricity.

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Current New Jersey CHP/FC and DER facilities		
DER	**Number**	**MW**
CHP/FC total	219	2,900
CHP/FC DER	117	378
PV total	41,294	1,567
PV Behind the Meter	41,165	1,230
PV Grid Supply	129	338
TOTAL DER	41,282	1,608

1,300 MW of DG Installed since 2011
100 MW of CHP installed since 2011 (Dec 2015)
Approximately 4-6% of total electricity

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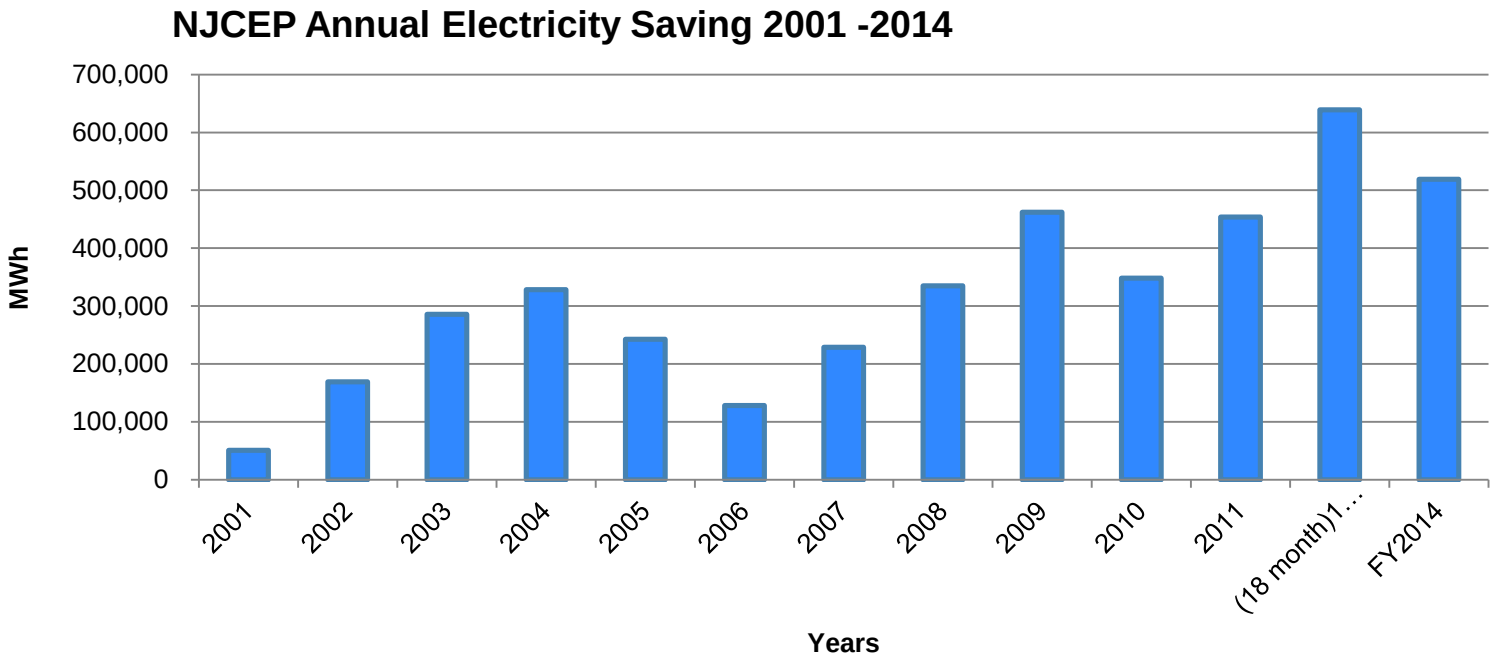
Reward Energy Efficiency and Energy Conservation/ Reduce Peak Demand



4 Million MWh of electricity saved 2001- FY 2014 on average 350,000 MWh (500,000 MWh)
About ½% of total retail electric sales
New NJCEP Administrator awarded to AEG/TRC
Energy Savings Improvement Programs (ESIP) 63 projects 16 completed ($14.7M)

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NJBPU Clean Energy Program EM&V

Electric Demand Savings = ΔkW = kWbaseline - kWenergy efficient measure

Electric Energy Savings = ΔkW X EFLH

Electric Peak Coincident Demand Savings = ΔkW X Coincidence Factor

Gas Energy Savings = ΔBtuh X EFLH

Where:

EFLH = Equivalent Full Load Hours of operation for the installed measure. Total annual energy use (kWh) of an end use over a range of operating conditions divided by the connected full load of the end use in kW.

ΔBtuh = Btuh baseline input – Btuhenergy efficient measure input

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NJBPU Clean Energy Program EM&V

PROGRAM/Measure	Measure Life
Residential Programs	
Residential Electric HVAC	
CAC 13	15
CAC 14	15
ASHP 13	15
ASHP 14	15
CAC proper sizing/install	15
CAC QIV	15
CAC Maintenance	7
CAC duct sealing	15
ASHP proper sizing/install	15
E-Star T-stat (CAC)	15
E-star T-stat (HP)	15
GSHP	30
CAC 15	15
ASHP 15	15
Residential Gas HVAC	
High Efficiency Furnace	20
High Efficiency Boiler	20
High Efficiency Gas DHW	10
E-Star T-stat	15
Boiler Reset Controls	7

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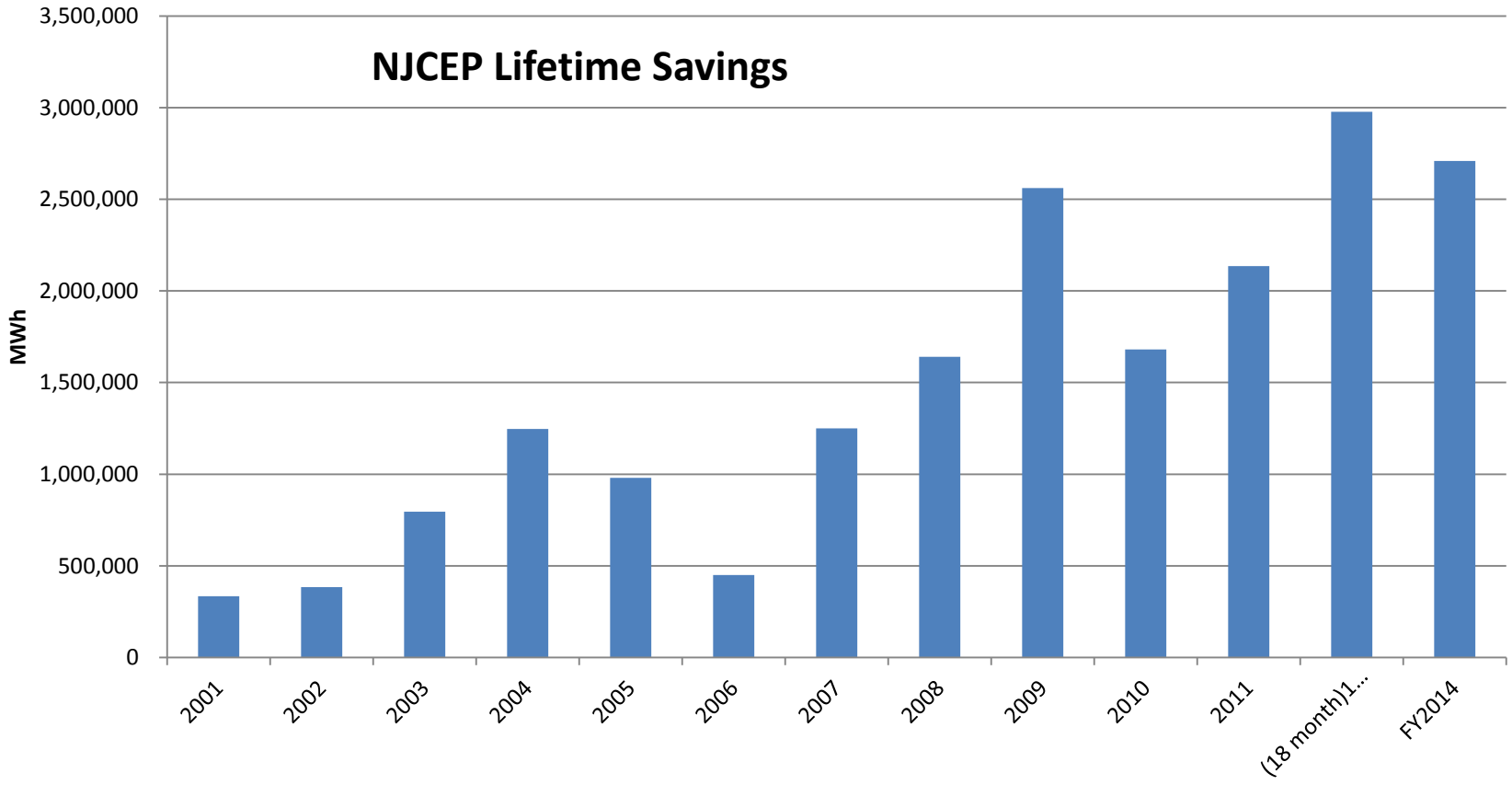
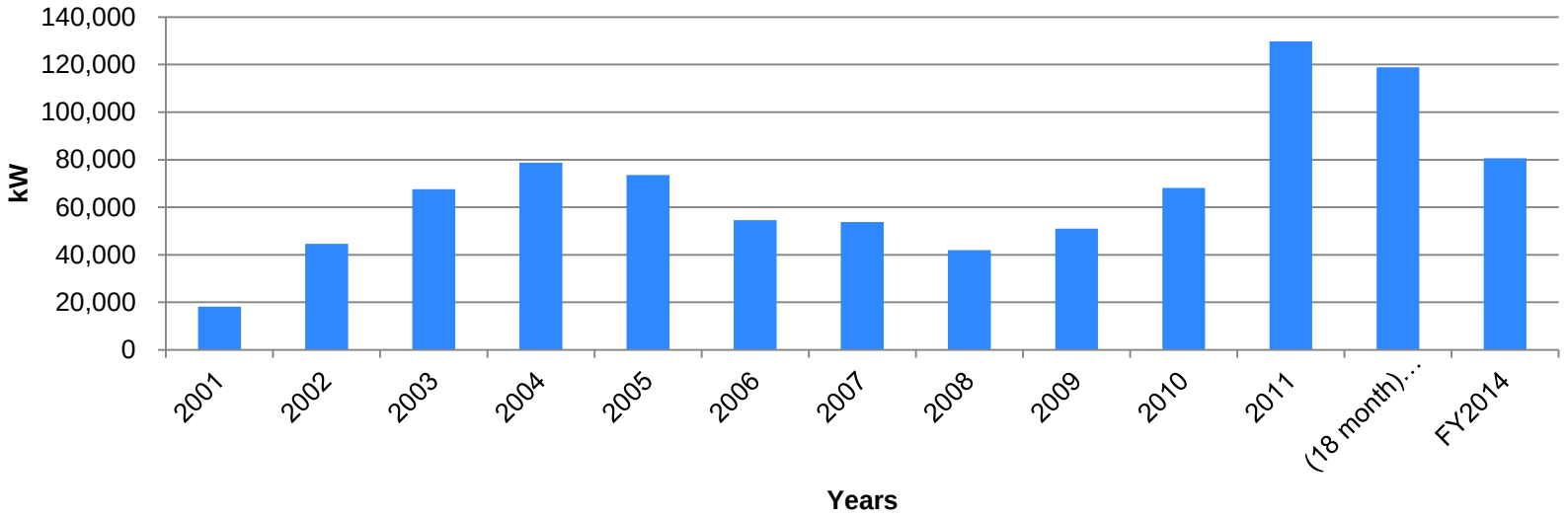
NJBPU Clean Energy Program EM&V



NJCEP Electric Peak Demand Reduction 2001-2014



860 MW of Peak Demand Reduction 2001 - FY 2014
EDC/TPCP programs provide 200 MW of DR
EPSA Case at SCOTUS – PJM Capacity Performance – summer and winter peak
State run DR programs ?

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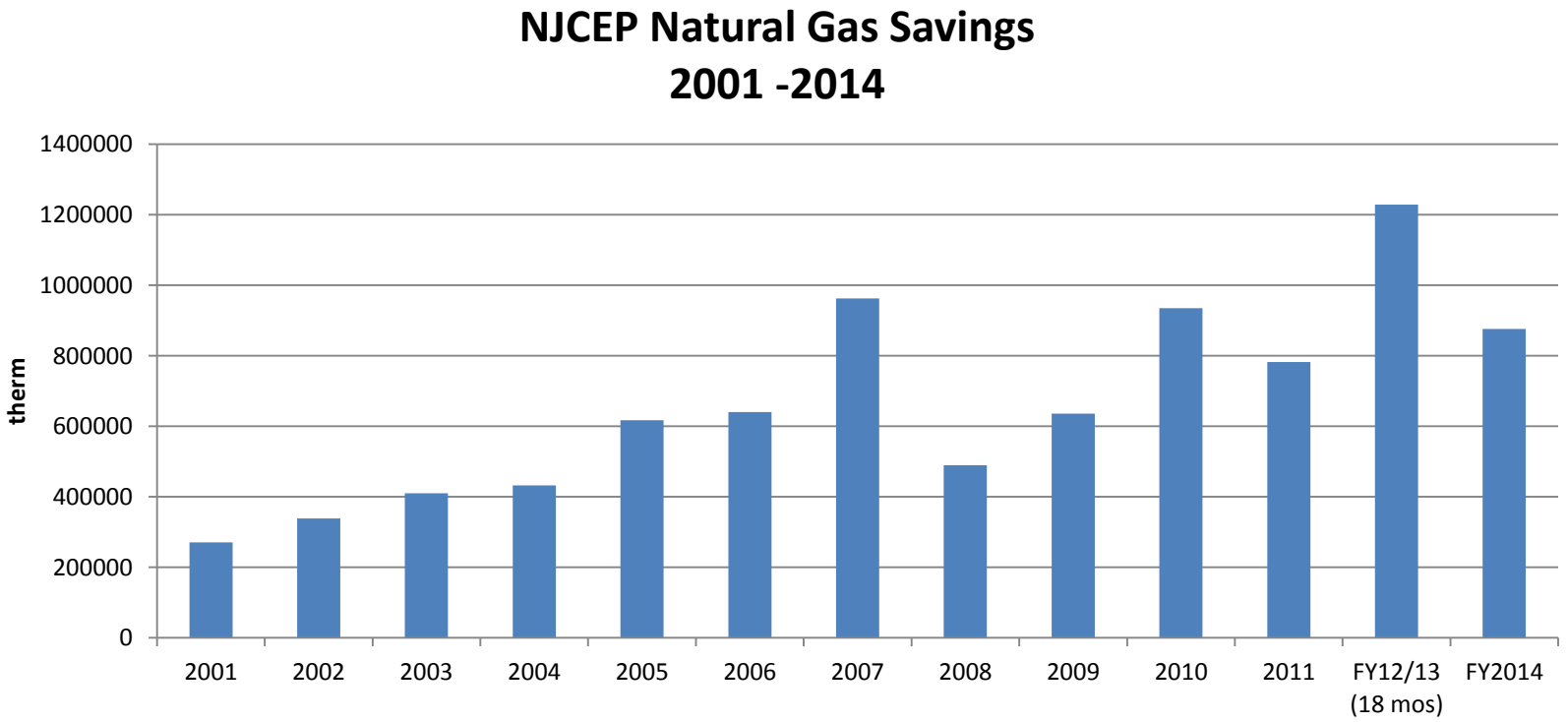

80 Million therms of natural gas savings 2001 – FY 2014
0.15% saving on retail sales

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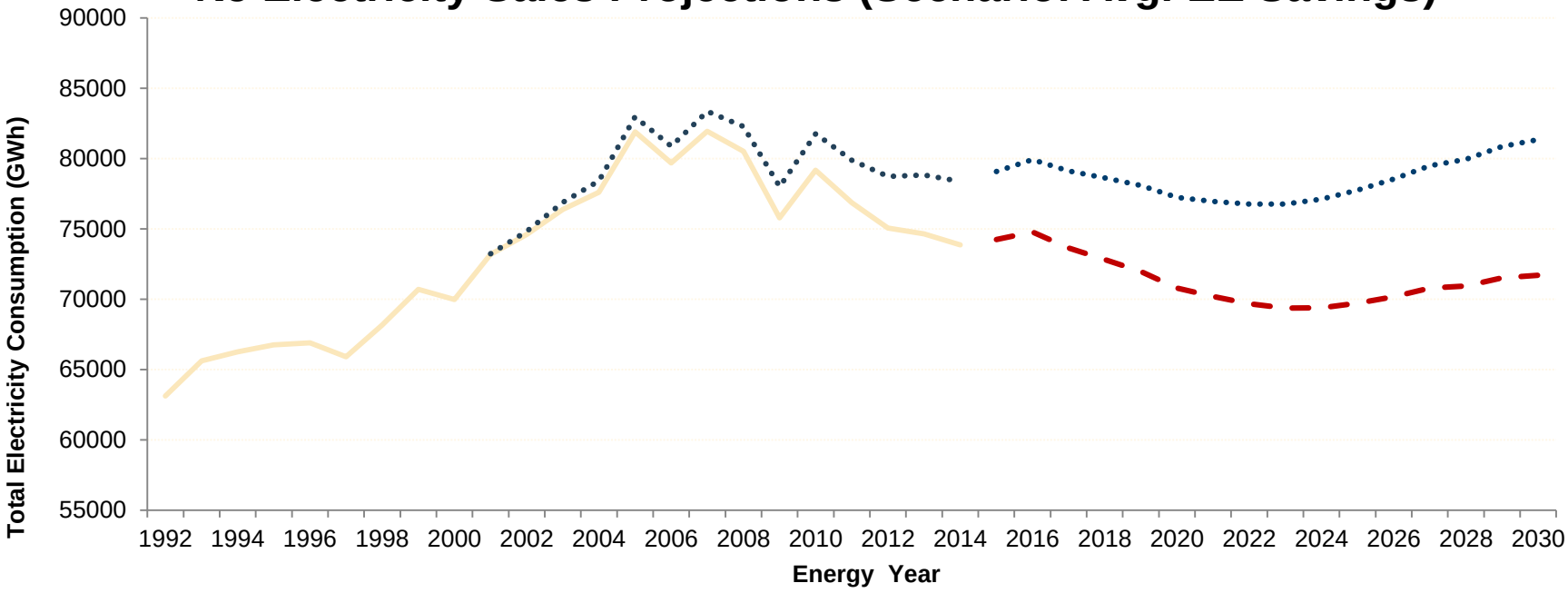
NJ Electricity Sales Projections (Scenario: Avg. EE Savings)



Invested $2.256 B in EE and RE – $1.689 B for EE and $572M for RE and Adm.
$727.4M in EDC/GDC EE programs (E'town, RECo, PSE&G, NJNG, SJG)
4.6 million MWh less in 2014 - Collectively 27.5 million MWh
$300 Million in savings at wholesale or $600 M at retail
Adopted 2014 IECC and ASHREA Residential and Commercial Building Energy Code - **sets the floor**

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NJBPU Clean Energy Program EM&V

System average air emissions reduction factors provided by the NJDEP are:

Electric Emissions Factors

Emissions Product	Jan 2001-June 2002	July 2003-February 2014	March 2014 - Present
CO2	1.1 lbs per kWh saved	1,520 lbs per MWh saved	1,111.79 lbs per MWh saved
NOX	6.42 lbs per metric ton of CO2 saved	2.8 lbs per MWh saved	0.95 lbs per MWh saved
SO2	10.26 lbs per metric ton of CO2 saved	6.5 lbs per MWh saved	2.21 lbs per MWh saved
Hg	0.00005 lbs per metric ton of CO2 saved	0.0000356 lbs per MWh saved	2.11 mg per MWh saved

Gas Emissions Factors

Emissions Product	Jan 2001-June 2002	July 2003-Present
CO2	NA	11.7 lbs per therm saved
NOX	NA	0.0092 lbs per therm saved

All factors are provided by the NJ Department of Environmental Protection and are on an average system basis. They will be updated as new factors become available.

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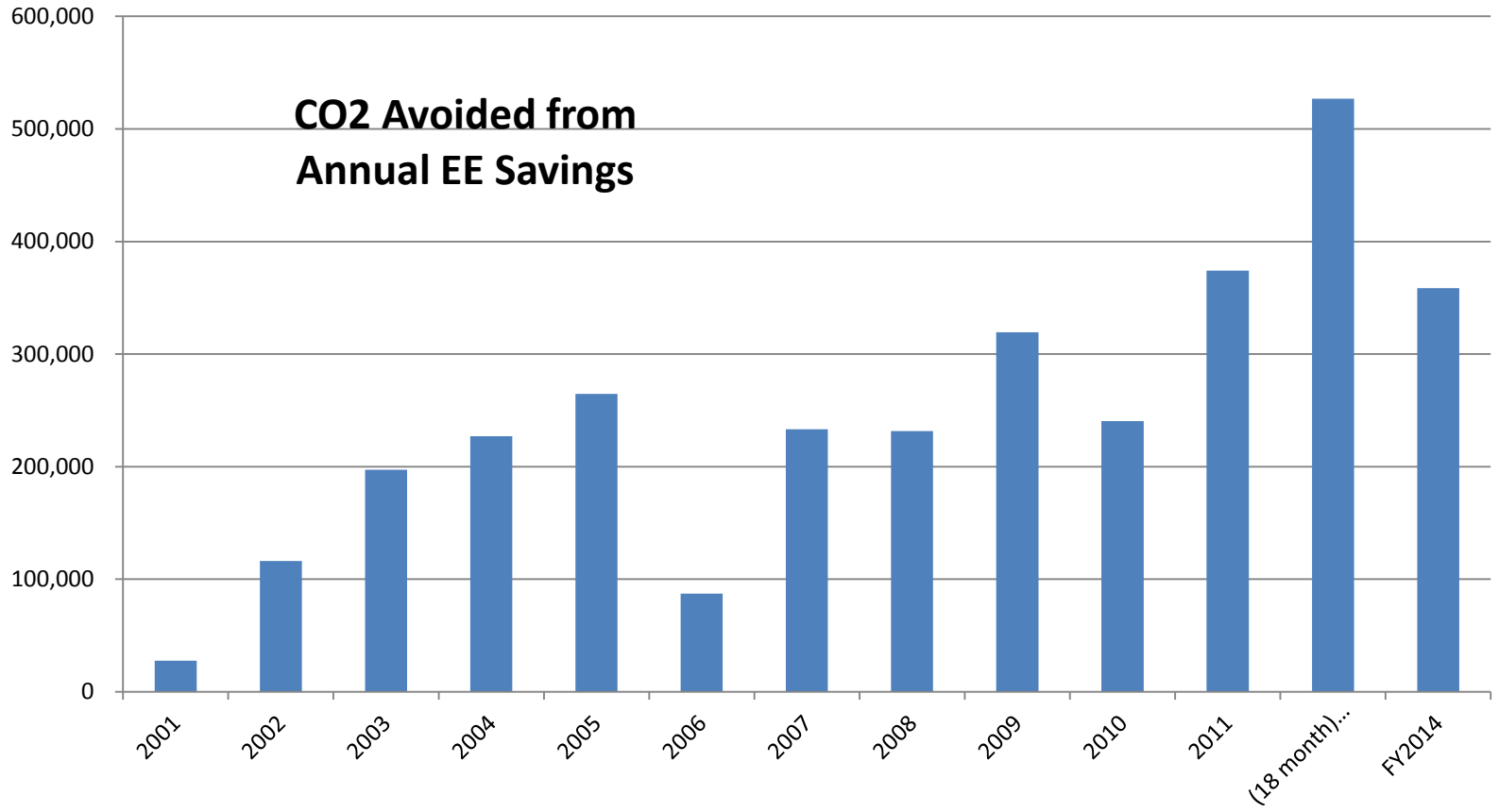
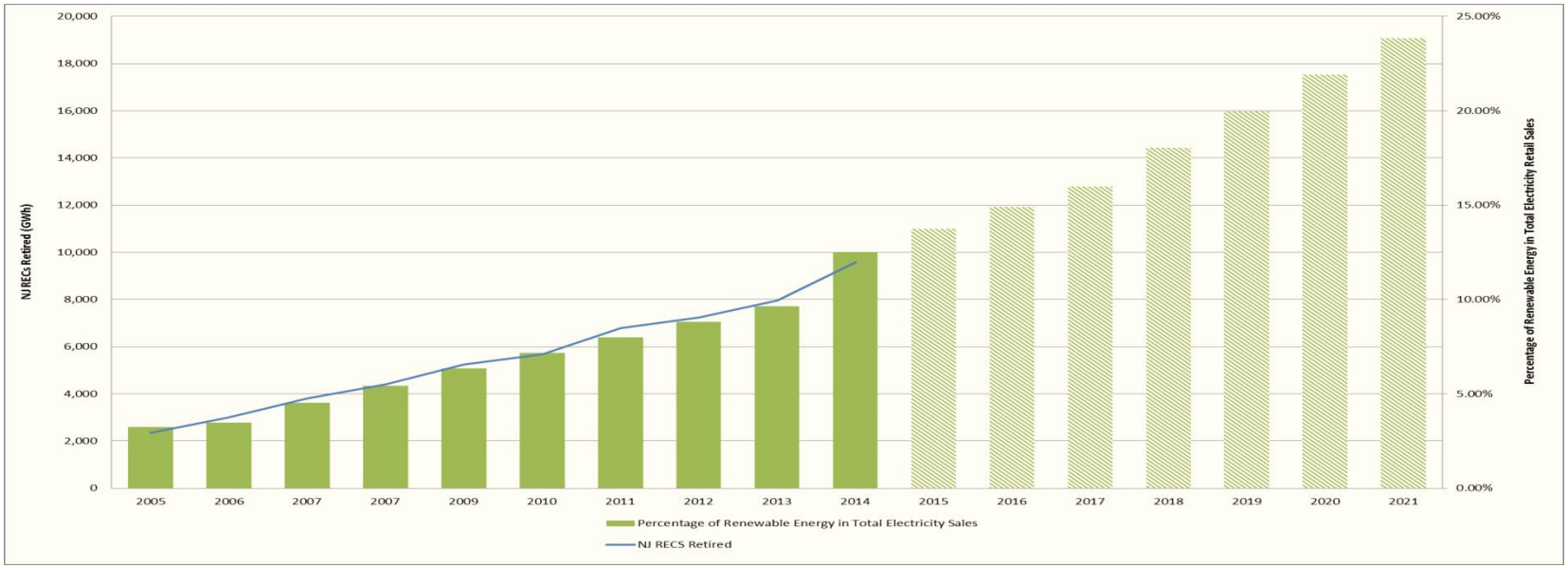

CO2 Avoided from
Annual EE Savings
600,000
500,000
400,000
300,000
200,000
100,000
0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
(18 month)...
FY2014

Maintain Support for the Renewable Energy Portfolio Standard



EY 2016 Class I 9.649%, Class II 2.500%, Solar 2.750%
76+% from Out of State Sources except for Solar 100% in-state resources
$25 M for Class I rebates, $242.4M for REC
Offshore wind – federal leases - Can OSW be economically viable ?
Biomass – biogas - food waste

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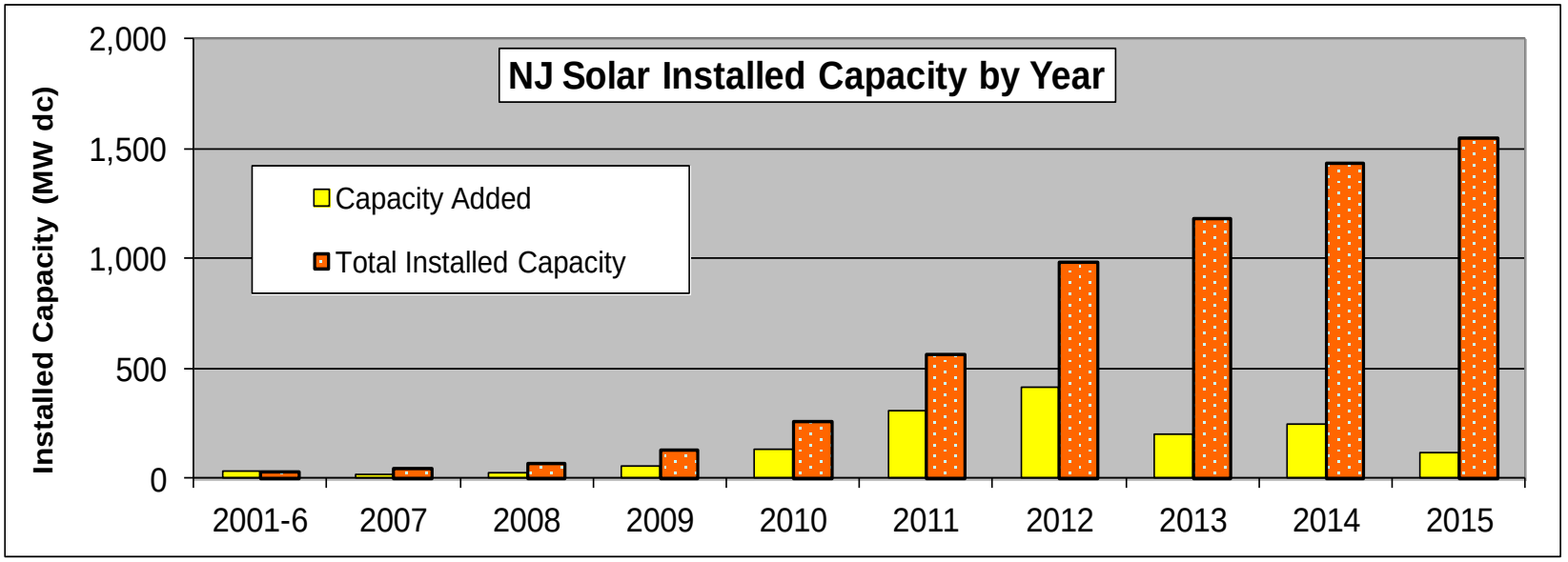

39,500 for 1,546 MW installed 9,796 for 430 MW in the pipeline
Stabilized the SREC market for now - Oversupplied in ER 2017
Lowered SREC Costs – Support Solar on brownfields not greenfields
$363.5M solar rebates, $910.5 M SREC - EDC invested $1.25 B
$3M for Solar Storage – new solar storage CG
Solar will be 2.8% of in-state electricity generation and 2.5% of total
New Net metering cap of 2.9% energy – Lower installed cost (EDC programs)

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Capitalize on Emerging Technologies for Transportation and Power Production

As of June 2014, a total of 222,590 plug-in vehicles have been sold since roll-out in late 2010. 99% growth over June 2013.

The drop in petroleum prices will likely affect this trend, slowing EV sales and driving an upsurge in purchases of light trucks and SUVs. Market forces and consumer interest can quickly overwhelm policy objectives.

11 Public CNG stations
143 Public electric charging stations

NJNG 3 public CNG stations
SJG 3 public CNG station working with WaWa for 3 pilots

BPU and DEP developing incentives using existing funds

New Office of State Energy Services

New section of the EMP Update - **Plan for Action**
Superstorm Sandy Response

Improve Energy Infrastructure Resiliency; and Emergency Preparedness and Response

- **Protect the State's critical energy infrastructure**

Implement Irene Order recommendations - work with OEM/OHSP at the local level
Energy Assurance Planning

- **Improve EDC emergency preparedness and response**

$1.5 B in EDC costs approved by BPU- work with OEM/OHSP at local level - EAP

- **Improve and Enhance the EDC Smart Grid and Distribution Automation Plans**

Require the EDC to file DA/SG plans with detailed cost/benefits

- **Increase the use of microgrid technologies and applications for distributed energy resources (DER)**

- **Create long-term financing for resiliency measures through the ERB**

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Needs Improvement

1,500 MW of CHP – installed 100 MW

ERB Financing

Alternate Fuel Vehicles – Working with DEP to establish a program

Support Peak Reduction

Demand Response – Capacity Performance at PJM
May consider a state program if the Circuit Case decision upheld

Dynamic Pricing/metering

Improve EE DR or RE

Lower Energy Costs

Increase Reliability and Resiliency

Distribution Automation/Smart Grid -

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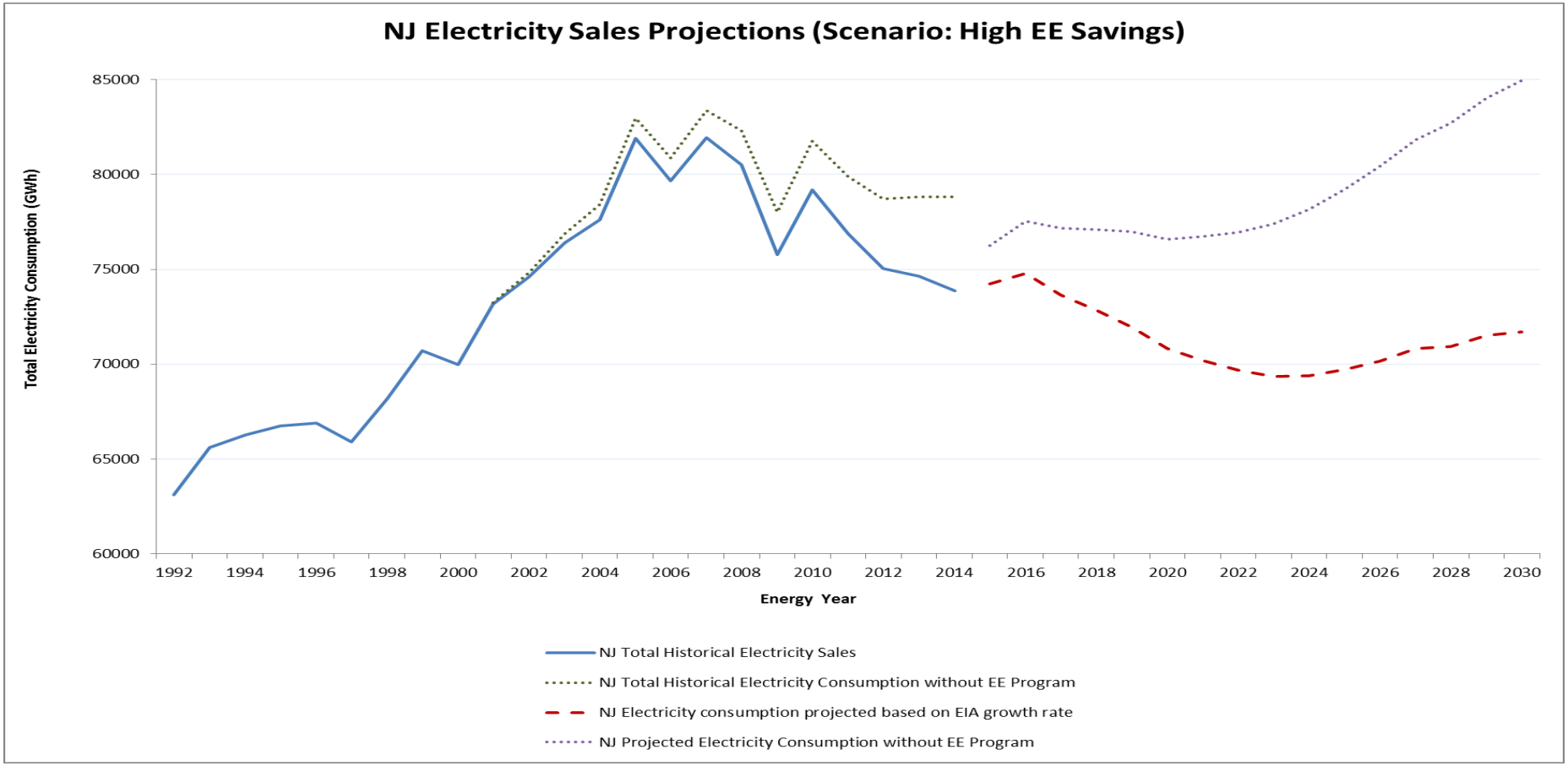
NJBPU Clean Energy Program EM&V



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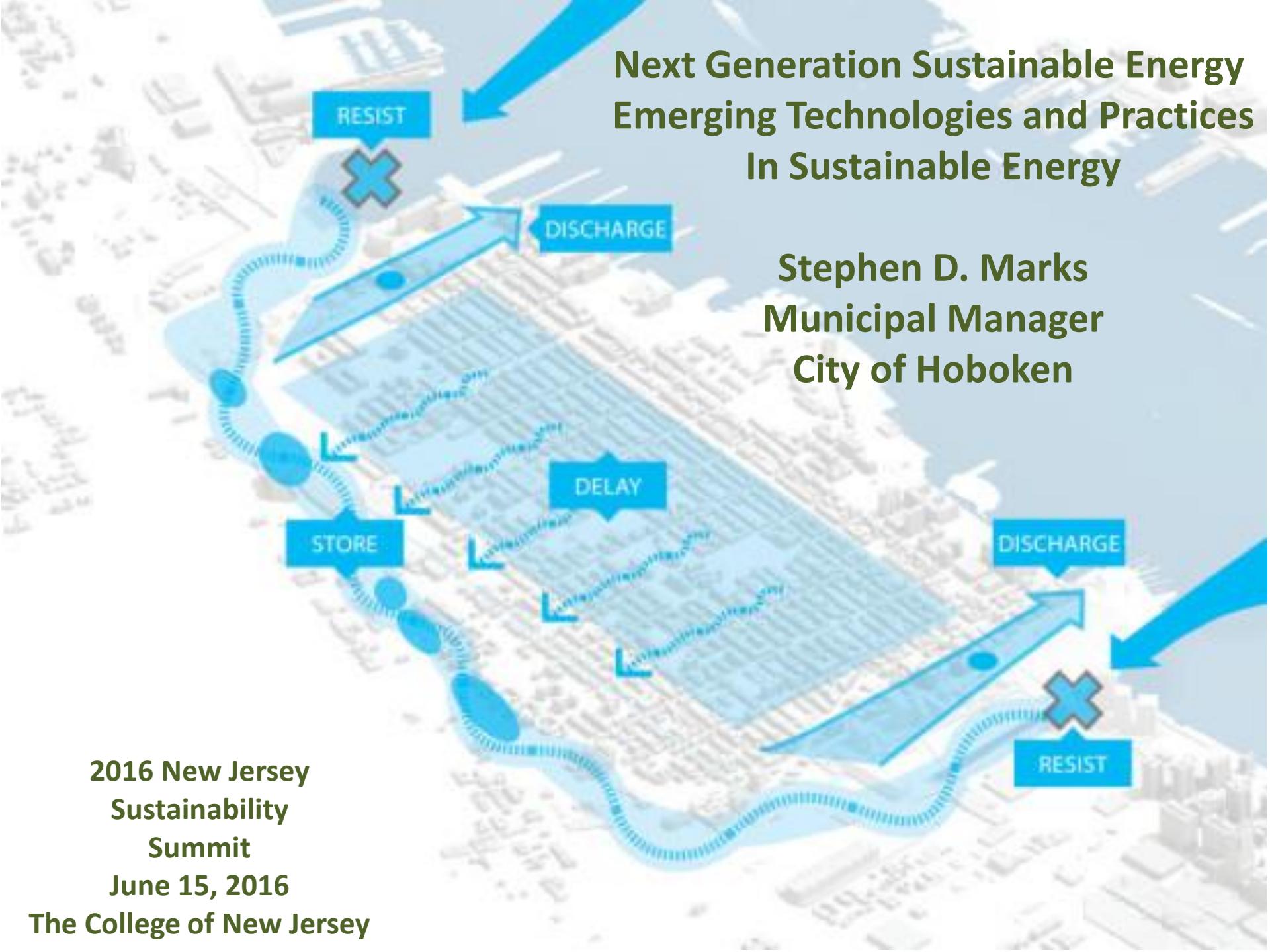
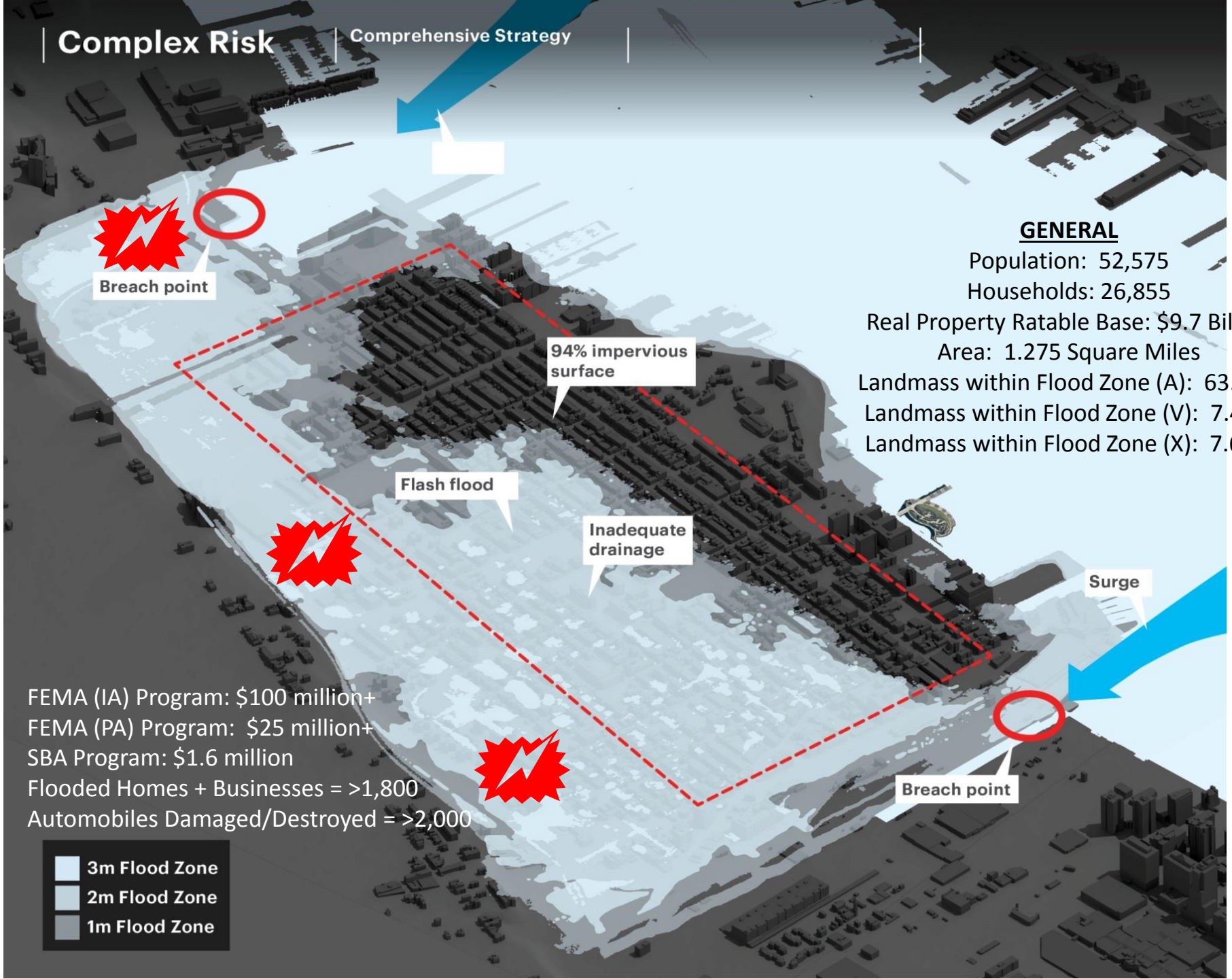


Next Generation Sustainable Energy
Emerging Technologies and Practices
In Sustainable Energy

Stephen D. Marks
Municipal Manager
City of Hoboken

2016 New Jersey Sustainability Summit
June 15, 2016
The College of New Jersey


Complex Risk
Comprehensive Strategy
Breach point
94% impervious surface
Flash flood
Inadequate drainage
Surge
Breach point
GENERAL
Population: 52,575
Households: 26,855
Real Property Ratable Base: $9.7 Billion
Area: 1.275 Square Miles
Landmass within Flood Zone (A): 63.85%
Landmass within Flood Zone (V): 7.41%
Landmass within Flood Zone (X): 7.66%
FEMA (IA) Program: $100 million+
FEMA (PA) Program: $25 million+
SBA Program: $1.6 million
Flooded Homes + Businesses = >1,800
Automobiles Damaged/Destroyed = >2,000
3m Flood Zone
2m Flood Zone
1m Flood Zone

MEMORANDUM OF UNDERSTANDING
Between and Among
Department of Energy–Office of Electricity Delivery & Energy Reliability,
New Jersey Board of Public Utilities,
Public Service Electric & Gas Company,
and the City of Hoboken, New Jersey

SUBJECT: Enhancing Electric Power Resiliency Using Advanced System Designs

Parties

The Parties to this Memorandum of Understanding (MOU) are the U.S. Department of Energy (DOE) Office of Electricity Delivery & Energy Reliability (DOE OE), the New Jersey Board of Public Utilities, the Public Service Electric & Gas Company (PSE&G), an investor-owned electric and gas utility, and the City of Hoboken, New Jersey (Hoboken). To the extent this MOU contemplates action by the Sandia Corporation (Sandia), a Delaware Corporation that operates Sandia National Laboratories (SNL) pursuant to Contract No. DE-AC04-94AL85000 with DOE, DOE will direct Sandia action and be responsible to the other parties to this MOU for Sandia action.

Background

Our nation faces significant risk from prolonged electrical outages, which, largely because of extreme weather events, have been steadily increasing in frequency since 1995. What our nation needs is a resilient grid that can adapt to large-scale disruptive events, and remain operational in the face of adversity, thus minimizing the catastrophic consequences that affect quality of life, economic activity, national security and critical-infrastructure operations. To address these challenges, DOE and SNL have developed an Energy Surety Design Methodology (ESDM) to enhance the reliability and resiliency of the electric infrastructure to meet local critical needs.

The ESDM is a quantitative risk-based assessment approach developed to help communities evaluate regional critical and priority energy needs and identify advanced solutions to attain energy system performance goals. At the core of this methodology is the use of advanced, smart-grid technologies and distributed and renewable-energy power generation and storage resources as a way to improve the reliability, security, and resiliency of the electric grid during a disruptive event. Advanced or smart design approaches use modern communication and energy-management and -control technologies to enable distribution system feeders to operate both 'grid-tied' and 'islanded,' using renewable and distributed energy generation and storage components to support demand/response opportunities for utilities when grid-tied, and to enhance local-area energy reliability and resiliency when islanded.

The ESDM process typically consists of 3 phases:

Phase 1: Team with local public officials and their infrastructure, public safety, social services, and others appropriate coordinators to develop a detailed understanding of (a) the municipality's critical and priority energy needs; (b) the local energy system design and functions relative to local and regional energy and other critical infrastructure interdependencies; and (c) potential

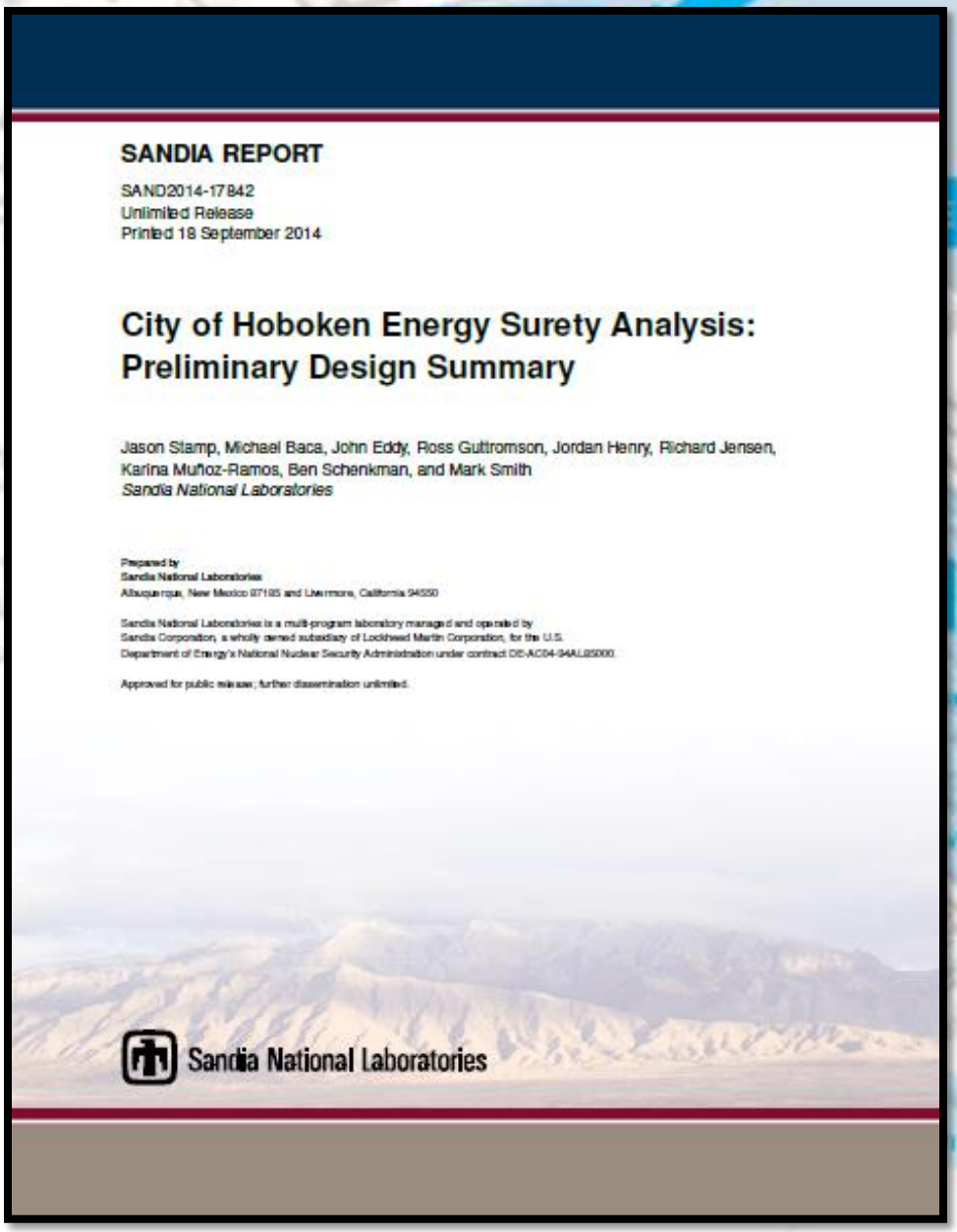
DEPARTMENT OF ENERGY – OFFICE OF ELECTRICITY DELIVERY & ENERGY RELIABILITY (DOE OE)
By: _____
Typed Name: Ravi Gorur
Title: Deputy Assistant Secretary, Power System Engineering
Date: 6/13/13

NEW JERSEY BOARD OF PUBLIC UTILITIES
By: _____
Typed Name: Robert M. Hanna
Title: President
Date: 6-13-2013

CITY OF HOBOKEN, NEW JERSEY
By: _____
Typed Name: Dawn Zimmer
Title: Mayor
Date: 6/13/13

PUBLIC SERVICE ELECTRIC & GAS COMPANY (PSE&G)
By: _____
Typed Name: Ralph LaRossa
Title: President and Chief Operating Officer
Date: 6/13/13

Energy Surety Design Methodology (ESDM) Risk Assessment Approach



SANDIA REPORT

SAND2014-17842
Unlimited Release
Printed 18 September 2014

City of Hoboken Energy Surety Analysis: Preliminary Design Summary

Jason Stamp, Michael Baca, John Eddy, Ross Guttromson, Jordan Henry, Richard Jensen, Karina Muñoz-Ramos, Ben Schenkman, and Mark Smith
Sandia National Laboratories

Prepared by
Sandia National Laboratories
Albuquerque, New Mexico 87185 and Livermore, California 94550

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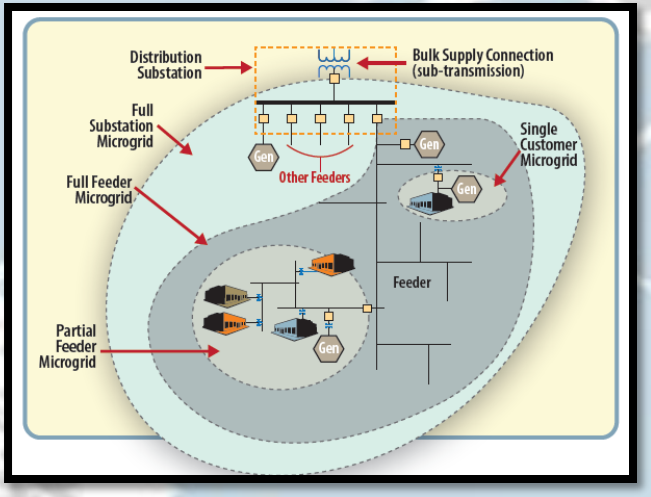
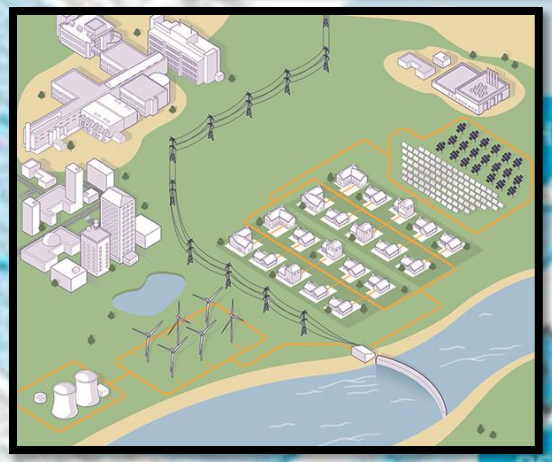




SPIDERS (Smart Power Infrastructure Demonstration for Energy Reliability and Security) is based on a Joint Command Technology Development (JCTD) project between Department of Energy, Department of Defense, and Department of Homeland Security.

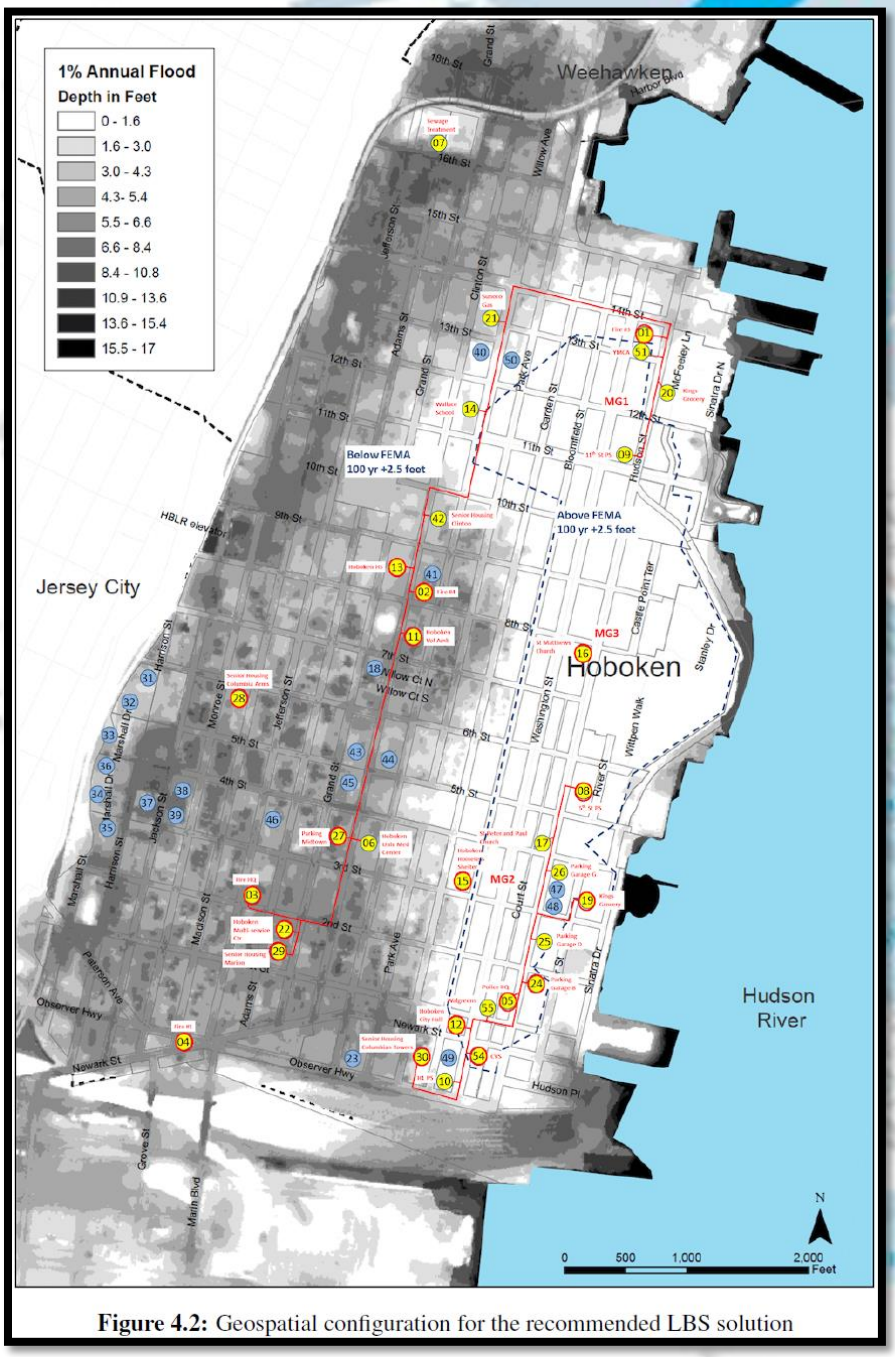


Figure 4.2: Geospatial configuration for the recommended LBS solution

Table C.2: Tier 1 buildings

Tier	Building Name	Type	Location
1	Fire Department Radio Repeater	Emergency	N/A
1	Pump Station 5th Street	Flood Control	500 River Road
1	Police Head Quarters	Emergency	106 Hudson Street
1	Pump Station 11th Street	Flood Control	83 11th Street
1	Police Department Radio Repeater	Emergency	N/A
1	Fire Engine Company 3	Emergency	1313 Washington Street
1	Pump Station H1	Flood Control	99 Observer Highway
1	Fire Engine Company 4	Emergency	801 Clinton Street
1	Fire Head Quarters	Emergency	201 Jefferson Street
1	Fire Engine Company 1	Emergency	43 Madison Street
1	Hoboken University Medical Center	Emergency	308 Willow Avenue
1	Sewage Treatment Plant	Flood Control	Adams Street
1	Hoboken Volunteer Ambulance	Emergency	707 Clinton Street

Table C.3: Tier 2 buildings

Tier	Building Name	Type	Location
2	St. Matthew's Church	Shelter	57 8th Street
2	St. Peter and Paul Church	Shelter	404 Hudson Street
2	Garage G	Parking Garage	315 Hudson Street
2	CVS	Pharmacy	59 Washington Street
2	Hoboken City Hall	Operation	94 Washington Street
2	Kings	Groceries	325 River Street
2	Garage B	Parking Garage	28 2nd Street
2	Garage D	Parking Garage	215 Hudson Street
2	Walgreens	Pharmacy	101 Washington Street
2	Wallace School	Shelter	1100 Willow Avenue
2	Hoboken Homeless Shelter	Shelter	300 Bloomfield
2	Kings	Groceries	1212 Shipyard Lane
2	Sunoco	Gas Station	1301 Willow Avenue
2	Hoboken Public Works Garage	Operation	256 Observer Highway
2	Hoboken High School	Shelter	800 Clinton Street
2	A&P	Groceries	614 Clinton Street
2	Hoboken Multi-Service Center	Shelter	124 Grand Street
2	Midtown Garage	Parking Garage	371 4th Street

Table C.4: Tier 3 buildings

TIER	Building Name	Type	Location
3	Columbian Towers	Senior Housing	76 Bloomfield Street
3	Columbian Arms	Senior Housing	514 Madison Street
3	Marion Towers	Senior Housing	400 1st Street
3	Fox Hill	Senior Housing	900 Clinton Street

Table C.5: Tier 4 buildings

TIER	Building Name	Type	Location
4	Marineview 1	Affordable Housing	331 Hudson Street
4	Marineview 2	Affordable Housing	301 Hudson Street
4	Applied	Affordable Housing	111 Newark
4	Applied	Affordable Housing	1203-1209 Willow Avenue
4	YMCA (SROs)	Affordable Housing	1301 Washington Street
4	Hoboken Housing Authority	Affordable Housing	655 6th Street
4	Hoboken Housing Authority	Affordable Housing	501 Marshall Drive
4	Hoboken Housing Authority	Affordable Housing	400 Marshall Drive
4	Hoboken Housing Authority	Affordable Housing	320 Marshall Drive
4	Hoboken Housing Authority	Affordable Housing	300 Marshall Drive
4	Hoboken Housing Authority	Affordable Housing	321 Harrison Street
4	Hoboken Housing Authority	Affordable Housing	311 Harrison Street
4	Hoboken Housing Authority	Affordable Housing	320 Jackson Street
4	Hoboken Housing Authority	Affordable Housing	310 Jackson Street
4	Hoboken Housing Authority	Affordable Housing	311 13th Street
4	Hoboken Housing Authority	Affordable Housing	804 Willow Avenue
4	Hoboken Housing Authority	Affordable Housing	5 Church Towers
4	Hoboken Housing Authority	Affordable Housing	10 Church Towers
4	Hoboken Housing Authority	Affordable Housing	15 Church Towers
4	Hoboken Housing Authority	Affordable Housing	300 Adams Street

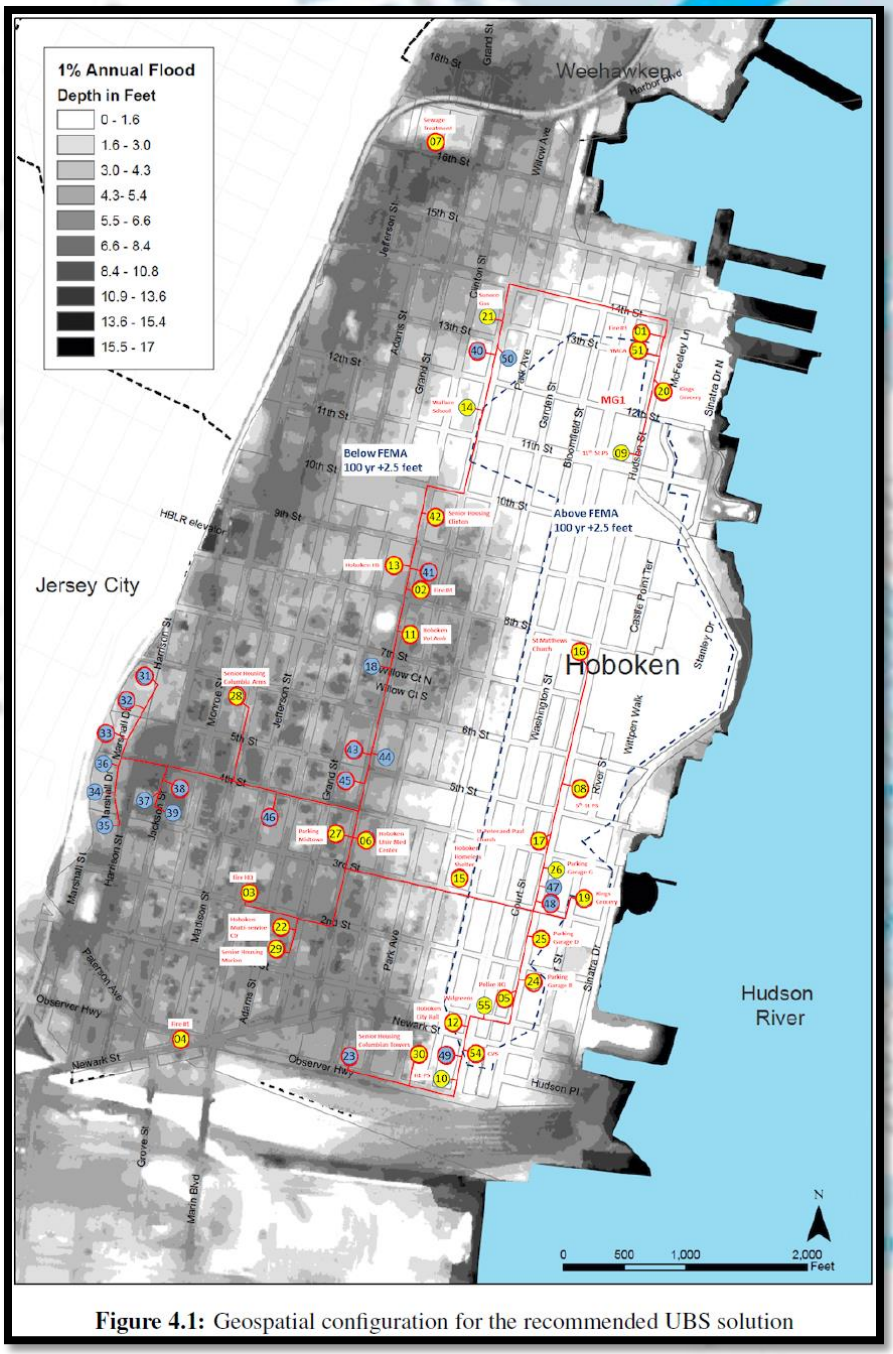


Figure 4.1: Geospatial configuration for the recommended UBS solution

Table 3.2: Hoboken mission critical building load demand

Building	Estimated Load (kW)
Grocery – Kings	450
YMCA (SROs)	150
Fire Engine Company 3	150
11th Street Pump Station	15
Gas Station – Sunoco	15
Applied	45
Hoboken Housing Authority	450
Wallace School	250
Senior Housing Fox Hill	45
Hoboken High School	150
Hoboken Volunteer Ambulance Corps	15
Fire Engine Company 4	22.5
804 Willow Ave	90
Hoboken University Medical Center	1000
Midtown Garage	150
Clock Towers	150
Church Towers 5	45
Church Towers 10	150
Church Towers 15	90
Grocery – A&P	45
Fire Head Quarters	37.5
Hoboken Multi-Service Center	90
Marion Towers	225
Columbian Arms	90
Hoboken Housing Authority	90
Hoboken Housing Authority	45
Hoboken Housing Authority	67.5
Hoboken Housing Authority	90
Hoboken Housing Authority	45
Hoboken Housing Authority	45
Hoboken Housing Authority	90
Hoboken Housing Authority	90

Continued on next page

Table 3.2 – *Continued from previous page*

Building	Estimated Load (kW)
Hoboken Housing Authority	90
Fire Department Radio Repeater	15
St. Matthew's Church	15
5th Street Pump Station	750
St. Peter and Paul Church	30
Marineview 1	450
Garage G	150
Marineview 2	450
Grocery – Kings	450
Garage D	225
Garage B	90
Police Head Quarters	150
Police Department Radio Repeaters	450
Walgreens	90
Hoboken City Hall	225
Applied	225
CVS Pharmacy	150
Columbian Towers	150
H1 Pump Station	225
Hoboken Public Works Garage	30
Sewage Treatment Plant	900
Fire Engine Company 1	45
Hoboken Homeless Shelter	45
TOTAL	9,883

Table 4.3: Potential good PV installations for Hoboken

Location	Rooftop Available (sq meters)	Usable PV Output	System Cost	Energy Value (PV Only)	SREC Value
Hoboken High School	7780	550.0	$2,635,000	$156,600	$94,900
University Medical Center	5110	360.0	$1,724,000	$102,500	$62,100
Grocery - Kings	4247	300.0	$1,437,000	$ 85,400	$51,700
Garage B	3389	240.0	$1,150,000	$68,400	$41,400
Wallace School (shelter)	3039	210.0	$1,006,000	$59,800	$36,200
Grocery - Kings	2639	180.0	$862,000	$51,300	$31,000
Hoboken Housing Authority	2382	170.0	$814,000	$48,400	$29,300
Grocery - A&P	2166	150.0	$719,000	$42,700	$25,900
Hoboken Multi-Service Center	1459	141.0	$675,000	$40,200	$24,300
Hoboken Public Works Garage	1841	130.0	$623,000	$37,000	$22,400
YMCA (SROs)	1096	78.0	$374,000	$22,200	$13,500
Marion Towers	990	71.0	$340,000	$20,200	$12,200
St. Peter and Paul Church	954	68.0	$326,000	$19,400	$11,700
Columbian Arms	820	58.0	$278,000	$16,500	$10,000
Columbian Towers	623	44.0	$211,000	$12,500	$7,600
Hoboken City Hall	782	29.4	$141,000	$8,400	$5,100
St. Matthew's Church (shelter)	382	27.0	$129,000	$7,700	$4,700
Hoboken Homeless Shelter	279	20.0	$96,000	$5,700	$3,400
Volunteer Ambulance Corps.	172	12.0	$57,000	$3,400	$2,100
Gas Station - Sunoco	165	11.0	$53,000	$3,100	$1,900
Police HQ	491	11.5	$55,000	$3,300	$2,000
Fire HQ	188	10.0	$48,000	$2,800	$1,700
Fire Engine Co 2	222	6.0	$29,000	$1,700	$1,000
Fire Engine Co 3	147	5.0	$24,000	$1,400	$900
Fire Engine Co 6	158	4.0	$19,000	$1,100	$700

Table 4.4: Summary of CHP design selections

Building #	Building Name	Size	UBS or LBS	Notes
1	Fire Engine Co 3	15	both	1
2	Fire Engine Co 3	25	both	1
3	Fire HQ	37.5	both	1
4	Fire Engine Co 1	15	both	1
5	Police HQ	100	both	
11	Volunteer Ambulance Corps	25	both	1
12	City Hall	100	both	
22	Multi-Service Center	100	both	
22	Public Works Garage	37.5	UBS	1

1: CHP units smaller than 100kW do not supply the microgrid

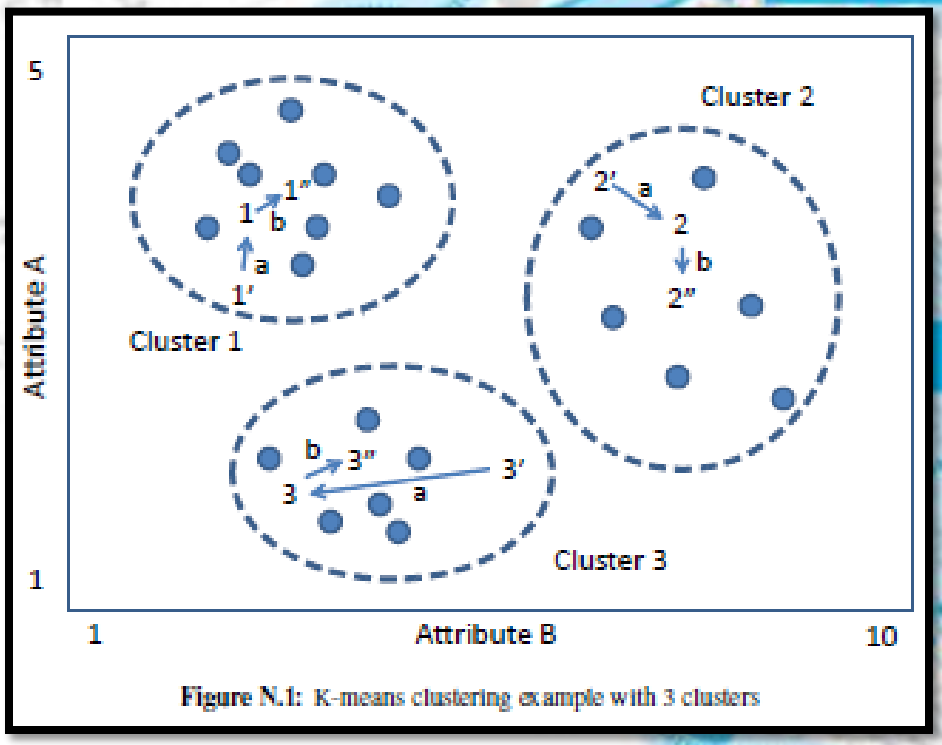


Figure N.1: K-means clustering example with 3 clusters

Table 4.7: Summary of design solutions

Design Parameter	UBS	LBS
Buildings	55	34
Critical Load (kW)	9232.5	6360.0
New NG Generators	56	37
New NG Generation (kW)	12340.0	7327.5
Building Retrofit Sites	37	19
Microgrids	1	3
Isolated Buildings	3	4

Table 4.8: Summary of estimated cost breakdowns

Type of Cost	UBS	LBS
Building Retrofits	$6.5M	$2.7M
Control and Communications	$5.6M	$3.7M
Microgrid Infrastructure	$21.7M	$12.1M
Combined Heat and Power	$0.9M	$0.8M
Design and Engineering	$8.6M	$4.8M
Contingency	$5.2M	$2.9M
Totals	$48.4M	$26.9M

Table K.1: PV and energy storage payback

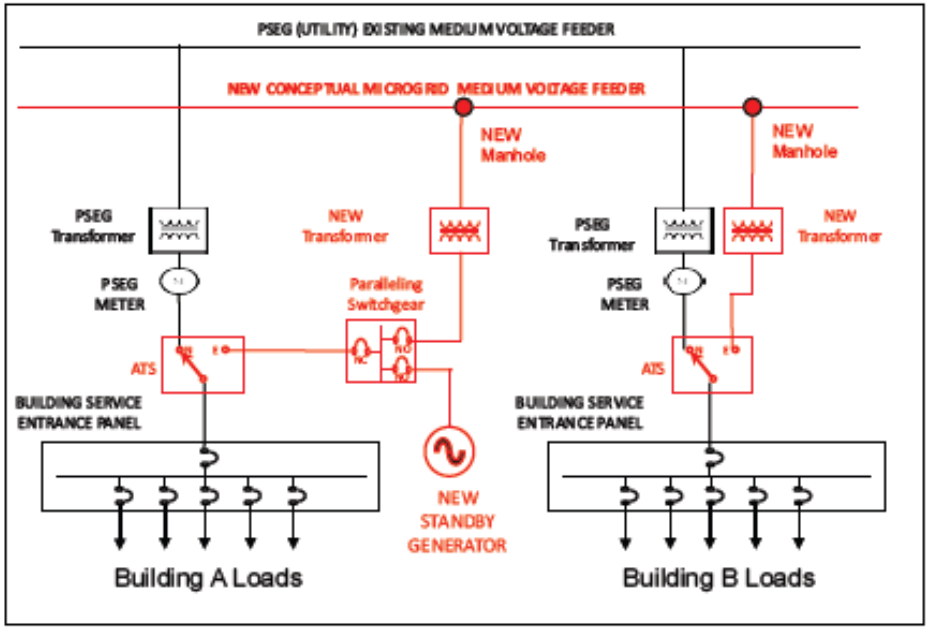
Building	PV Size (kW)	PV Cost	PV Value $/year	SREC Value $/year	Avg. Peak kW	ESS Sys Cost	Peak Cost	ESS Value $/year	ESS Cost $/year	PV Only	PV + SREC	PV + ESS	PV + ESS + SREC
City Hall	25	$120	$8	$5	100	$120	$11	$6	$8	15	10	44	23
Public Works Garage	130	$623	$38	$23	37.5	$45	$5	$3	$3	16	11	18	12
Volunteer Ambulance Corps	10	$48	$3	$2	15	$18	$2	$1	$2	16	10	33	17
Fire Department HQ	10	$48	$3	$2	30	$36	$4	$2	$3	16	10	42	21
Fire Department 801 Clinton	5	$24	$2	$1	15	$18	$2	$1	$2	12	8	42	21
Fire Department 1313 Washington	5	$24	$2	$1	15	$18	$2	$1	$2	12	8	42	21
Fire Department 501 Observer	5	$24	$2	$1	15	$19	$2	$1	$2	12	8	43	22
Multi Service Center	140	$671	$40	$25	100	$120	$9	$5	$8	17	11	22	13
Police HQ	10	$48	$3	$2	100	$120	$10	$5	$8	16	10	0	84

All dollar values are in $k, last 4 columns are in years

Table 4.2: All PV analysis sites for Hoboken, including storage

Building	Rooftop Available (sq meters)	Audit-Based PV Output (kW)	Calculated PV Output (kW)	Usable PV Output (kW)	System Cost ($2013)	Storage System (kWh)	Storage Value Cost ($2013)	Energy Value (PV Only) ($2013)	SREC Value ($2013)	Total Yearly Value (PV Only)	Simple Payback (yearly savings/ sale only)	IRR
Hoboken High School	7780		559.7	559.7	2,680,766	279.8	671,591	159,391	96,520	255,911	16.8	2.66%
University Medical Center	5110		367.6	367.6	1,760,760	183.8	441,109	104,690	63,396	168,085	16.8	2.66%
Grocery - Kings	4247		305.5	305.5	1,463,395	152.8	366,612	87,009	52,689	139,698	16.8	2.66%
Garage B	3389		243.8	243.8	1,167,795	121.9	292,548	69,451	42,045	111,496	16.8	2.66%
Wallace School (shelter)	3039		218.6	218.6	1,047,153	109.3	262,335	62,261	37,702	99,963	16.8	2.66%
Grocery - Kings	2639		189.8	189.8	909,324	94.9	227,806	54,066	32,740	86,806	16.8	2.66%
Hoboken Housing Authority	2382		171.4	171.4	820,769	85.7	205,621	48,801	29,552	78,352	16.8	2.66%
Grocery - A&P	2166		155.8	155.8	746,342	77.9	186,975	44,375	26,872	71,247	16.8	2.66%
Hoboken Multi-Service Center	1459	141	105.0	141.0	675,390	70.5	169,200	40,157	24,317	64,474	16.8	2.66%
Hoboken Public Works Garage	1841		132.4	132.4	634,356	66.2	158,920	37,717	22,840	60,557	16.8	2.66%
YMCA (SROs)	1096		78.8	78.8	377,650	39.4	94,610	22,454	13,597	36,051	16.8	2.66%
Marion Towers	990		71.2	71.2	341,126	35.6	85,459	20,282	12,282	32,564	16.8	2.66%
St. Peter and Paul Church	954		68.6	68.6	328,721	34.3	82,352	19,545	11,836	31,380	16.8	2.66%
Columbian Arms	820		59.0	59.0	282,540	29.5	70,785	16,800	10,173	26,975	16.8	2.66%
Columbian Towers	623		44.8	44.8	214,668	22.4	53,779	12,764	7,729	20,493	16.8	2.66%
Hoboken City Hall	782	29.44	56.3	29.4	141,018	14.7	35,328	8,384	5,077	13,462	16.8	2.66%
St. Matthew's Church (shelter)	382		27.5	27.5	131,626	13.7	32,975	7,826	4,739	12,565	16.8	2.66%
Hoboken Homeless Shelter	279		20.1	20.1	96,138	10.0	24,084	5,716	3,461	9,177	16.8	2.66%
Volunteer Ambulance Corps	172		12.4	12.4	59,266	6.2	14,848	3,524	2,134	5,658	16.8	2.66%
Gas Station - Sunoco	165		11.9	11.9	56,854	5.9	14,243	3,380	2,047	5,427	16.8	2.66%
Police HQ	491	11.5	35.3	11.5	55,085	5.8	13,800	3,275	1,983	5,259	16.8	2.66%
Fire HQ	188	10	13.5	10.0	47,900	5.0	12,000	2,848	1,725	4,573	16.8	2.66%
Fire Engine Co 2	222	6	16.0	6.0	28,740	3.0	7,200	1,709	1,035	2,744	16.8	2.66%
Fire Engine Co 3	147	5	10.6	5.0	23,950	2.5	6,000	1,424	862	2,286	16.8	2.66%
Fire Engine Co 6	158	4	11.4	4.0	19,160	2.0	4,800	1,139	690	1,829	16.8	2.66%

Figure 4.3: Diagram for recommended building connections



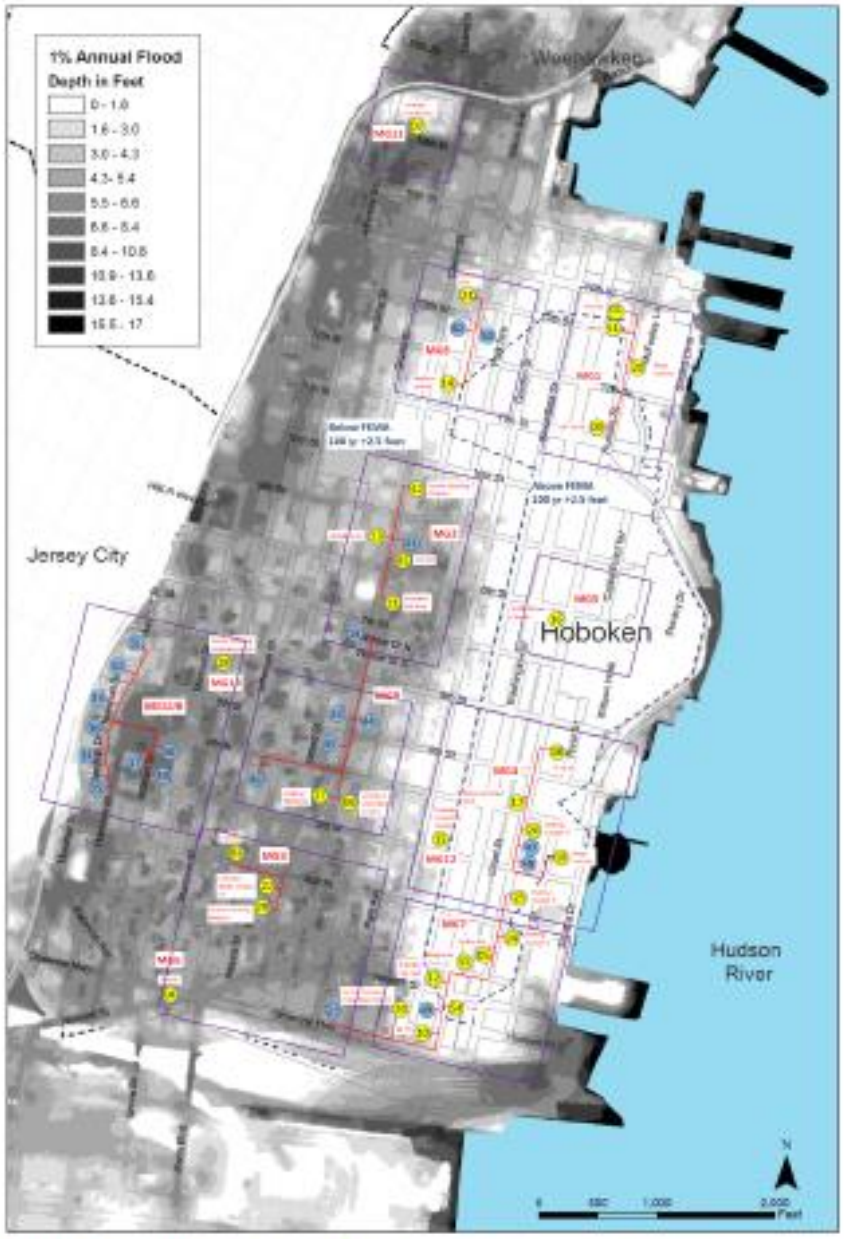


Figure N.6: K-means cluster analysis for 10 clusters for the upper bound set of buildings as well as initial microgrid clusters selected for TMO/PRM analysis

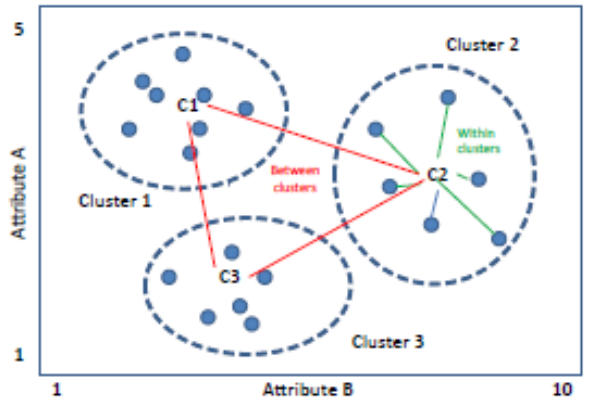


Figure N.3: Determination of distances of objects to cluster centroids within each cluster and between cluster centroids

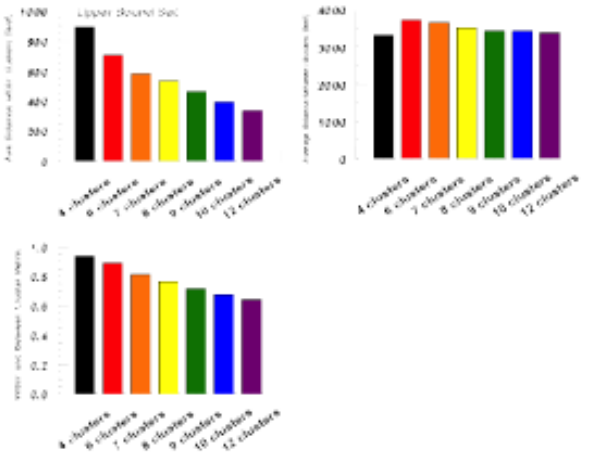


Figure N.4: Results of K-means cluster analysis for the upper bound set of buildings

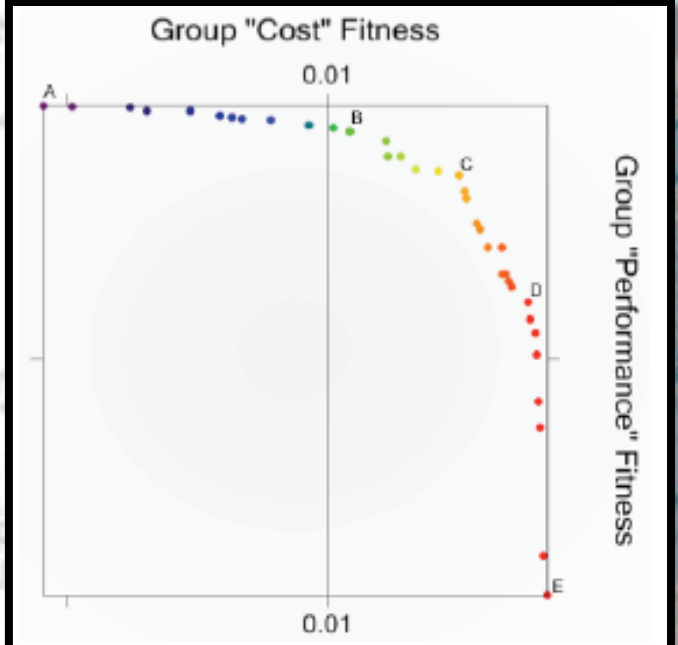


Figure O.1: Pareto chart for UBS solutions

Table O.3: Selected UBS optimization solutions

Solution	Cost ($M)	FOI (% DBT)	Cond. EENS (kWh/h)	EIR
A	14.25	0.001	0.016	0.99999
B	11.80	0.247	0.035	0.99994
C	10.52	0.658	0.069	0.99985
D	9.59	4.295	0.114	0.99899
E	9.33	9.355	0.181	0.99781

Table N.2: List of microgrid clusters

Cluster	Building #	Name
1	20	Grocery - Kings
	51	YMCA (SROs)
	1	Fire Engine Co 3
	9	11th Street PS
2	42	900 Clinton Senior Housing Fox Hill
	13	Hoboken High School
	11	Hoboken Volunteer Ambulance Corps.
	4	Fire Engine Co 1
	41	804 Willow Ave
3	3	Fire HQ
	22	Hoboken Multi-Service Center
	29	Marion Towers
4	8	5th Street PS
	17	St. Peter and Paul Church
	47	Marineview 1
	26	Garage G
	48	Marineview 2
	19	Grocery - Kings
5	53	Fire Department Radio Repeater
	16	St. Matthew's Church (shelter)
6	4	Fire Engine Co 1
7	25	Garage D
	24	Garage B
	5	Police HQ
	52	Police Department Radio Repeater
	55	Walgreens
	12	Hoboken City Hall
	49	Applied
	54	CVS
	30	Columbian Towers
	10	H1 PS
	23	Hoboken Public Works Garage
8	21	Gas Station - Sunoco
	50	Applied
	40	Hoboken Housing Authority
	14	Wallace School (shelter)

Continued on next page

Table N.2 – *Continued from previous page*

Cluster	Building #	Name
9	6	Hoboken University Medical Center
	27	Midtown Garage
	46	Clock Towers
	44	Church Towers
	45	Church Towers
	43	Church Towers
	18	Grocery - A&P
10	28	Columbian Arms
11	7	Sewage Treatment Plant
12	15	Hoboken Homeless Shelter
1UB	31	Hoboken Housing Authority
	32	Hoboken Housing Authority
	33	Hoboken Housing Authority
	34	Hoboken Housing Authority
	35	Hoboken Housing Authority
	36	Hoboken Housing Authority
	37	Hoboken Housing Authority
	38	Hoboken Housing Authority
	39	Hoboken Housing Authority

Chris Christie
Governor

Kim Guadagno
Lt. Governor

Irene Kim Asbury
Secretary of the Board
Tel. # (609) 292-1599

STATE OF NEW JERSEY
Board of Public Utilities
44 South Clinton Avenue, 9th Floor
Post Office Box 350
Trenton, New Jersey 08625-0350
www.nj.gov/bpu/

NOTICE[1]

Energy Master Plan Update

Pursuant to the Open Public Meetings Act, N.J.S.A. 10:4-6 et seq., the New Jersey Board of Public Utilities (Board) has provided notice of three scheduled Public Hearings to solicit comments for an update of the 2011 Energy Master Plan. We request comments be focused on the specific Goals and Recommendations of the 2011 Energy Master Plan summarized in the following section of this Notice and regarding several areas that have emerged since 2011 as described in the second section below.

2011 Energy Master Plan Goals & Recommendations

The following is a summary of the 2011 Energy Master Plan goals and policy recommendations. The dates of the public hearing, the full 2011 Energy Master Plan, and all supporting documents can be accessed at http://nj.gov/emp/.

The 2011 EMP contains five overarching goals:

- Drive down the cost of energy for all customers;
- Promote a diverse portfolio of new, clean, in-state generation;
- Reward energy efficiency and energy conservation and reduce peak demand;
- Capitalize on emerging technologies for transportation and power production;
- Maintain support for the renewable energy portfolio standard of 22.5% of energy from renewable sources by 2021.

In addition to the overarching goals, the 2011 Energy Master Plan contains 31 policy recommendations in the four general sections of:

- Expand In-State Electricity Resources;
- Cost Effective Renewable Resources;
- Promote Cost Effective Conservation and Energy Efficiency;
- Support the Development of Innovative Energy Technologies.

[1] Not a Paid Legal Advertisement

NEW JERSEY ENERGY MASTER PLAN | UPDATE

New Jersey Board of Public Utilities
New Jersey Department of Environmental Protection

November 2015

The development of microgrid projects, including single building, campus-wide and advanced microgrids to address enhanced energy resilience will also help meet the goal for new DG, CHP, and fuel cells. Two advanced microgrid studies funded by the U. S. Department of Energy (DOE) in partnership with BPU have been completed – one in Hoboken and one for NJ TRANSIT.

Emergency Generators

Washington Street Conduit

Thank You!

Questions?

@SJ_Program
#SustainableStateNJ

Sustainable Jersey Energy Actions

Making Your Community Friendly
for
Solar Installations and Electric Vehicles

Nancy Quirk
Program Coordinator Advanced Infrastructure
Sustainable Jersey

Make Your Town Friendly . . .

Make Your Town EV Friendly

- Zoning Ordinance and EV Friendly Parking Policies
  - 15 point action
  - Provide Training
  - Encourage Charging Stations
    - Multi-Family Charging Stations
    - Workplace Charging Stations
  - Community Awareness Event
- Public EV Charging Station
  - 15 point action

Make Your Town Solar Friendly

- Solar Friendly Zoning Ordinance
- Streamlined Solar Permitting
- Community Engagement to Promote Solar
  - Outreach
  - Incentives
  - Financing
- Variable point action

Make Your Town EV Friendly: Details

- Encourage and facilitate adoption of EV by consumers
  - 15 point action
- Mandatory:
  - Zoning ordinance addressing accessory use
  - Update parking policies
- Optional activities (must do TWO)
  - Update building ordinances – pre-wiring for EV chargers
  - Training for local officials
  - Commitment from three local partners for workplace chargers
  - Commitment from three local partners for multi-family chargers
  - Awareness event
  - Public EV Charging Station Promotion

Make Your Town EV Friendly: Options

- Workplace Chargers
  - THREE local partners install workplace charging stations
  - Potentially doubles daily driving range for employees
  - Potentially earn LEED points for the building
  - Employee recruitment and retention
  - Public image
- Multi-Family Home Chargers
  - THREE local multi-family dwelling units
  - Overnight residential charging stations
  - Most apartment dwellers don't purchase EVs

Image: EERE. Plug-in Electric Vehicle Handbook. www.afdc.energy.gov/uploads/publication/pev_workplace_charging_hosts.pdf

Public EV Charging Infrastructure: Details

- Publicly available EV Charging Station
  - 15 point action
  - Different from workplace or home based charging
  - Helps address ‘range anxiety’
- Mandatory:
  - Municipality instrumental in the project
  - Publicly available
- Charging station may be:
  - Located on private property
  - Owned and operated by
    local nonprofit

Image: EERE. Plug-in Electric Vehicle Handbook. www.afdc.energy.gov/uploads/publication/pev_workplace_charging_hosts.pdf

Public EV Charging Infrastructure: Options

- Public EV Charging Infrastructure
  - Flexible on where charger installed
  - Flexible on how charger is financed
  - Identifying best location is critical
  - Including on “public directory” is key requirement

City of Elizabeth, NJ
Christian Bollwage Garage

Make Your Town Solar Friendly Action

Supportive Solar Zoning Ordinance

- Purpose
  - Protect public health, safety, welfare
  - Reduce reliance on fossil fuels
- Definitions
  - Rooftop, ground-mounted
  - Accessory use in all districts
  - Energy consumed on-site
- Considerations
  - Historic districts
  - Tree commissions

Streamlined Permitting

- Post requirements online
- Expedited permitting
- Permitting checklist
- Offer narrow inspection timeframe
- Training for staff:
  - Permitting
  - Codes
  - Inspection

Activities and Incentives to Promote Solar

- Awareness building events
- Group purchase for solar
  - Solarize campaign
  - Sustainable Jersey Solar Challenge with EnergySage
  - Employer-based group purchase
  - Community solar gardens
  - Collaborative procurement
- Incentives
  - Install solar on energy efficient buildings
  - Utilize local workforce trainees

Image: NREL. Emerging Opportunities and Challenges in Financing Solar. www.nrel.gov/docs/fy16osti/65638.pdf

@SJ_Program
#SustainableStateNJ

Making Your Community Friendly for Solar Installations and Electric Vehicles

Thank you!

Nancy Quirk

quirkn@tcnj.edu

RUTGERS
THE STATE UNIVERSITY OF NEW JERSEY

Emerging Clean Energy Technologies for "*Smart Communities*"

Serpil Guran

New Jersey Sustainability Summit
June 15, 2016

Outline

- *Short Info about the EcoComplex*
- *How to make communities more sustainable and resilient?*
  "Need for Smart Communities"
- *Emerging Trends*
- *Bioenergy Assessment of New Jersey*
- *Simple approaches for bigger impacts*

ECOCOMPLEX

"Clean Energy Innovation Center"

Early Member of EV Charging Infrastructure

The EcoComplex:

- **The EcoComplex is a multidisciplinary environmental and alternative/clean energy innovation center of Rutgers University that harnesses research and education resources towards the development and industrial application of innovative environmental and clean energy technologies.**

- **The Center also serves as a "Business Incubator" and houses 14 start-up companies.**

The EcoComplex

- Originally formed as

  "**Agricultural and Environmental Extension Center**"

- Clean/Alternative Energy matters are also part of the Agricultural & Environmental activities

- EcoComplex is also serving as

  "**Clean Energy Innovation Center**"

The EcoComplex: A Real Time Laboratory!

Located Adjacent to the Burlington County Landfill

Opportunities for pilot applications

Landfill gas clean-up technology demonstration, testing and verification

For Landfill Gas-to-Power Cogen Unit: 250 kW

Cogeneration at Landfills for Controlled Environment Agriculture:

An Economic Development Opportunity

Burlington County Research and Demonstration Greenhouse

Greenhouse heating with LFG

Clean Energy Incubator

- Currently 14 start-up companies are housed at the EcoComplex.
- Current and past clean energy related topics including energy crops development:
  - Hydrogenation
  - Liquefaction
  - Algae development
  - Sorghum development
  - Landfill gas clean-up and power generation
  - Landfill gas to ethanol
  - Landfill gas to CNG/LNG
  - Environmental remediation
  - Life science research

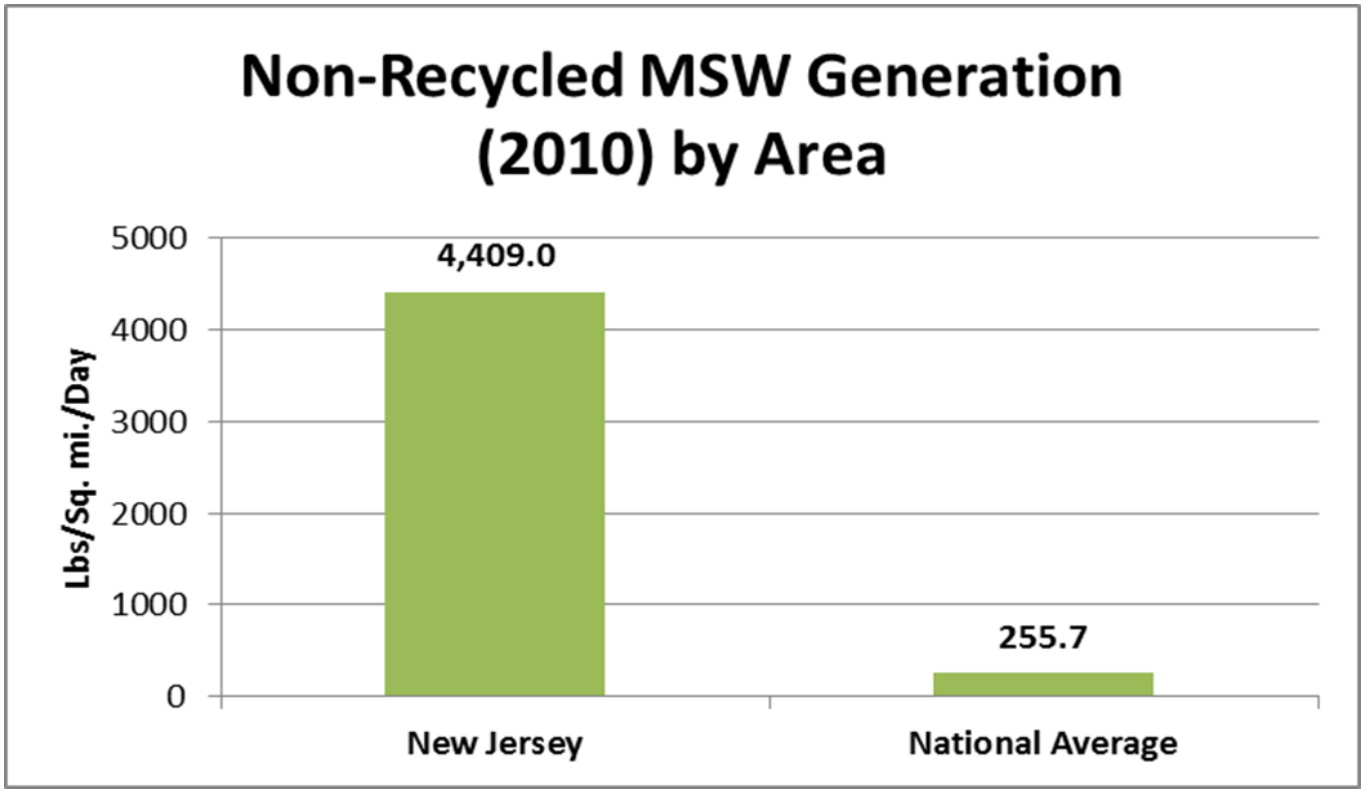
World is Getting Crowded!

- From now to 2030 the world will need to build a city of one million people, in every five days, in developing countries!

- Between now and 2050, increased world population (Approximately 9 Billion) and New Jersey is the most densely populated state in the Union! (1210.1 people/sq. mile)

New Jersey Facts:

- New Jersey waste generation per square mile is 17 times higher than national average



Need for Smart Communities!

- Sustainable City
- Low Carbon City
- Resource Efficient and Productive City
- Resilient City
- BiodiverCity
- Eco-mobile City

- Smart City has embedded "**smartness**" into its operations, and is guided by the overarching goal of becoming more "***sustainable and resilient***".

http://www.iclei.org/activities/agendas/sustainable-city.html

Need For Smart Communities!

- **Smart Communities**:
  - Educate its residents
  - Analyze, monitor and optimize their systems of
    - Energy,
    - Water,
    - Waste,
    - Transportation,
    - Emissions
  - Provide:
    - Social and Economic Inclusion;
    - Governance
    - Citizen Participation

    Through Transparent and Inclusive Information Feedback Mechanisms.

Need For Smart Communities!

Increased need to solve the problems of:

- Energy
- Water
- Food
- Waste

to achieve:

- Climate Change Mitigation & Adaptation

-Clean and Healthy Environment

-Economic Development

-Resilient jobs

RUTGERS


SUSTAINABLE DEVELOPMENT GOALS
1 NO POVERTY
2 ZERO HUNGER
3 GOOD HEALTH AND WELL-BEING
4 QUALITY EDUCATION
5 GENDER EQUALITY
6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE, JUSTICE AND STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS
SUSTAINABLE DEVELOPMENT GOALS


SUSTAINABLE DEVELOPMENT GOALS
1 NO POVERTY
2 ZERO HUNGER
3 GOOD HEALTH AND WELL-BEING
4 QUALITY EDUCATION
5 GENDER EQUALITY
6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
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SUSTAINABLE DEVELOPMENT GOALS


SUSTAINABLE DEVELOPMENT GOALS
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2 ZERO HUNGER
3 GOOD HEALTH AND WELL-BEING
4 QUALITY EDUCATION
5 GENDER EQUALITY
6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE, JUSTICE AND STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS
SUSTAINABLE DEVELOPMENT GOALS


SUSTAINABLE DEVELOPMENT GOALS
1 NO POVERTY
2 ZERO HUNGER
3 GOOD HEALTH AND WELL-BEING
4 QUALITY EDUCATION
5 GENDER EQUALITY
6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
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Food-Energy-Water "FEW" Nexus

Understanding the Interconnectedness of the Three Pillars of the Nexus!

- There is **energy** embedded in every gallon of **water**.
- There is **water** embedded in every kWh (or joule) of **energy** used and every mile travelled.
- There is **water and energy** embedded in every calorie of **food** humans consume.

- Successful nexus can result "Sustainable Development " and "Resilient Communities"

Smart Communities

RUTGERS

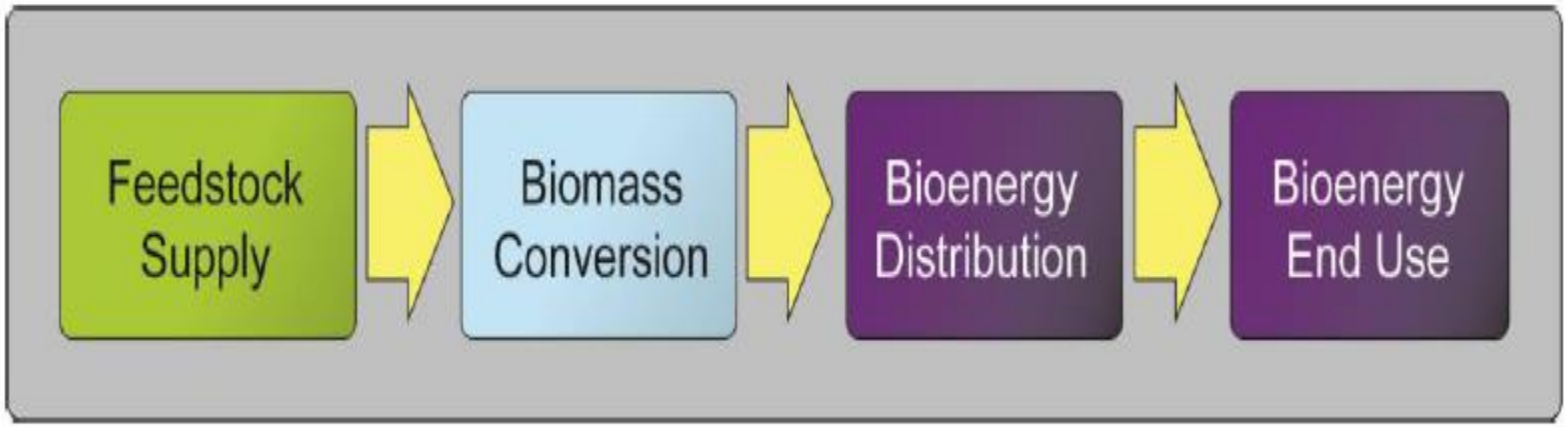
RUTGERS
New Jersey Agricultural
Experiment Station

ASSESSMENT OF BIOMASS ENERGY POTENTIAL IN NEW JERSEY

VERSION 2.0 JULY 2015

EcoComplex
Clean Energy Innovation Center

Biomass-to-Bioenergy Supply Chain



Feedstock Supply: Produce large, sustainable supplies of regionally available biomass and implement cost-effective biomass feedstock infrastructure, equipment, and systems for biomass harvesting, collection, storage, preprocessing, and transportation

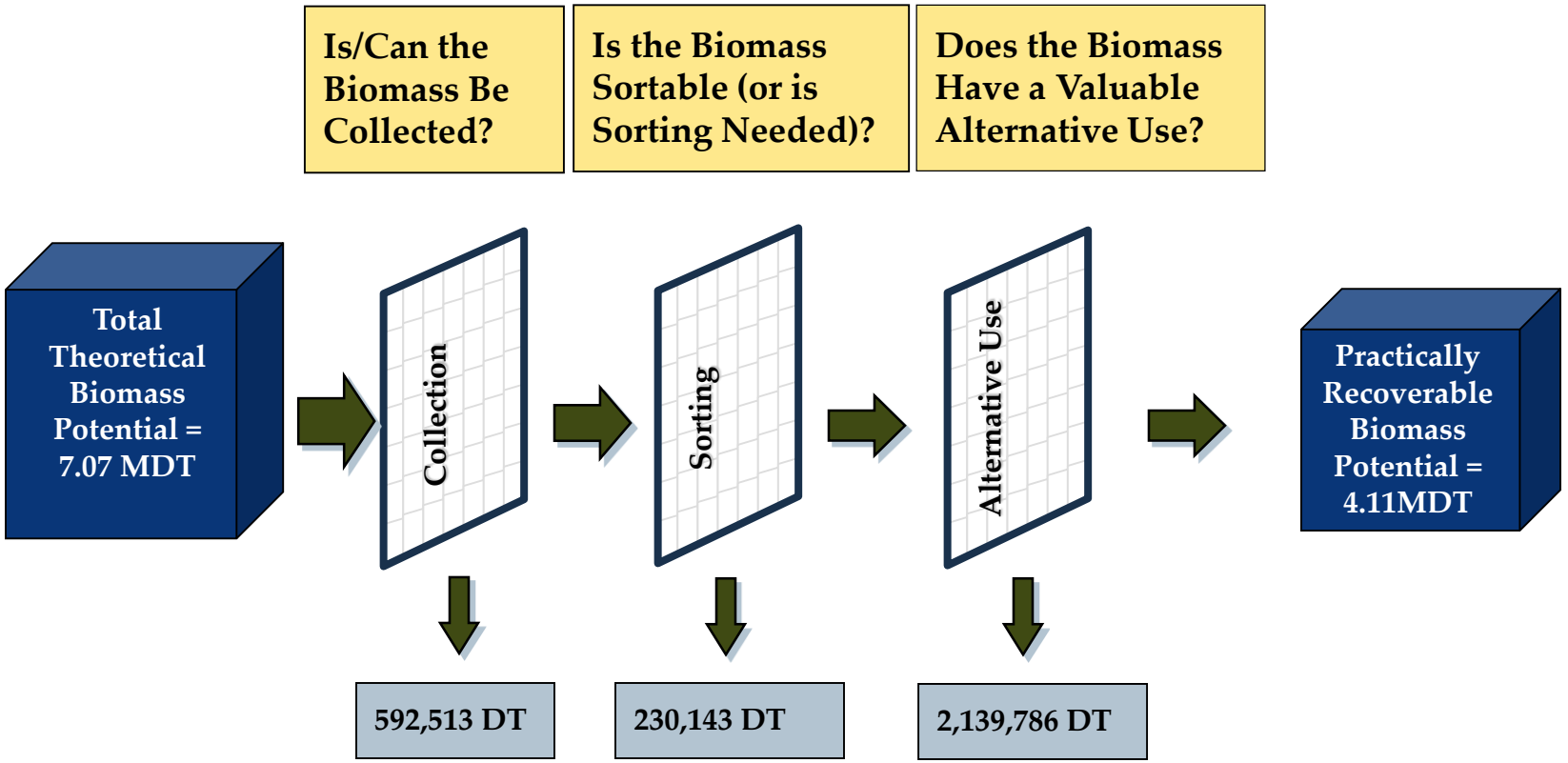
Bioenergy Production: Develop and deploy cost-effective, integrated biomass conversion technologies for the production of biofuels and bioproducts

Bioenergy Distribution: Implement biofuels distribution infrastructure (storage, blending, transportation—both before and after blending and dispensing)

Bioenergy End Use: Assess impact of bioenergy on end-users.

https://www1.eere.energy.gov/bioenergy/pdfs/mypp_may_2013.pdf.

The results of this process indicate that approximately 4.11 MDT (~58%) of New Jersey's biomass could ultimately be available to produce energy in the form of power, heat, or transportation fuels.



Note: This screening process is preliminary and would require considerably more analysis to reach any final conclusions. The screening analysis has been incorporated into the database, and provides flexible "scenario analysis" capabilities for the user.

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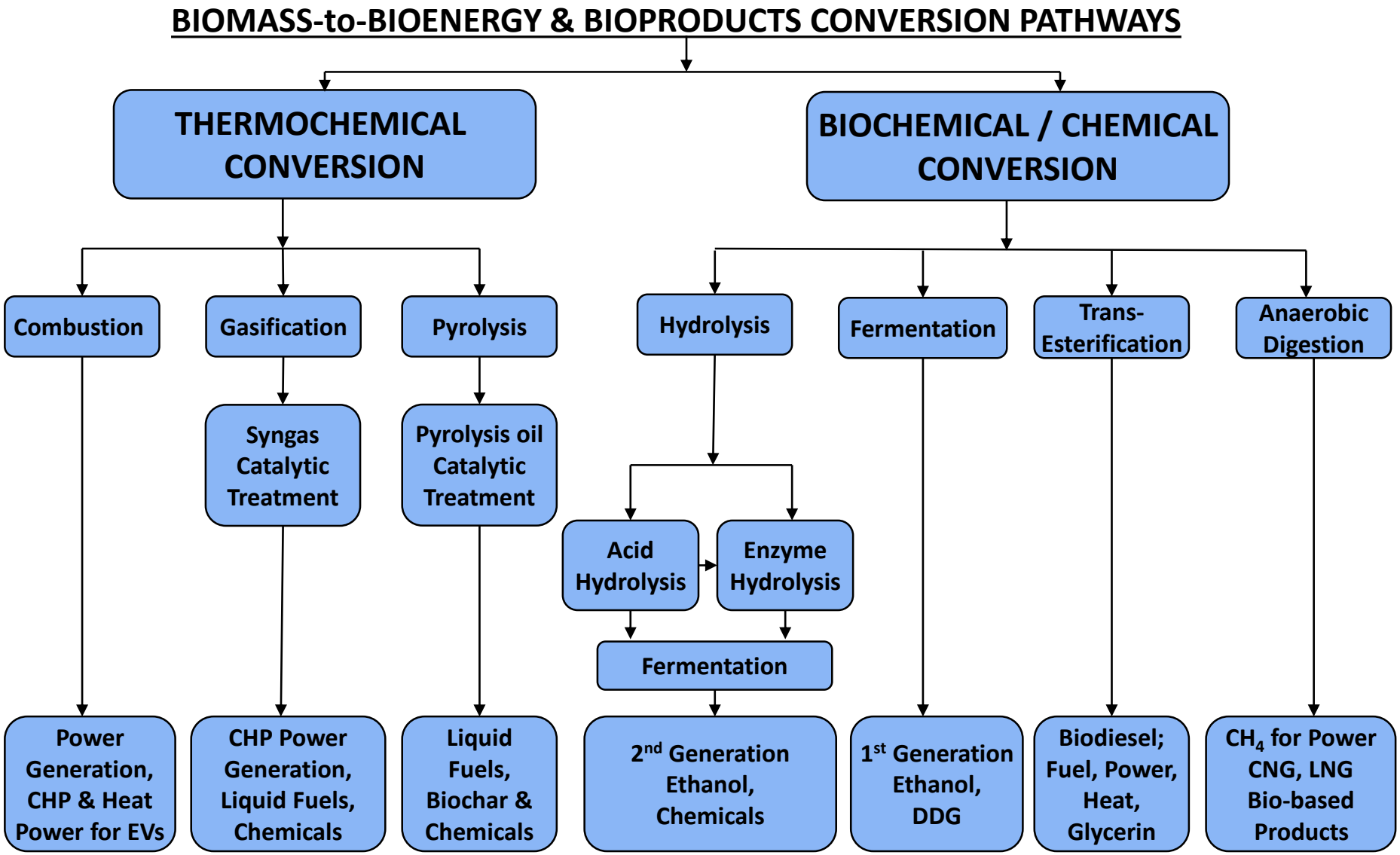

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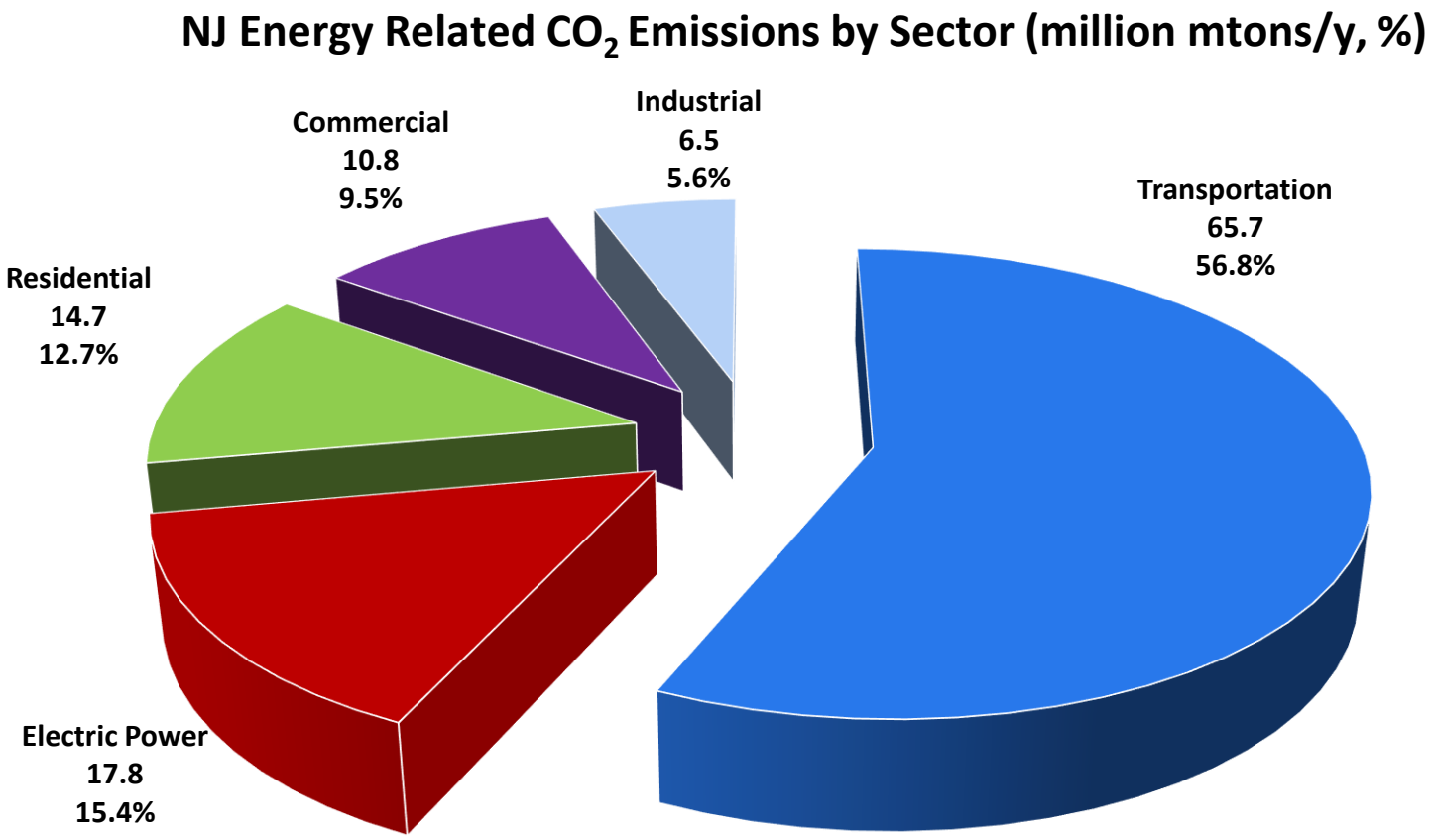
Greenhouse Gas Reduction Potential: NJ ENERGY CO_2 EMISSIONS*,**



*http://www.eia.gov/environment/emissions/state/state_emissions.cfm
** 2012 Emissions

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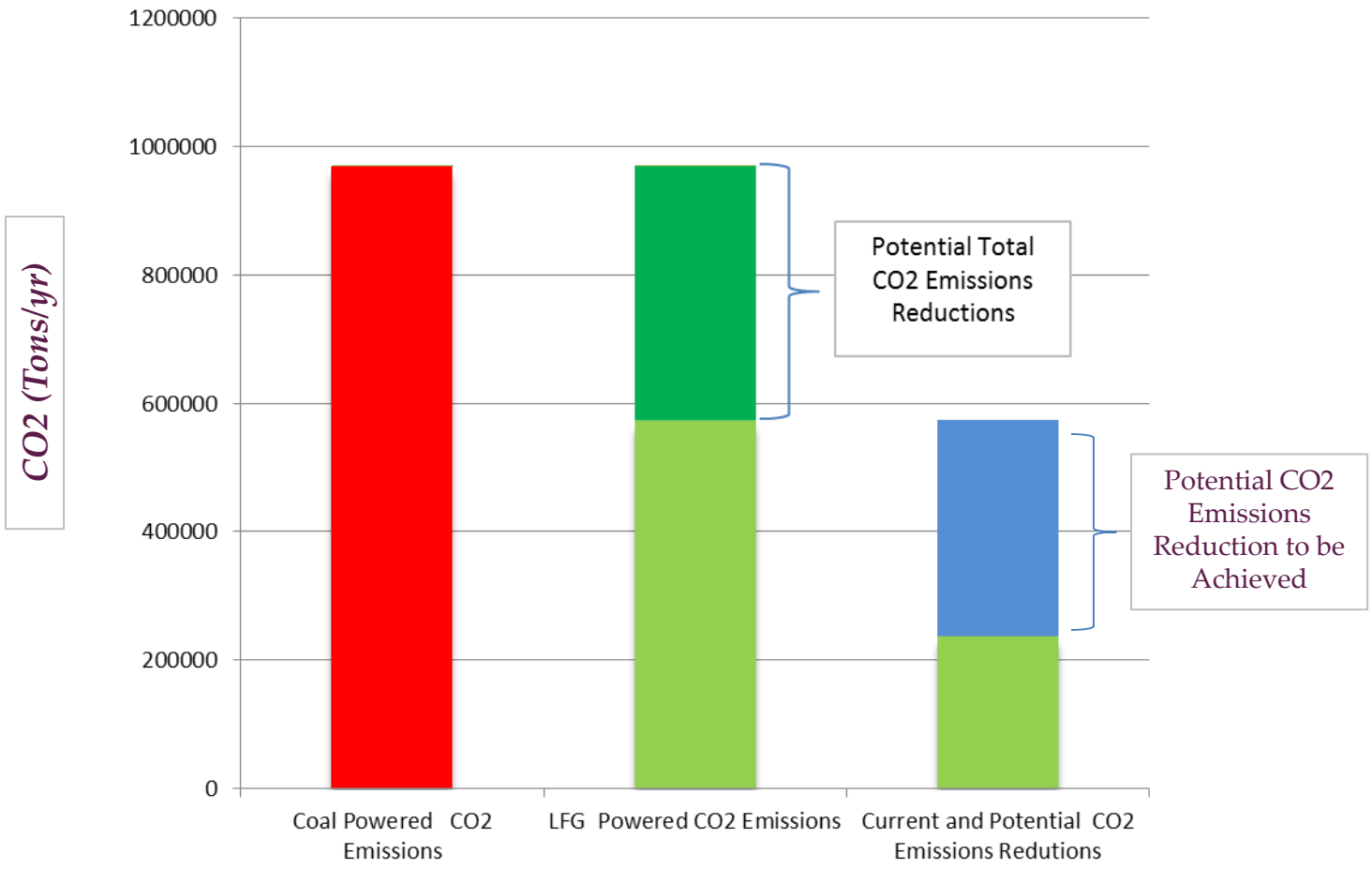
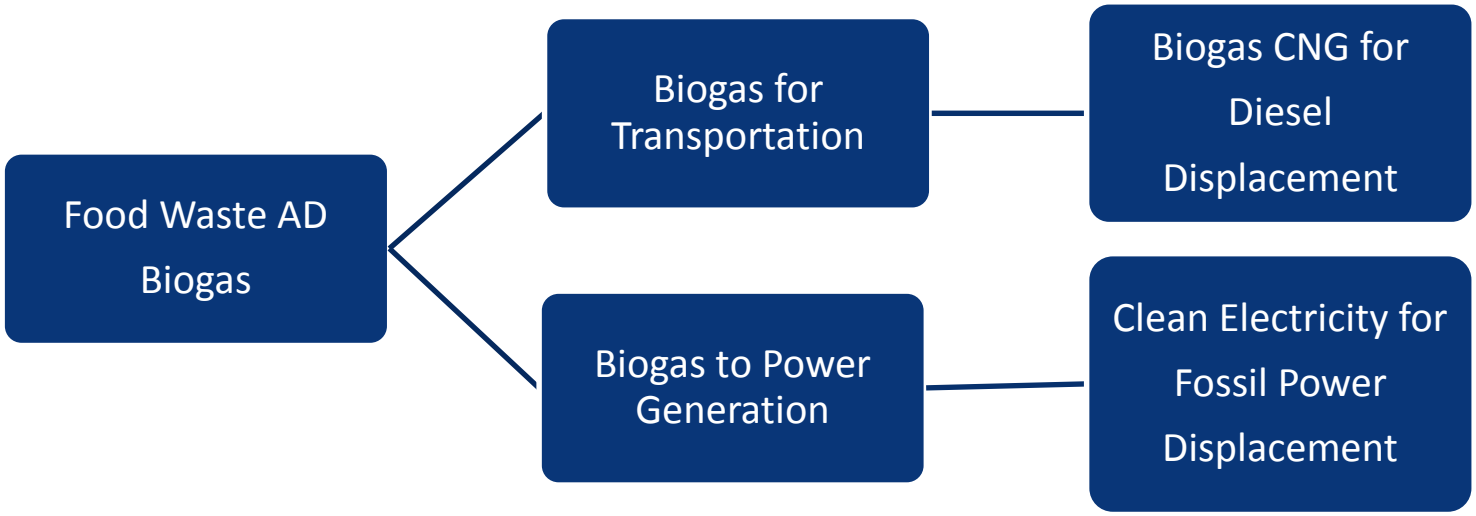
New Jersey LFG To Power Generation Potential:



SCENARIO: Food Waste AD to Energy



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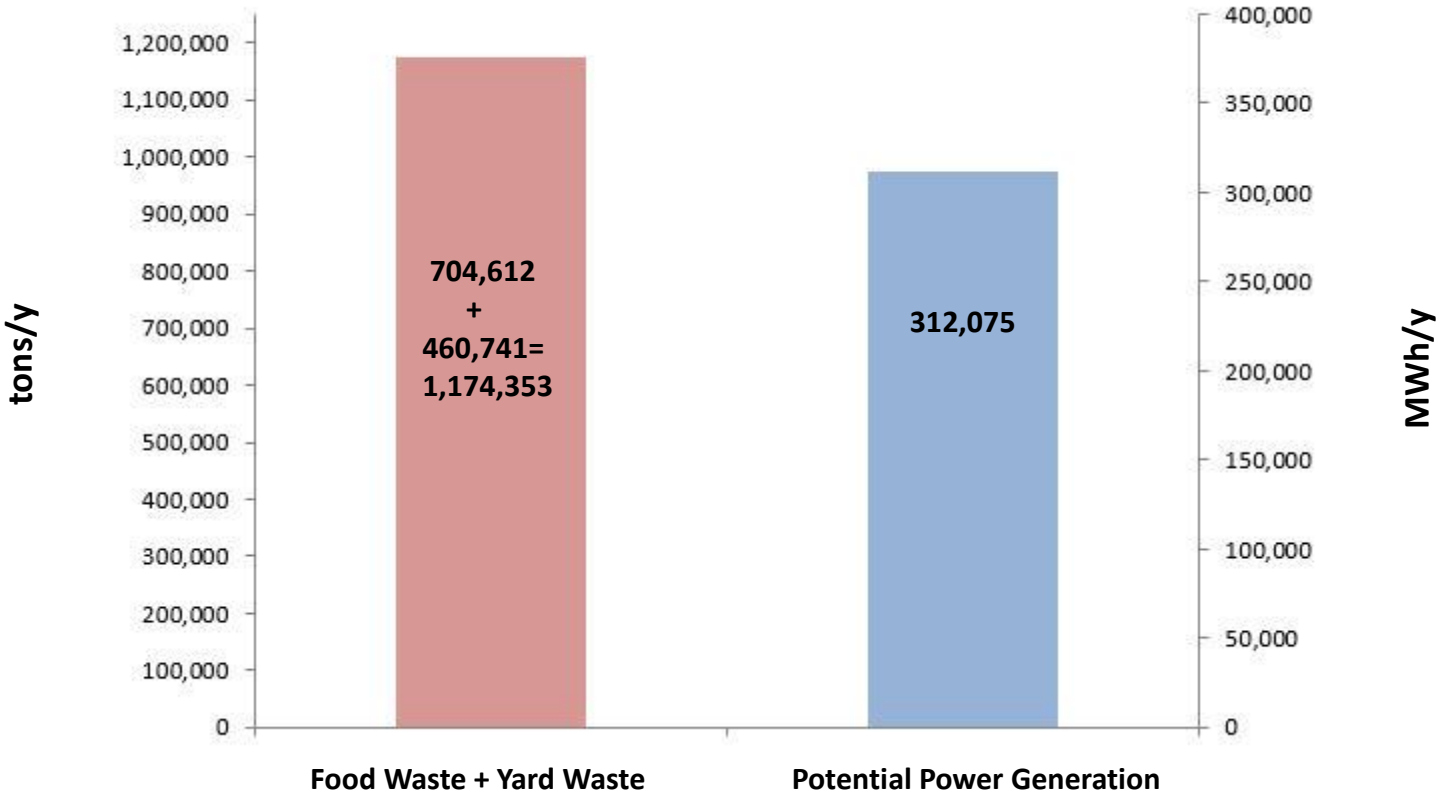
Food Waste Anaerobic Digestion to Power Generation



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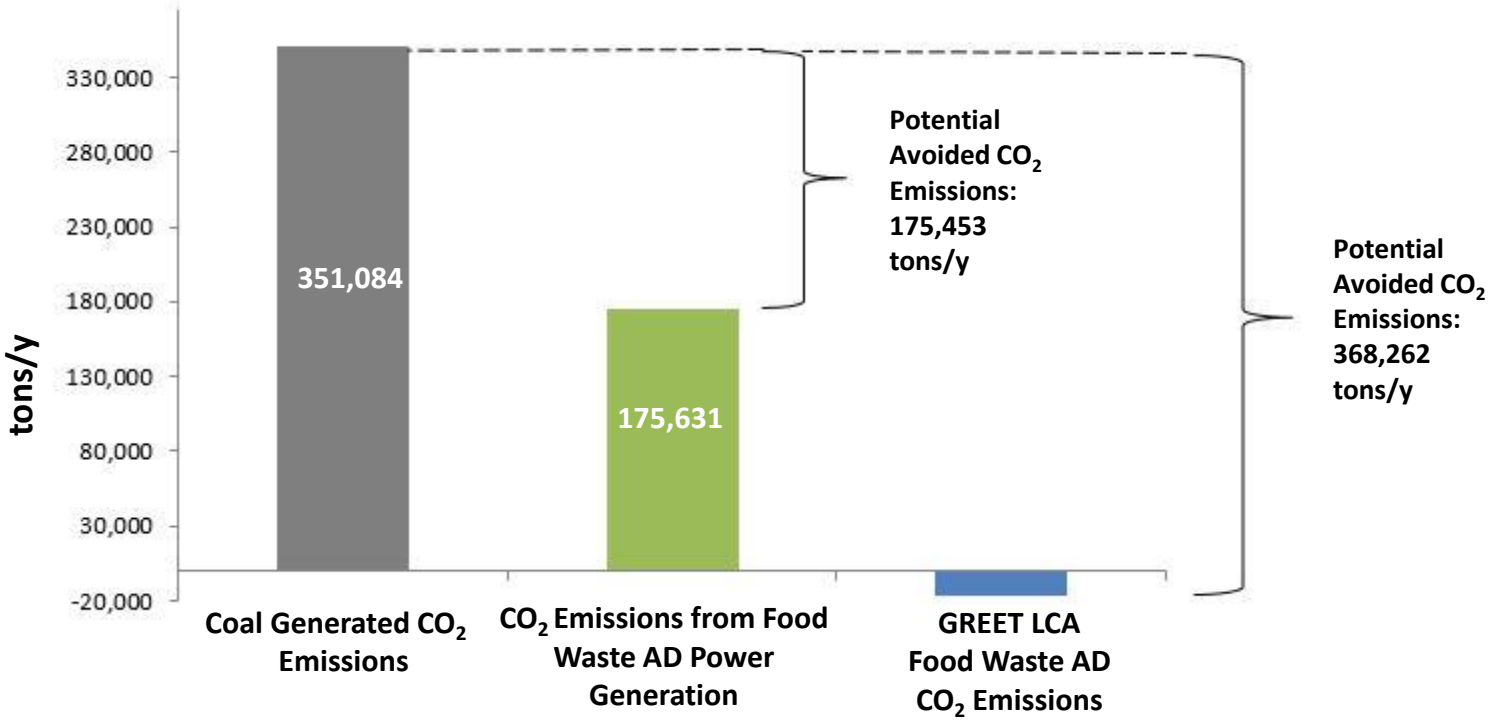
Food Waste AD Biogas for Power Generation Potential CO_2 Reductions Comparison



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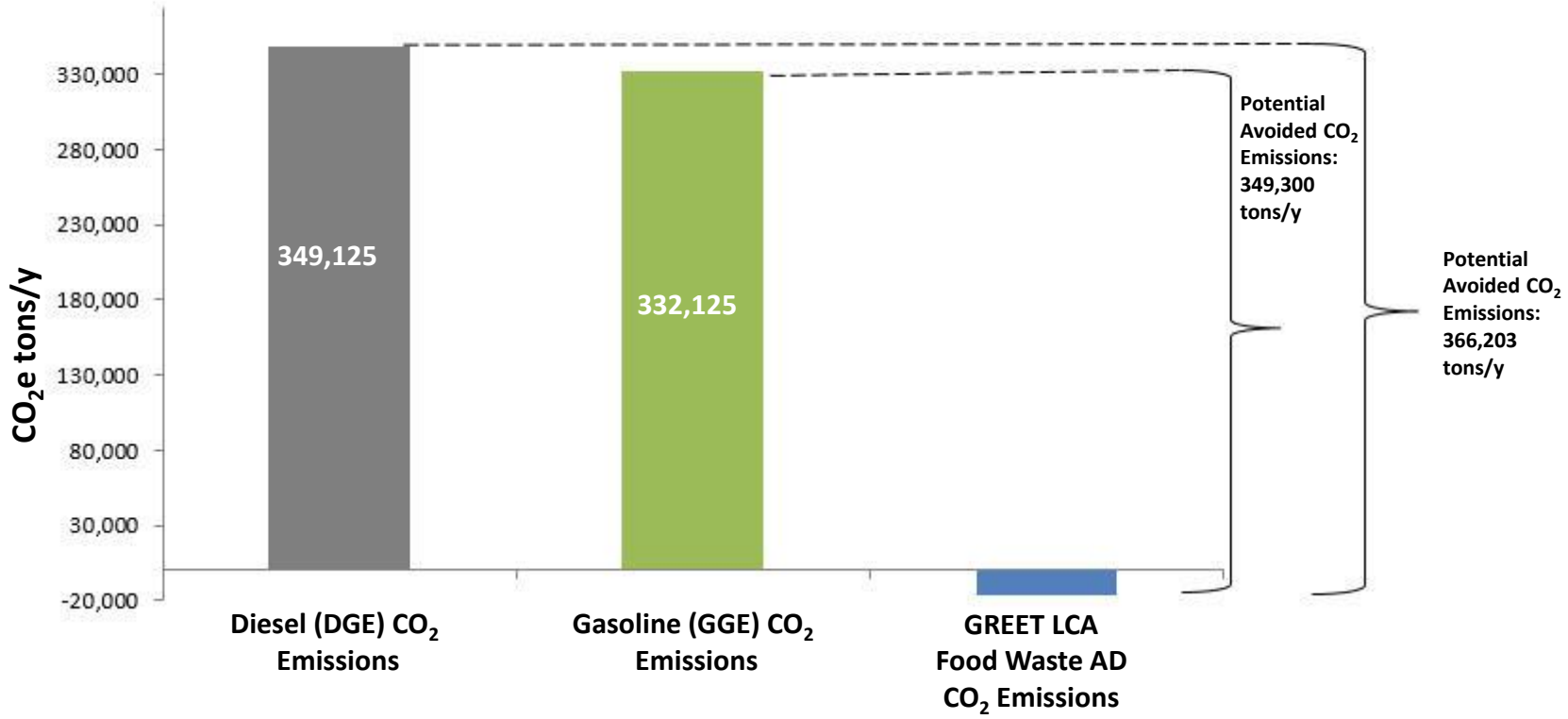
Food Waste AD Biogas as Transportation Fuel
Potential CO_2 Reductions Comparison



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New Jersey Coastal Counties Institutional and Commercial Food Waste Generation

County	Food Waste tons/year
Atlantic	**146,872.6**
Bergen	41,327.4
Cape May	**12,770.0**
Hudson	24,636.7
Middlesex	52,406.6
Monmouth	44,155.0
Ocean	33,224.8
Union	24,635.0
Total	**380, 028.0**

New Jersey Coastal Counties Food Waste Generation by Food Stores & Hospitality Sector

County	Food Stores		Full Service Restaurants		Limited Service Restaurants		Hotels		Total
	Food Waste (tons)	# of Facility	Food Waste (tons)	# of Facility	Food Waste (tons)	# of Facility	Food Waste (tons)	# of Facility	
Atlantic	3008	194	133,340	662	135	59	4,027	158	140,510
Bergen	16,451	428	15,422	1,492	155	140	1,661	63	33,690
Cape May	2,858	116	7,701	507	1601	32	1,160	297	11,880
Hudson	6,366	653	11,975	1,534	144	217	1,847	62	20,332
Middlesex	10,162	505	19,229	1,497	150	131	7,029	97	36,570
Monmouth	14,975	429	20,963	1,625	317	128	1,372	135	37,626
Ocean	9,857	311	14,208	1,060	244	72	1,076	142	25,384
Union	6,822	388	11,427	1,164	129	91	1,042	53	19,420
Total	70,497	3,024	234,264	9,541	1,434	870	19,214	1007	325,408

New Jersey Coastal Counties Food waste Generation by Schools and Universities

County	Higher Education		Public Schools		Private Schools		Total
	Food Waste (tons)	# of Facility	Food Waste (tons)	# of Facility	Food Waste (tons)	# of Facility	
Atlantic	1,235.7	3	540	27	58.9	23	1,834.5
Bergen	1,215.5	5	1,472	124	394.5	169	3,082
Cape May	122.9	1	124	18	18.7	11	265
Hudson	987	5	576	23	162.8	67	1,725.8
Middlesex	10,451.	5	1,467	27	254.37	130	12,172.7
Monmouth	1892.4	3	1,214	58	402.80	147	3,506
Ocean	773.8	2	694.5	28	254.8	96	1,723.1
Union	1343.8	2	1020	26	216.7	98	2,580.4
Total	18,022	26	7107	331	1763.6	741	26,893

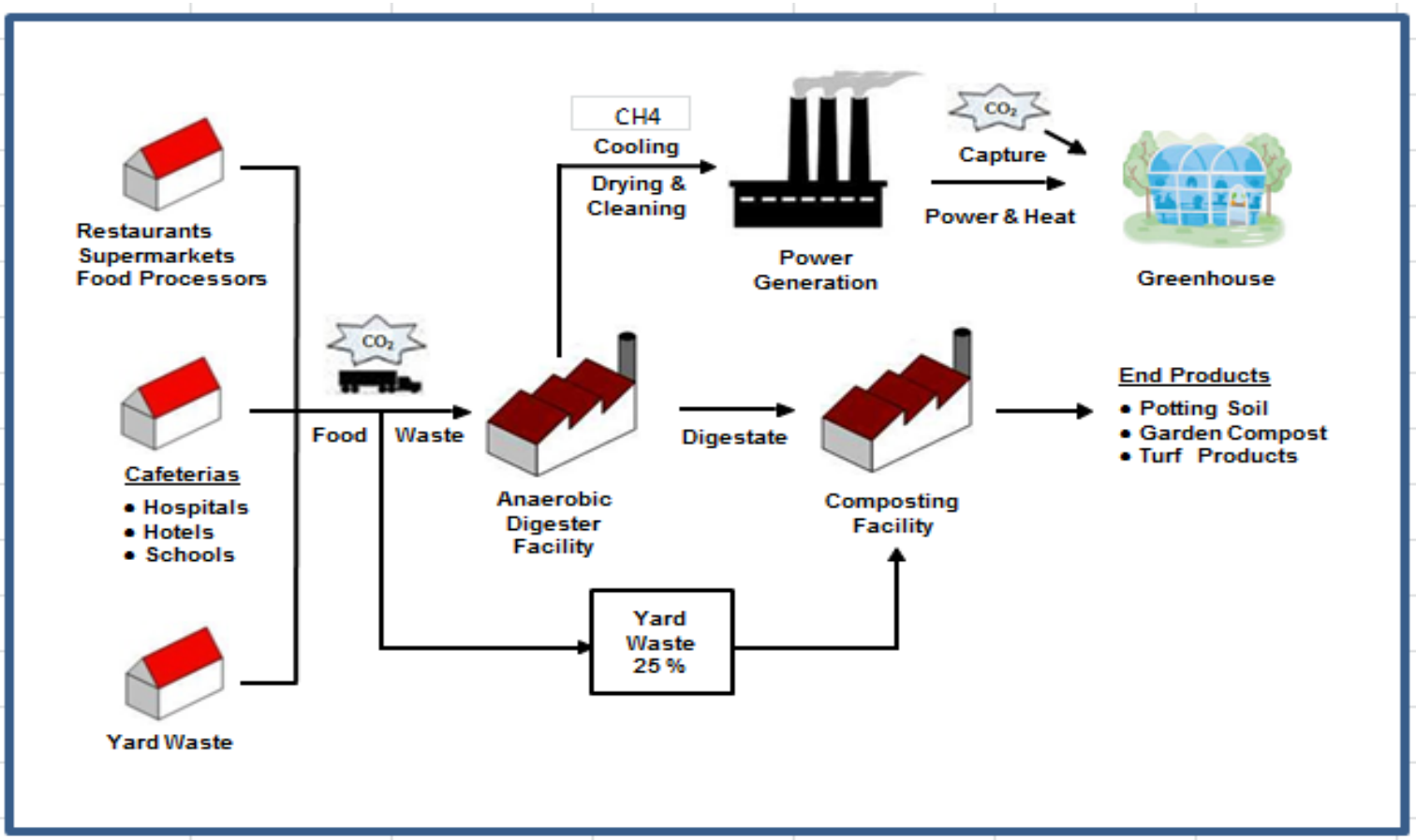
New Jersey Coastal Counties Food Waste Generation by Health Sector

County	Nursing Homes		Hospitals		Total
	Food Waste (tons)	# of Facility	Food Waste (tons)	# of Facility	
Atlantic	967.7	29	3,561.4	4	4,529.1
Bergen	2,722.3	65	1,834	6	4,556.3
Cape May	474.4	13	151	3	625.4
Hudson	1,393.2	32	1,185.9	7	2,579.1
Middlesex	2,427	58	1,237.7	5	3,664.7
Monmouth	2,374.7	64	645.4	5	3,020.0
Ocean	2,265	62	901.3	4	3,166.3
Union	1,731.2	46	904	4	2,635.2
Total	14,355.4	369	10,420.7	38	24,776.0

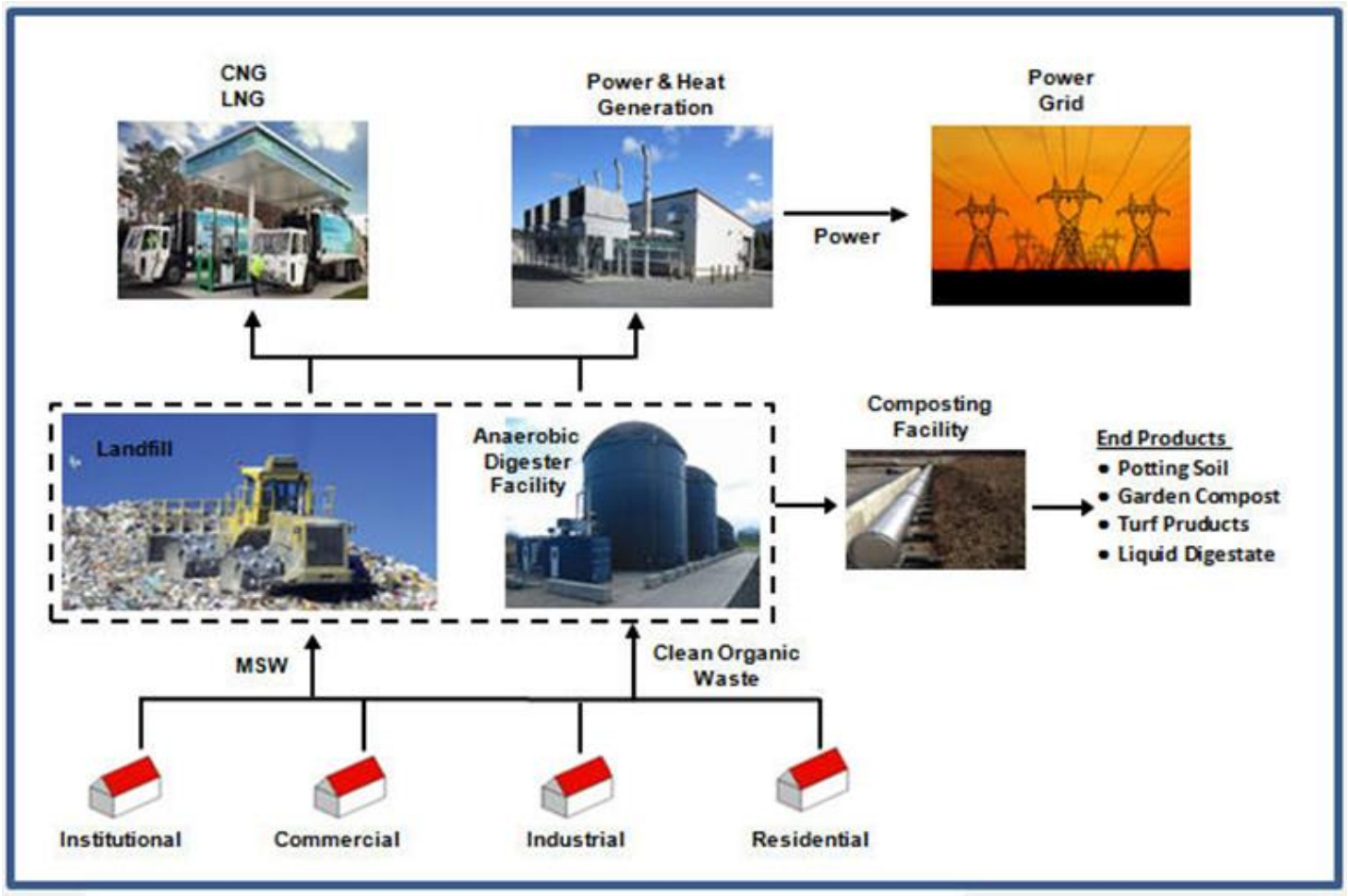
Current Food Waste Disposal in Coastal Counties of New Jersey

Disposal Method	Frequency	Percent (%)
Donate	156 / 820	19
Animal Feed	44 / 820	5.4
AD (via WWTP)	5 / 820	0.6
Aerobic Digestion	1 / 820	0.1
Grease Repurposed	11 / 820	1.3
Meat Rendered	11 / 820	1.3
Reused for Juices	3 / 820	0.4
Compost	95 / 820	11.6
Landfill	363 / 820	44.3

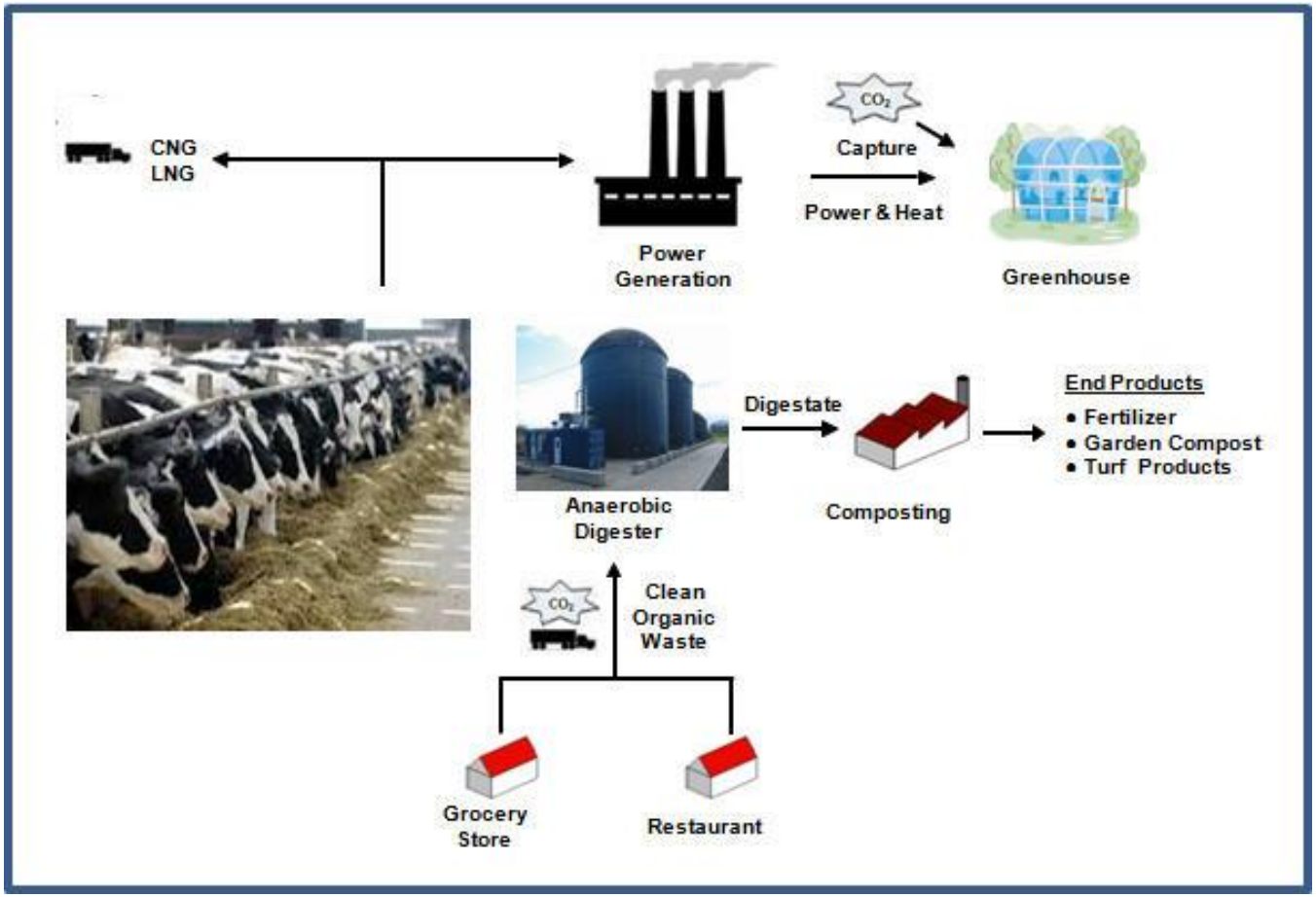
Source Separated Food Waste-to-Energy



New Approaches



New Approaches



Thank You!