NYISO DER Study

Project Update

4 April 2014

PRELIMINARY CONTENT – FOR DISCUSSION ONLY

DRAFT

Discussion Topics

1	Study Background
2	Draft Content
3	Findings to Date
4	Next Steps

Project Objectives

A comprehensive review of Distributed Energy Resource (DER) technologies, market potential and drivers, regulatory and environmental policies, and treatment in other balancing authority and utility regions.

- Categorize DER technologies
- Identify DER uses, configurations and customer motivations
- Describe regulatory and market-based drivers for DER adopters
- Detail current and potential DER market penetrations in New York
- Assess the treatment of DERs in other ISOs/RTOs and utility regions in their various forms

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Study Definition of DER

- Distributed Energy Resource technologies are "behind-the-meter" power generation and storage resources typically located on an end-use customer's premises and operated for the purpose of supplying all or a portion of the customer's electric load, and may also be capable of injecting power into the transmission and/or distribution system, or into a non-utility local network in parallel with the utility grid.
- Distributed energy resources includes such technologies as solar photovoltaic, combined heat and power or cogeneration systems, microgrids, wind turbines, micro turbines, back-up generators and energy storage.

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Study Outline

1. Introduction
2. Behind-the-Meter Applications
   - i. DER Applications & Benefits
   - ii. Challenges and Constraints
   - iii. Looking at the Full Picture
3. State of Distributed Resources
   - i. Technology Assessment
   - ii. Market Penetration
   - iii. Market Potential
   - iv. Environmental Requirements
4. Retail Rates, Regulations and Incentives for Distributed Energy Resources
   - i. Retail Rates and Regulations
   - ii. Government Incentive Programs
5. Comparative Analysis & Identification of Potential Best Practices in ISO/RTO Treatment of DERs
   - i. Market and Business Rules for DERs
   - ii. Metering Configurations
   - iii. Telemetry Requirements
   - iv. Measurement & Verification

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DER Investments Are Prompted for Numerous Reasons

Behind-the-Meter Applications

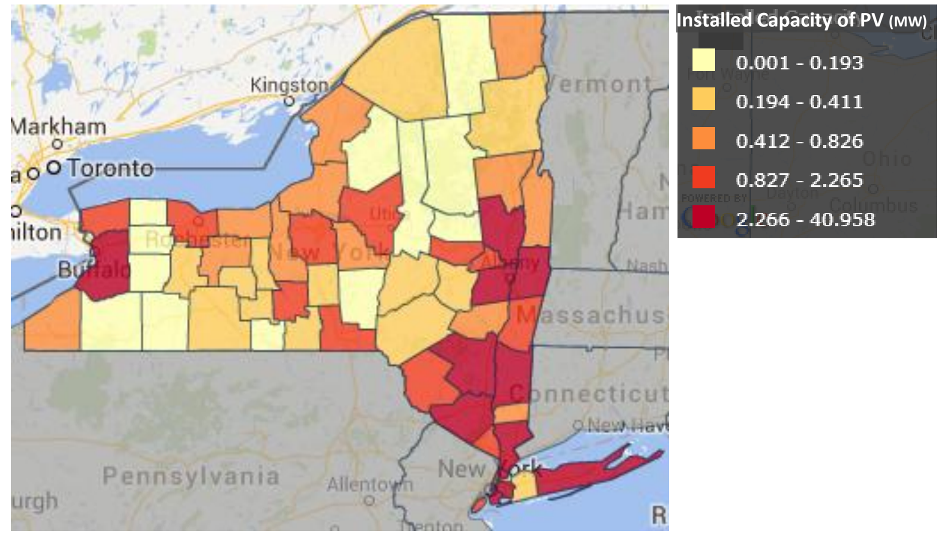
- **Economic Benefits**. Avoided costs, increased efficiencies, and gained revenues. For customers, benefits are tied to incentive payments as well as avoided costs associated with electricity bills. For utilities and regulators, benefits are tied to more efficient utilization of the grid and deferred investments.
- **Deferred or Avoided Network Investments.** Avoided cost of expanding generation, transmission or distribution. This benefit applies to utilities, and indirectly benefits customers. Apart from providing economic benefits, DERs can also help avoid lengthy siting processes. For some cases, DERs can provide a quick means for addressing grid challenges.
- **Resiliency.** Uninterrupted service in the event of loss of grid service. This can be applied to both customers and utilities.
- **Power Quality.** Ability to ride through transients and short-term interruptions. This can support both customers and utilities.
- **Clean Energy.** Social, regulatory, and economic reasons to invest in low or no-emission DERs. Many customers are motivated to purchase clean DERs to support clean energy goals. Likewise, many utilities are doing the same (often, motivated by goals or explicit targets). The net effect on emissions, however, has to be investigated per system because the displacement of centralized generation can have different effects on total emissions.

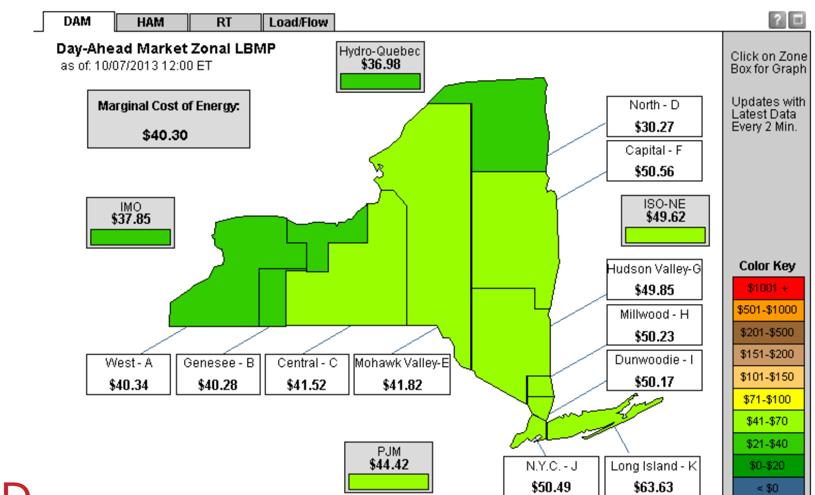
DER Value Varies by Region & Across Studies

Behind-the-Meter Applications

Regional Circumstances

- Resource characteristics (location, quantity, coincidence with demand, etc.)
- Load growth
- Level of congestion
- Utilization & need for upgrades / increased capacity
- Reliability standards & market rules (e.g., reserve requirements, penalties)
- Generation mix (emissions, ramping ability)
- Information about marginal resources, ancillary needs, and value of capacity versus energy (existence of markets, market structures that explicitly value capacity, etc.)





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Sources: https://openpv.nrel.gov & RMI, 2013

DER Applications – Key Requirements
Behind-the-Meter Applications

- DER applications have different technology requirements, such as power vs. energy
- Choosing the right technology is paramount for cost effectiveness and performance

Illustrative

Application	Characteristics							Duration			Frequency of use		
	High Efficiency	Low Emissions	Environment (temp / noise)	High Thermal Output	Islanding	Start-Up Time	Ramping Time	Continous	2-6 hours	< 2 hours	Daily (> 2000 h)	Seasonal (500-2000h)	Yearly (< 500 h)
Continuous Power / Base Load	X	X						X			X		
Uninterrupted Power Supply (UPS)						X	X			X			X
Back Up						X			X				X
Back-up with Islanding	X		X		X			X					X
Renewables							X		X	X	X	X	
Peak Shaving						X	X			X	X	X	
Demand Response						X			X				X
Regulation						X	X				X		
Reserves						X			X	X			X
Supply Capacity								X	X	X			
T&D Deferral									X			X	

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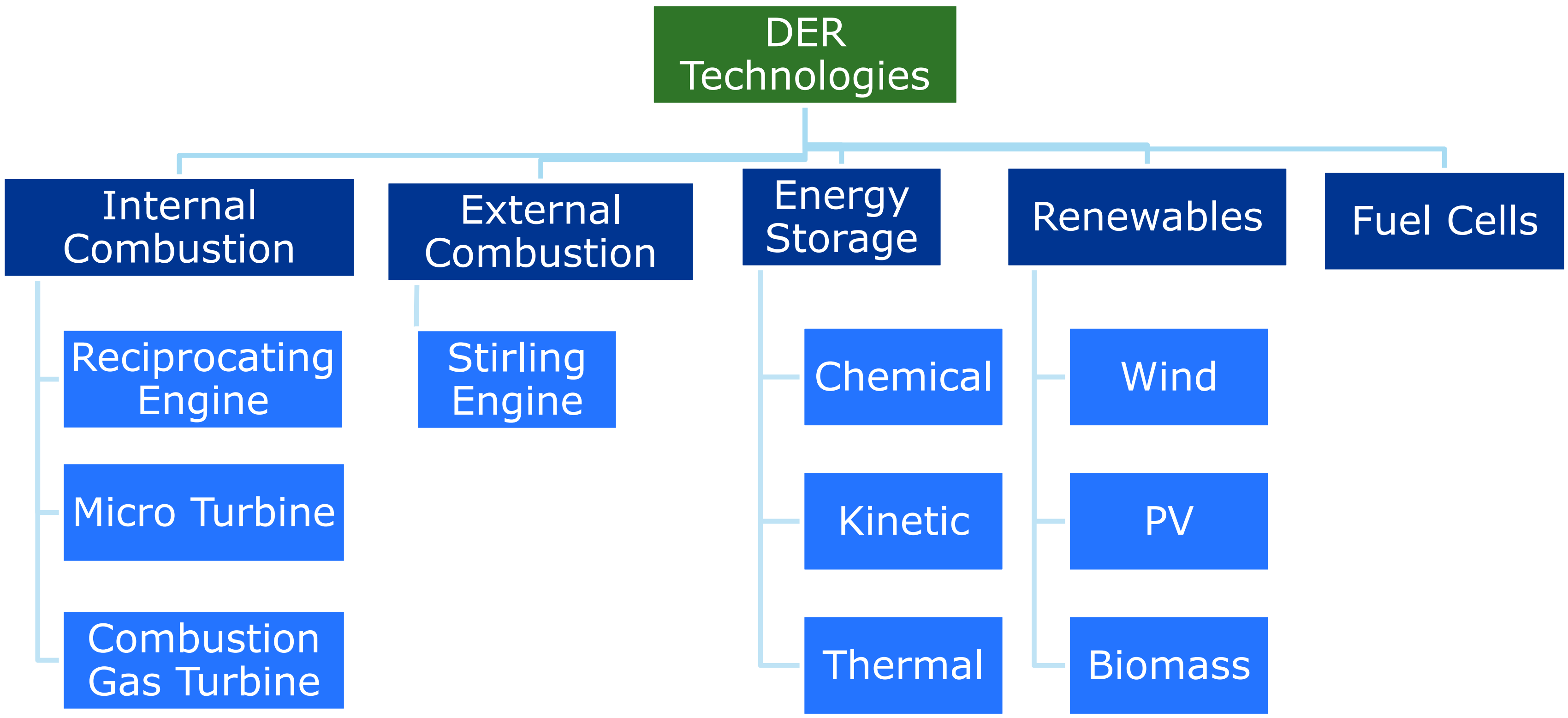
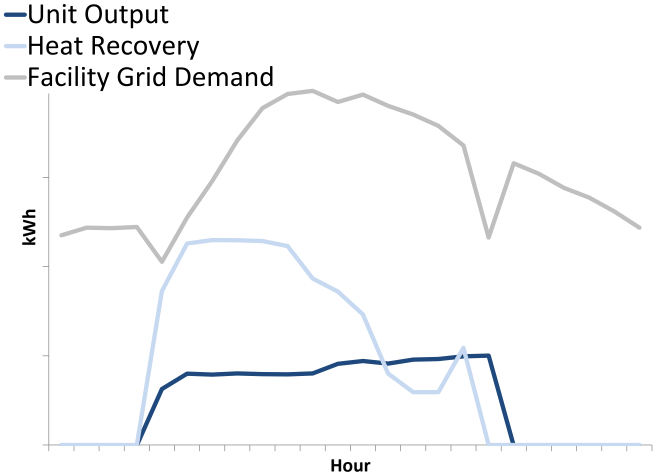
DER Technologies
State of Distributed Resources

A variety of distributed energy resources exist today, ranging from those with extensive use and history to newer technologies.

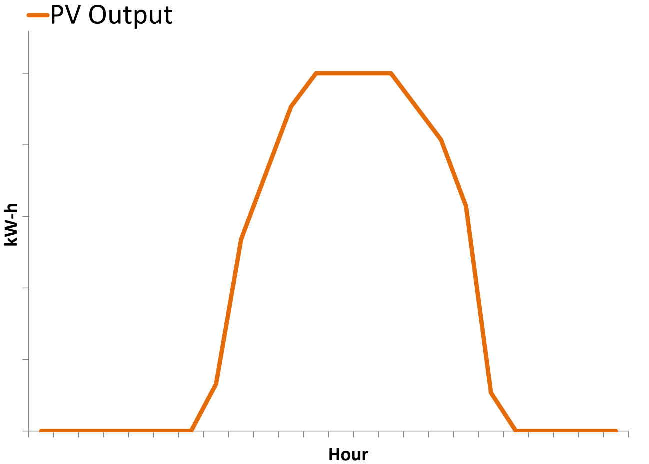


Sample Load Profiles
State of Distributed Resources

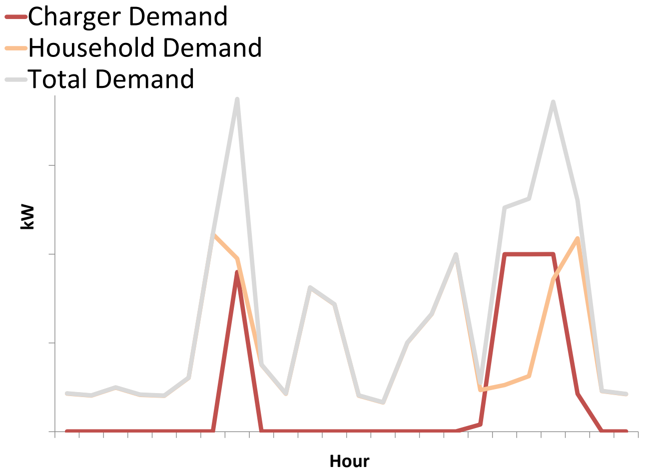
CHP



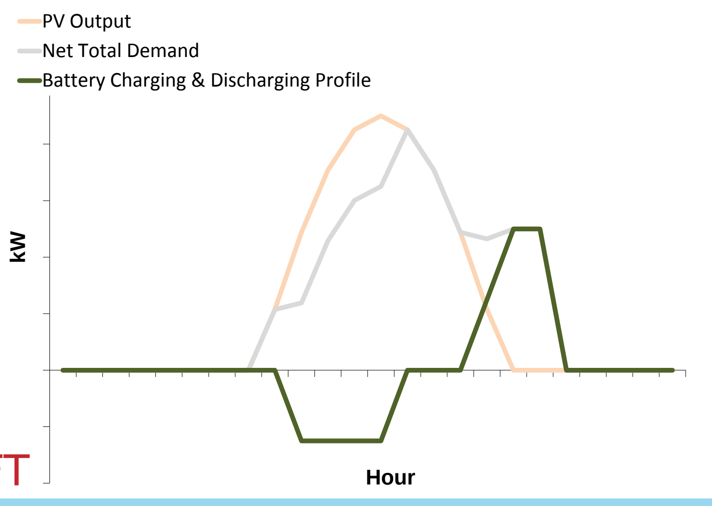
Non-Utility PV



Electric Vehicles



Non-Bulk Storage



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Market Penetrations
State of Distributed Resources

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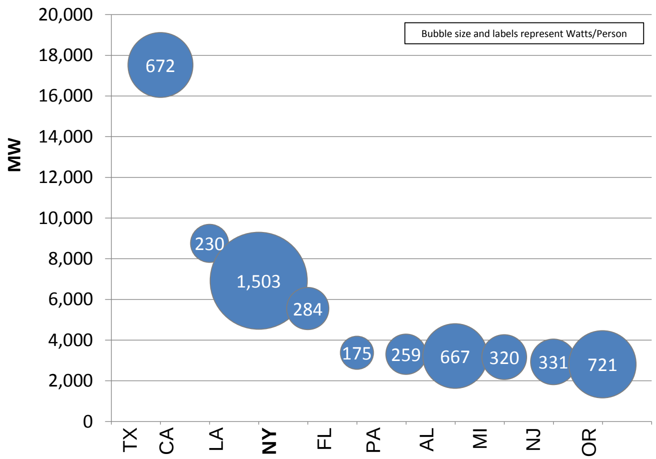
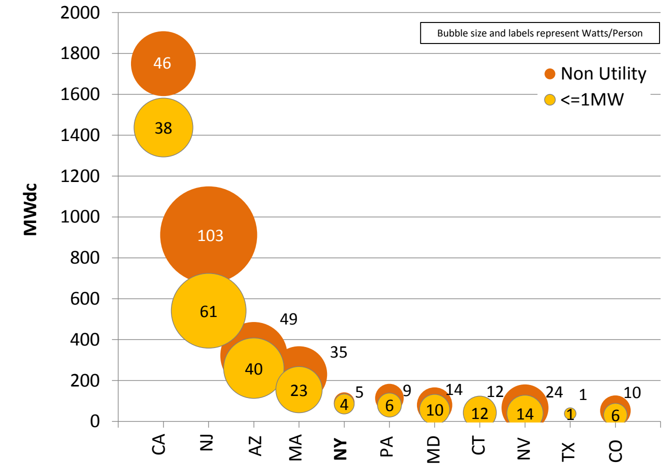


Non-Utility PV



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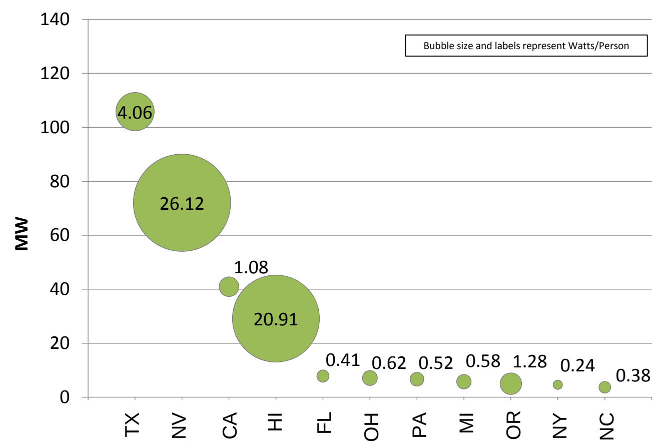

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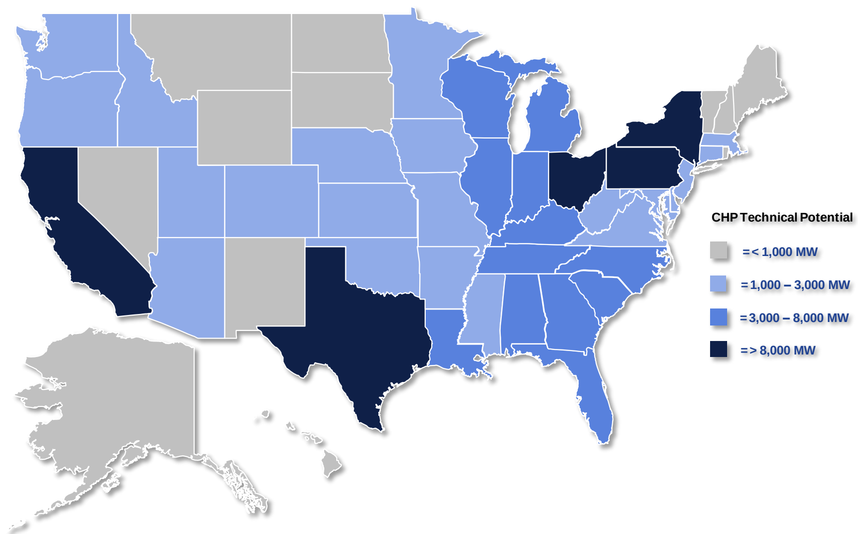
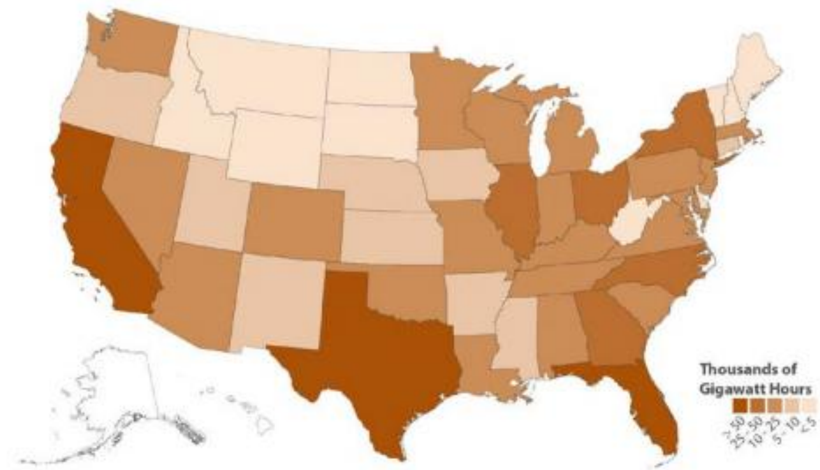
Sources: CHP: www.eea-inc.com/chpdata; PV: DOE NREL Open PV; ES: www.energystorageexchange.org

Technical Potential
State of Distributed Resources

CHP Tech Potential



PV Rooftop Tech Potential



Non-Bulk Storage

TO BE COMPLETED

Source: US Renewable Energy Technical Potentials: A GIS-Based Analysis. 2012

Economic Signals to Customers – Capital Investments

Retail Rates, Regulations and Incentives

Economic incentives exist that influence customers decisions about investing in or operating DERs. These derive from energy and demand prices, program opportunities and financial policy incentives. The types of prices, program opportunities and incentives can vary significantly, influencing the economic calculation for DERs.

Income | Cost

DG incentive provider	**Direct Capital Rebate**				Notes: $/KW installed cap rebates
	Federal programs		State programs		
DG incentive provider	**Tax rebate**				Notes:% of $/KW as tax deduction
	Federal programs		State programs		
DG incentive provider	**Accelerated depreciation**				Notes: years
	Federal programs		State programs		
Equipment vendor, EPC contractor	**Generation and Storage**				Notes: Costs in $/KW or $/KWhr installed
	Equipment		Installation		
Equipment vendor, EPC contractor	**Controls and communication**				Notes: Depends on existing infrastructure, desired functionality, as well as distribution utility interconnection regulations
	Equipment		Installation		
Equipment vendor, EPC contractor	**Telemetry and protection**				Notes: Depends on existing infrastructure, desired functionality, as well as ISO visibility and control requirements
	LSE	NYISO	Aggregator	Internal	

Source: DNV GL, NYSERDA SOC interim deliverable

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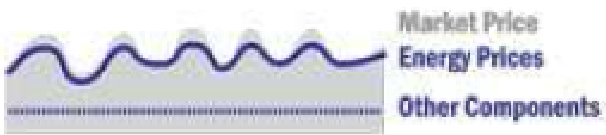
Economic Signals to Customers – Operating Decisions
Retail Rates, Regulations and Incentives

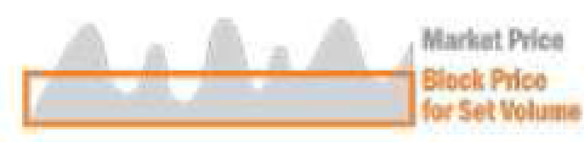
Income | Cost | Rebate

DG incentive provider	**Production incentives**	Federal programs; State programs; LSE programs	Notes: $/KWh rebates. Might be related to fuel source and type for conventional generation sources
Self	**Market Products**		Notes: $/KW and/or $/KWhr incentives
DR aggregator / LSE / Self	**DR programs**		Notes: $/KW and/or $/KWhr incentives
Electric energy purchaser	**Sell back rates**	Net metering; Buy back; Sellback rate; Emergency generation	Notes: $/KWhr sold back
Electric energy provider	**Electric energy charge**	Hourly DAP; TOU rate; Flat rate	Notes: $/KWhr charge
T&D provider	**Demand charge**	TOU; Flat rate; Standby rate	Notes: $/KW charge
T&D provider	**Distribution charge**		Notes: $/KWhr charge
Gas provider	**Flat rate gas cost**		Notes: $/MMBtu charge

Retail Rates Structures
Retail Rates, Regulations and Incentives

- There are a variety of possible retail rate structures, mostly differentiated by the division of risk between customer and retail organization
  - **Fixed:** Customer pays a set $/kWh value for all energy consumed
  - **Variable:** Customer pays based on dynamic $/kWh value. This value can change hourly or by peak / off-peak
  - **Combination:** Customer pays a fixed rate for the pre-decided amount, then an indexed price for the remainder
- In addition to energy charges, demand charges apply.
- Large, utility-served loads in New York are defaulted to a Mandatory Hourly Pricing though other pricing options are available.





Increased variability in a customer's retail rates can provide an incentive to increase management of demand and energy use

Examples of T&D Owner/Operator Incentives
Retail Rates, Regulations and Incentives

	Total IPEC Market Forecast MW	EE/DR Budget (in Millions)
Load Management	44	$77
Permanent Demand	40	$54
Fuel Switching	16	$15
Performance & Verification Services		$15
CHP*	25	$65
Total	125	$226

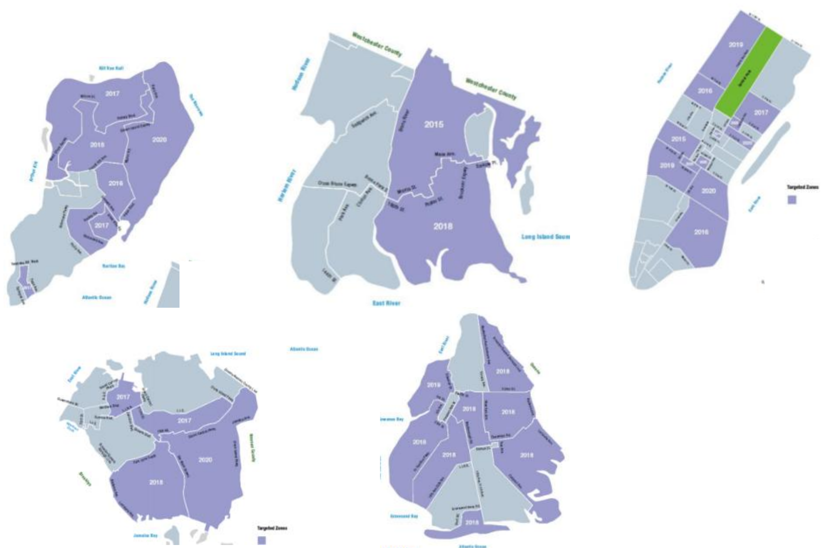
- Transmission and Distribution owners / operators may have reason to incentivize specific DER adoption
- Con Edison & NYSERDA are incentivizing 100 MW of storage and other DSM as well as 25 MW of CHP as a contingency for the possible 2016 summer closing of the Indian Point Energy Center
- NYSERDA currently offers a 10% bonus to standard DER incentives in "Targeted Zones", which are subject to change annually
- In June 2011, the PSC approved a new 4-year, $100M Targeted Incentive Program for Con Edison. Since 2003, Con Edison has solicited a total of 515 MW of demand reduction within 49 of its 82 network load areas.

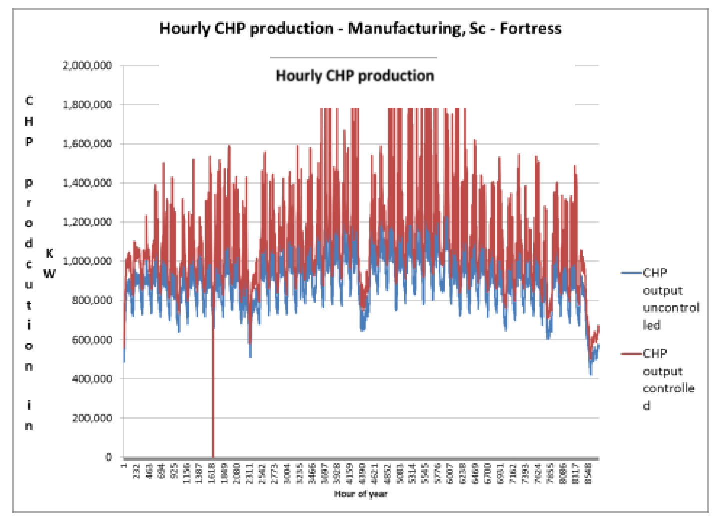
** 25 MW of CHP is in addition to 60 MW of on-going EE/DR/CHP, 30 MW of which has been approved*

Source: http://www.coned.com/

The Role of Incentives
Retail Rates, Regulations and Incentives

- Motivate investment in particular locations or shift in operations to align customer benefits with grid benefits
  - Capacity Deferral: Deferral of distribution or generation capacity investments
    - Relies on coincidence of DER with local delivery system peaks or with system peaks (where demand for supply is high and supply is more limited)
    - Some locations are more valuable than others





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Source: Con Ed: http://www.iea.org/media/workshops/2013/energyproviders/RebeccaCroftOttawaSection1..pdf

The Role of Incentives

Retail Rates, Regulations and Incentives

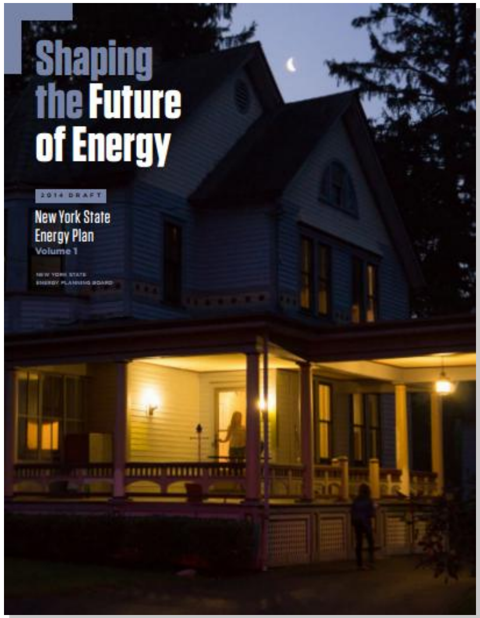
- To motivate a shift in operations or location, or investment in certain types of DERs or integration equipment.

  - Operational Savings: T&D loss reductions, avoided energy purchases
    - The benefit of avoided energy depends on alternative costs for supply (which can vary by time of day)
    - Timing and location can influence loss reductions

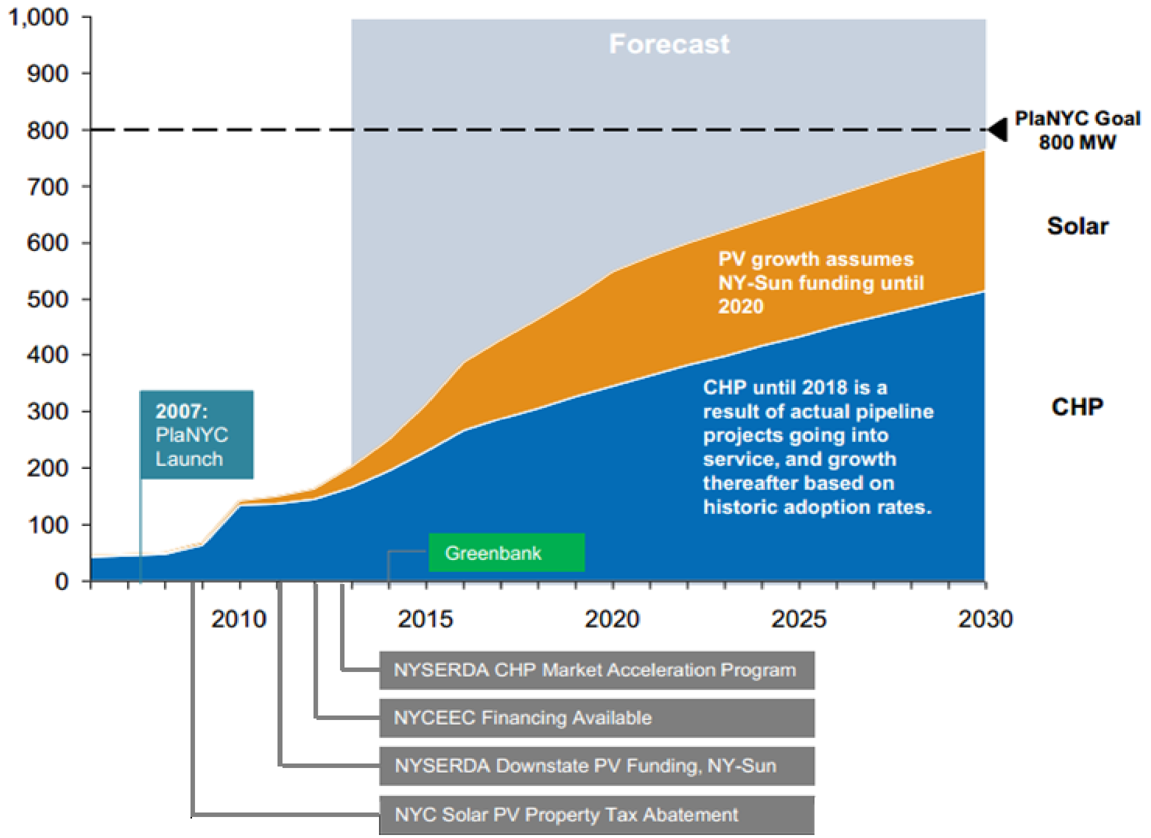
  - Emissions, Voltage Management, Resiliency are dependent on the type of DER and other supporting equipment.

Several NY Initiatives are Supporting DER Adoption
Retail Rates, Regulations and Incentives

State Initiatives



Local Initiatives



Source: Con Edison, NYC Mayor's Office

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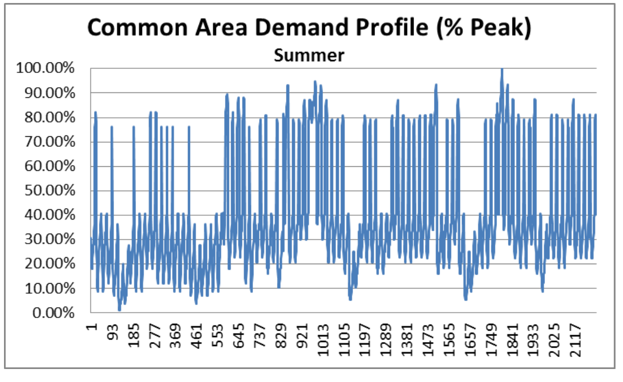
Sample Case Input Summary – Common Area with PV & Storage
Retail Rates, Regulations and Incentives

Analysis considers the following inputs:

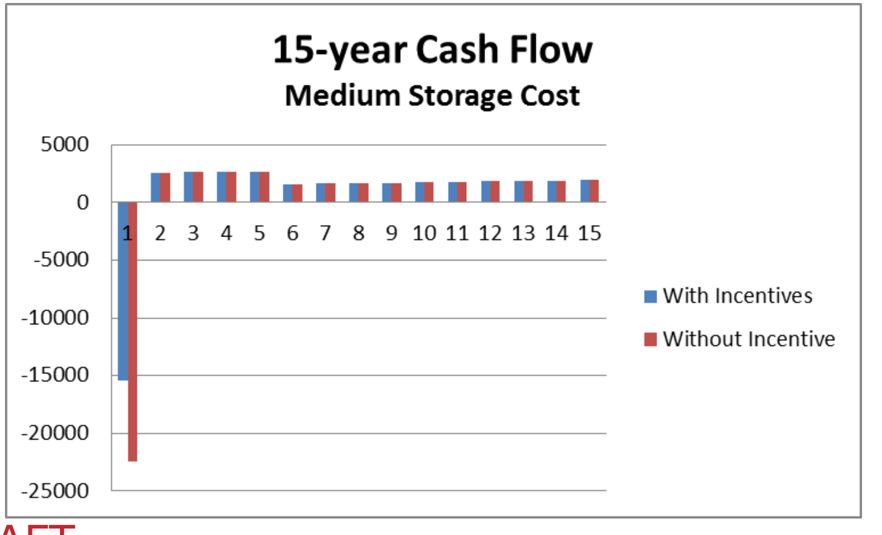
- Facility characteristics:
  - Peak demand, load profiles, and load growth, etc.
- Equipment characteristics:
  - PV size, storage size, storage duration, storage efficiency, etc.
- Technology cost and financial parameters:
  - PV installed cost, storage installed cost, cost of debt, rebates or incentives, tariffs, etc.



Analysis outputs include:

- Multi-year cash flows
- IRR, NPV, etc.
- Net load profiles

- Scenarios explore:
- Storage costs, Storage characteristics, Role of incentives, Tariff changes, etc.



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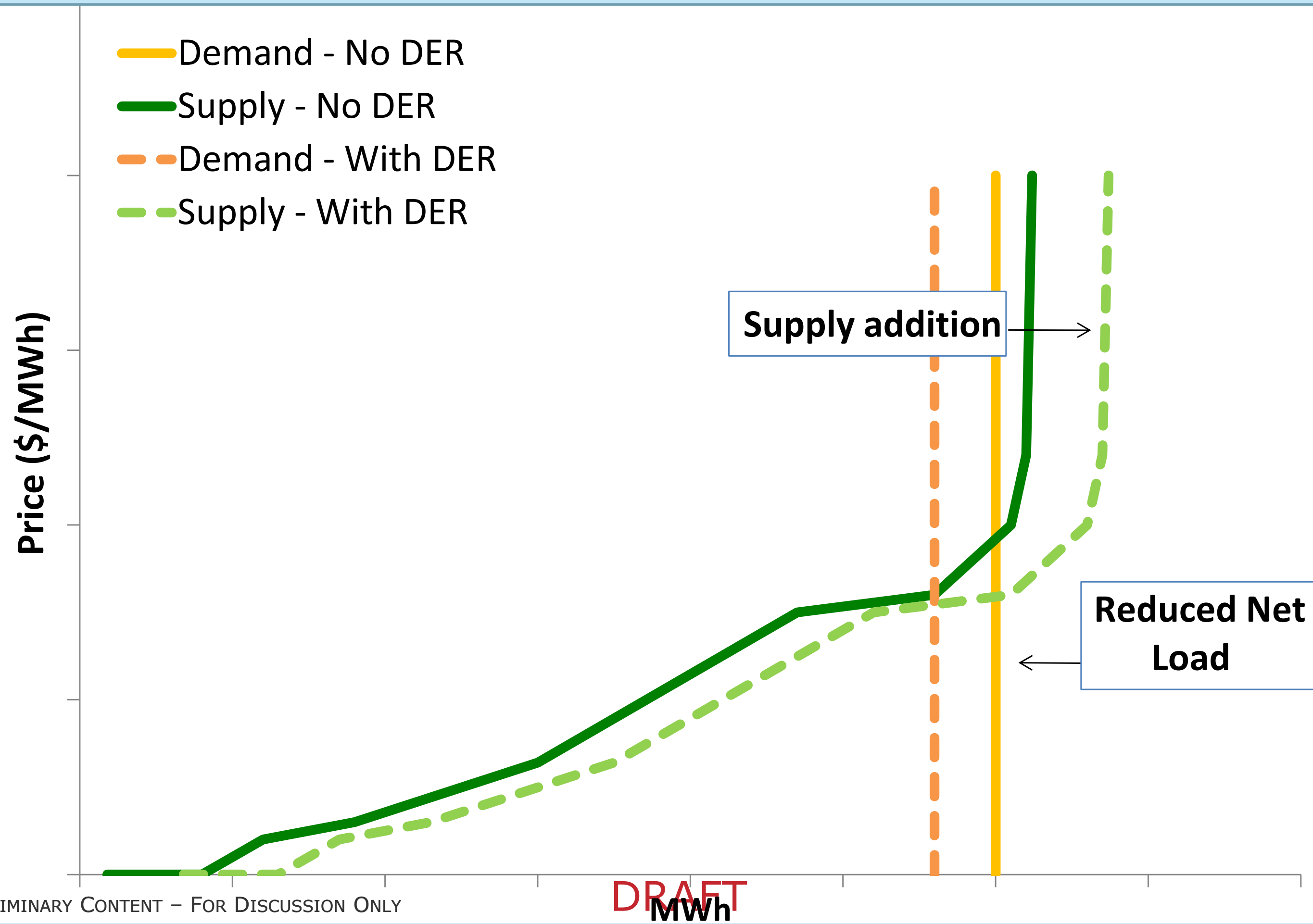
DERs – Looking at the Full Picture

Analysis & Identification of ISO/RTO Treatment of DERs

DERs can potentially reduce production costs by lowering net load or offering relatively low-cost supply.



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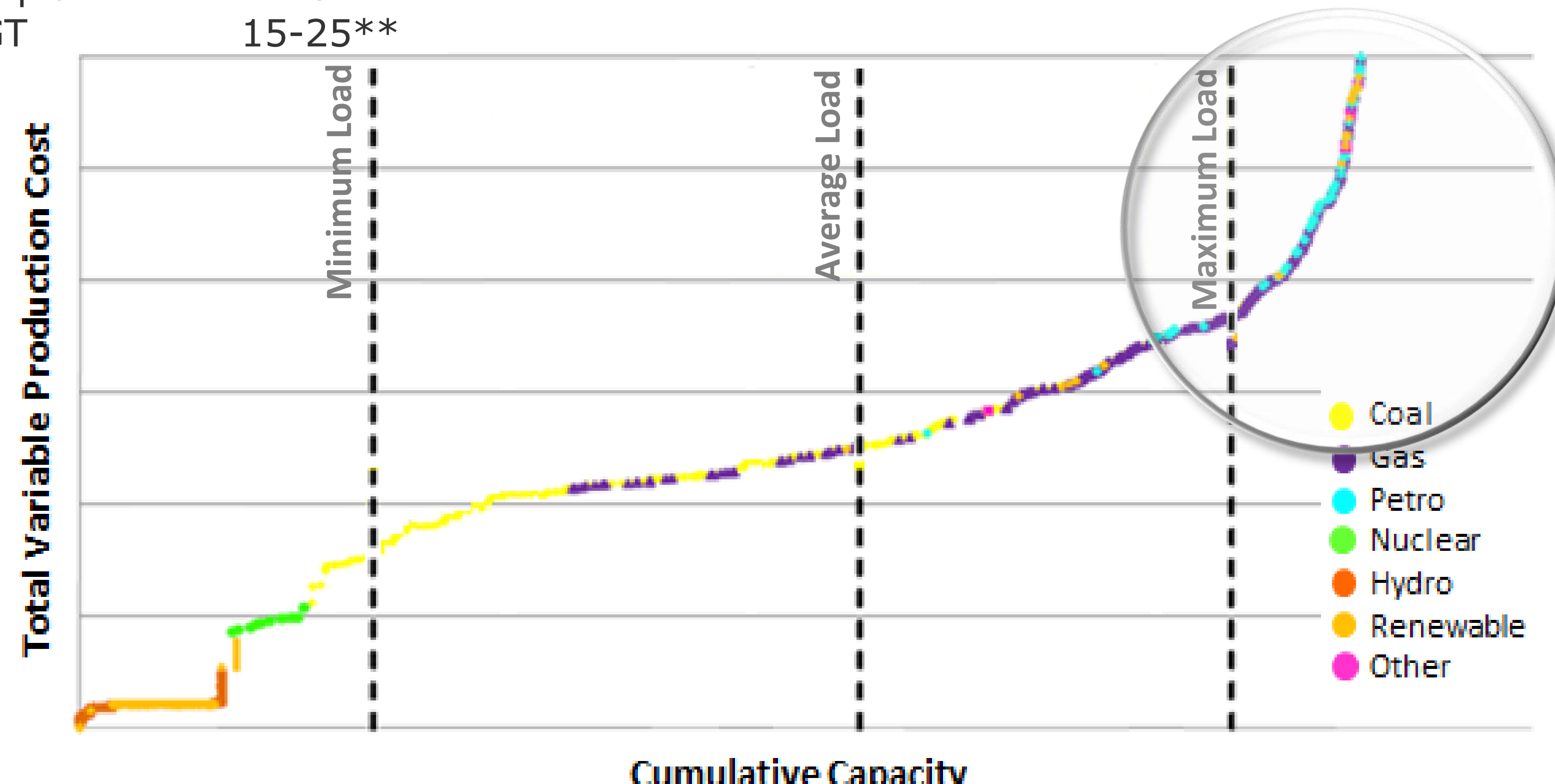
DERs – Looking at the Full Picture

Analysis & Identification of ISO/RTO Treatment of DERs

However, DERs also have the potential to affect demand for some centralized units with higher costs which also represent high flexibility assets.

Plant Type	Ramp Rate (MW/min)
Coal plant *	3
CCGT	15-25**



Source: Image adapted from Dynegy bondholder presentation, 2012.

* This does not represent a NYISO bid stack

Interconnection Policy
Analysis & Identification of ISO/RTO Treatment of DERs

- FERC has published guidelines for interconnection policy, but each ISO Tariff includes a unique process
- Depending on the size and complexity of the proposed resource, more lenient interconnection processes may exist
  - For example, CAISO provides a Fast Track Process for resources under 5 MW that takes around a year, an Independent Study process that takes around two years, and the standard requests in a Queue Cluster that take around three years.
  - By comparison, NYISO has a Large Generator Interconnection Process (>20MW), a Small GIP (between 2 and 20MW) and a Fast Track (<2MW)
- Distribution operators also have their own interconnection requirements, which vary by territory and often depend on unit size
- FERC Order 792 amends the pro formal Small Generator Interconnection Procedures (SGIP) to expand and accelerate the Fast Track procedure. NYISO is currently preparing a compliance filing to modify its SGIP.

Sources: California ISO Generator Interconnection Procedures Overview, New York ISO Large Generator Interconnection

Precedent for DERs in Wholesale Markets
Analysis & Identification of ISO/RTO Treatment of DERs

- *Many ISO/RTOs are not yet explicitly integrating DERs into their markets. However, there is precedent for use of non-generation assets in the market*
- **Limited Energy Resource Policies**
- PJM – Capacity Value for Storage Resources
  - PJM is considering two procedures for evaluating the capacity value of a storage resource; one based on the existing DR capacity model, and another based on Loss of Load Expectation
- CAISO – Regulation Energy Management
  - A new product that allows fast but energy limited resources to take advantage of their flexibility
- ERCOT – Wholesale Storage Load Settlement
  - Program that allows storage resources to pay wholesale prices when charging, rather than retail

  Applies to thermal storage as well as batteries, flywheels, compressed air, and hydro facilities

Precedent for DERs in Wholesale Markets
Analysis & Identification of ISO/RTO Treatment of DERs

- **Demand Response Products**
  - There are a variety of demand response products already available across the ISO/RTOs
  - The requirements for participation in each market varies from region to region

NYISO	Service Type	Minimum Size	Primary Driver
DA DR Program	Energy	1 MW	Economic
Demand Side AS Program	Reserve	1 MW	Economic
Demand Side AS Program	Regulation	1 MW	Economic
Emergency DR Program	Energy	100 kW	Reliability
Installed Capacity Special Case Resources (Energy Component)	Energy	100 kW	Reliability
Installed Capacity Special Case Resources (Capacity Component)	Capacity	100 kW	Reliability

PJM	Service Type	Minimum Size	Primary Driver
Economic Load Response	Energy	100 kW	Economic
Economic Load Response	Reserve	100 kW	Reliability
Economic Load Response	Regulation	100 kW	Reliability
Emergency Load Response - Energy Only	Energy	100 kW	Reliability
Full Emergency Load Response (Energy Component)	Energy	100 kW	Reliability
Full Emergency Load Response (Capacity Component)	Capacity	100 kW	Reliability

Source: DNV GL Baseline Consumption Methodology, Phase I Report.

Discussion Topics

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Aligning Interests

- Market rules, incentives and tariffs can align customer interests with grid interests
  - System benefits can be realized with grid operator management of DER integration, and customer adoption of DERs can be prompted by related incentives (operational, locational, etc.).

- Present structures, however, may not fully align grid and customer interests
  - Misalignment can lead to uncertainty and volatility of net loads.
  - There is also a tension between dropping sales volume and upward pressure on rates, but this can be addressed with alternative compensation methods for lost volume and DER integration costs.

→ Policy and regulatory structures will be key to aligning interests and maximizing benefits for all parties

Additional Observations

- There is large variation across DER types with regards to capabilities and costs, and suitability for DER adoption varies by geographic location and customer type.

- There is potential for DERs to affect customer energy consumption patterns, and the relationship of such changes on long-term capacity forecasts and, short-term energy forecasts.

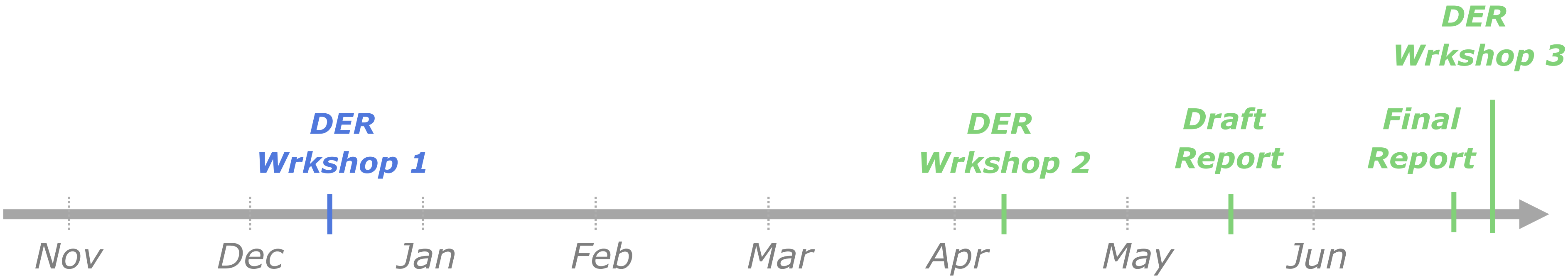
- DERs can also potentially impact costs and incentives for bulk generation.

Discussion Topics

1. Study Background
2. Draft Content
3. Findings to Date
4. **Next Steps**

Study Timing

- Workshop **December 2013**
- A ***presentation*** on the findings of the draft report on **April 4, 2014**
- ***Draft report*** in **mid May 2014**
- ***Comments back*** by **early June 2014**
- A ***final report*** by **end of June of 2014**
- A ***presentation to the NYISO's stakeholders*** on the findings in the final report during the **second quarter of 2014**



Next Steps

- Additional details on topics today
- Additional sample use cases
- More on telemetry & metering, emissions, interconnection, etc.

Jessica Harrison

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SAFER, SMARTER, GREENER

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Sample Case Input Summary – Common Area with PV & Storage

Retail Rates, Regulations and Incentives

Facility inputs

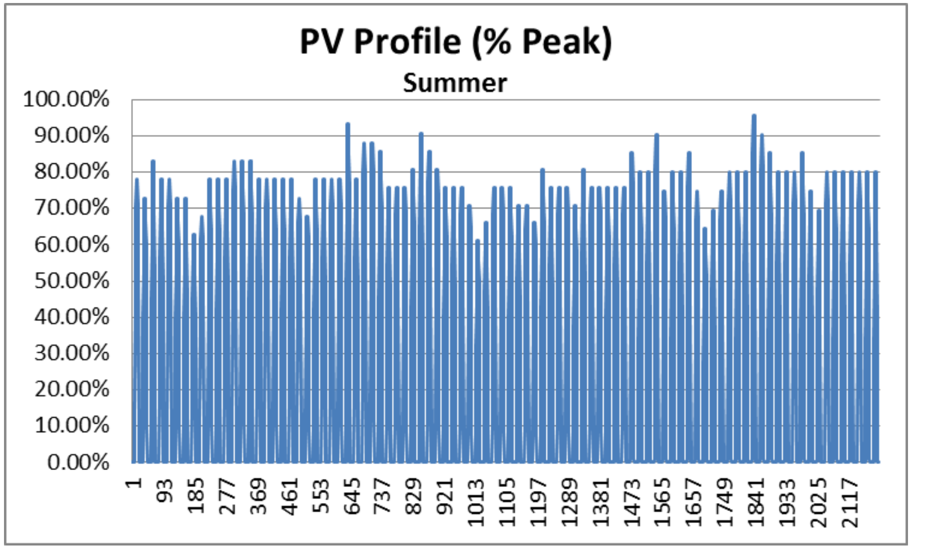
Parameter	Unit	Value
Peak Demand (2013)	kW	22.5
Capacity factor of PV (without derating or losses	%	23.92%

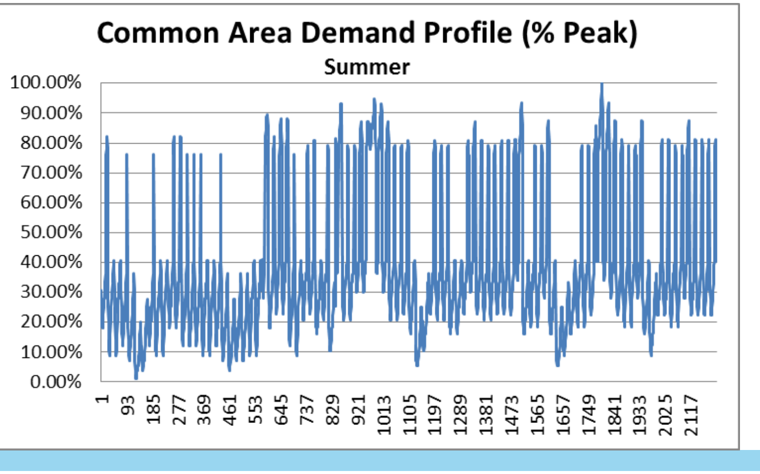
Storage & PV technology parameters

Parameter	Unit	Value
Storage technology	—	High energy Li-Ion
Rated power	KW	5
Discharge duration at rated power	hours	2
Round trip storage & inverter efficiency	%	87.0%, 94.0%
Installed capacity of PV	kW	50
Accelerated depreciation term for solar PV	years	5

Technology cost and investment financial parameters

Parameter	Unit	Value		
		Low	Med	High
Installed cost of storage	2013 $/KW	3, 000	3, 500	4, 500
Storage system O&M cost	2013 $/KW	$20		
PV Installation cost (full cost)	2013 $/KW	$5,440		
PV Installation cost (only panels)	2013 $/KW	$3,260		
PV O&M cost	2013 $/KW	25		
Cost of debt	%	7.49%		
Federal income tax rate	%	35%		
Direct rebate on storage	2013 $/KW	1800		
Direct rebate on solar PV	2013 $/KW	350		
Income tax rebate on solar PV	%	30%		
Income tax rebate on storage	%	22.50%		





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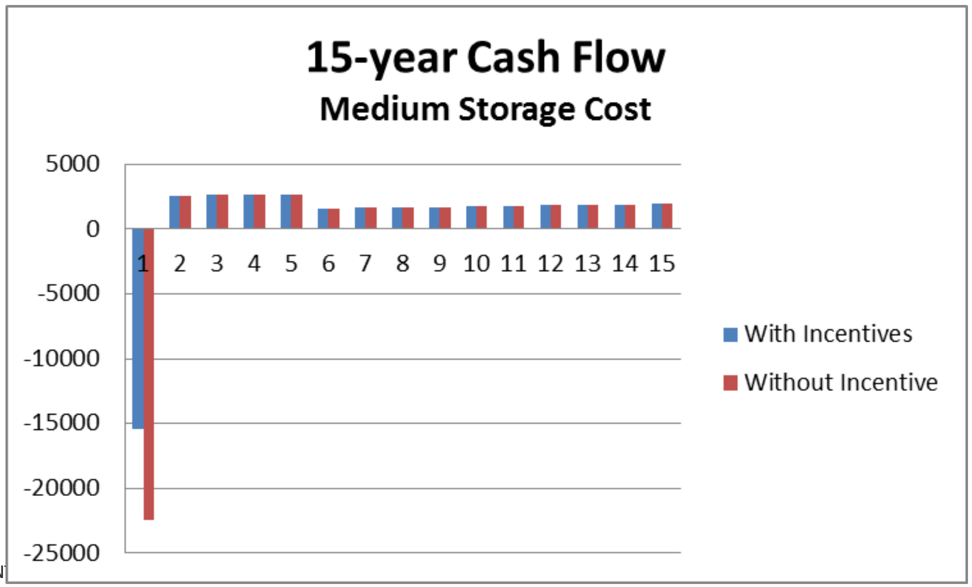
Sample Case Results Summary – Common Area with PV & Storage

Retail Rates, Regulations and Incentives

Sc #	Scenario Characteristics				Installation			Incentives					Financial Results	
	Configuration	Customer type	Primary function	Storage cost ($/KW)	Facility Peak Demand	Installed Storage (KW, KWhr)	Installed PV	Storage Direct Rebate	Solar Direct Rebate	Income Tax Credit		MACRS*	IRR	NPV
										PV	Storage			
1	Storage and Solar PV dc-coupled	Common area meter of multi-family residence	Demand and energy charge reduction	Low - $3000/KW	22.5	5 KW, 10 KWhr	5 KW	YES	YES	YES	YES	YES	13.12%	$3,702
				Med - $3500/KW									10.24%	$2,025
				High - $/4500/KW									5.99%	($1,329)
2				Low - $3000/KW				NO	NO	YES	YES	YES	4.97%	($2,346)
				Med - $3500/KW									3.47%	($4,023)
				High - $/4500/KW									1.01%	($7,377)



***MACRS**: Modified Accelerated Cost Recovery System: The new accelerated cost recovery system which allows for greater accelerated depreciation over longer time periods. Applicable to renewable generation assets.

PRELIMINARY CONTEN