

# Aggregating Distributed Generators

## DOE DPP & Industrial DG Annual Review Meeting

*January 29-30, 2002*

*NREL Subcontract AAD-1-30605-08*

*NREL Technical Monitor: Ben Kroposki*

*Principle Investigator: Howard Feibus*



A WPT Company



# *Project Goals*

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- To demonstrate the aggregation of backup generators by adding controls to make them immediately dispatchable from a single control point when required to provide spinning reserve, interruptible load and peak power to the utility grid.
- This supports DOE Office of Power Technologies' goal and vision for full-value distributed generation captured in an electric market in which consumers can sell power, employ load management, and provide support services in an automated and adaptive electric power system.

# *Project Objectives*

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- Base Year: Develop monitoring/controls; conduct feasibility analyses, design Field Test and survey backup generators in LIPA territory.
- Option Year 1: Develop, Install and Conduct Field Test; Develop Commercial Design.
- Option Year 2: Procure, Install and Operate a 30 MW commercial aggregation/dispatch service.

# **Statement of Work- *Base Year***

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- **Survey of Backup Units in Nassau and Suffolk Counties and Recruitment of Four Participants**
- **Design of Controls, Monitoring Equipment, and Communications Needed for Backup Units**
- **Develop Backup Generator Connections and Controls**
- **Conduct Analysis of Costs, Benefits and Market Opportunities for the Dispatch System**
- **Design of Field Test with Four Participants**

## ***Backup Gen Capacity (BUG) on LI***

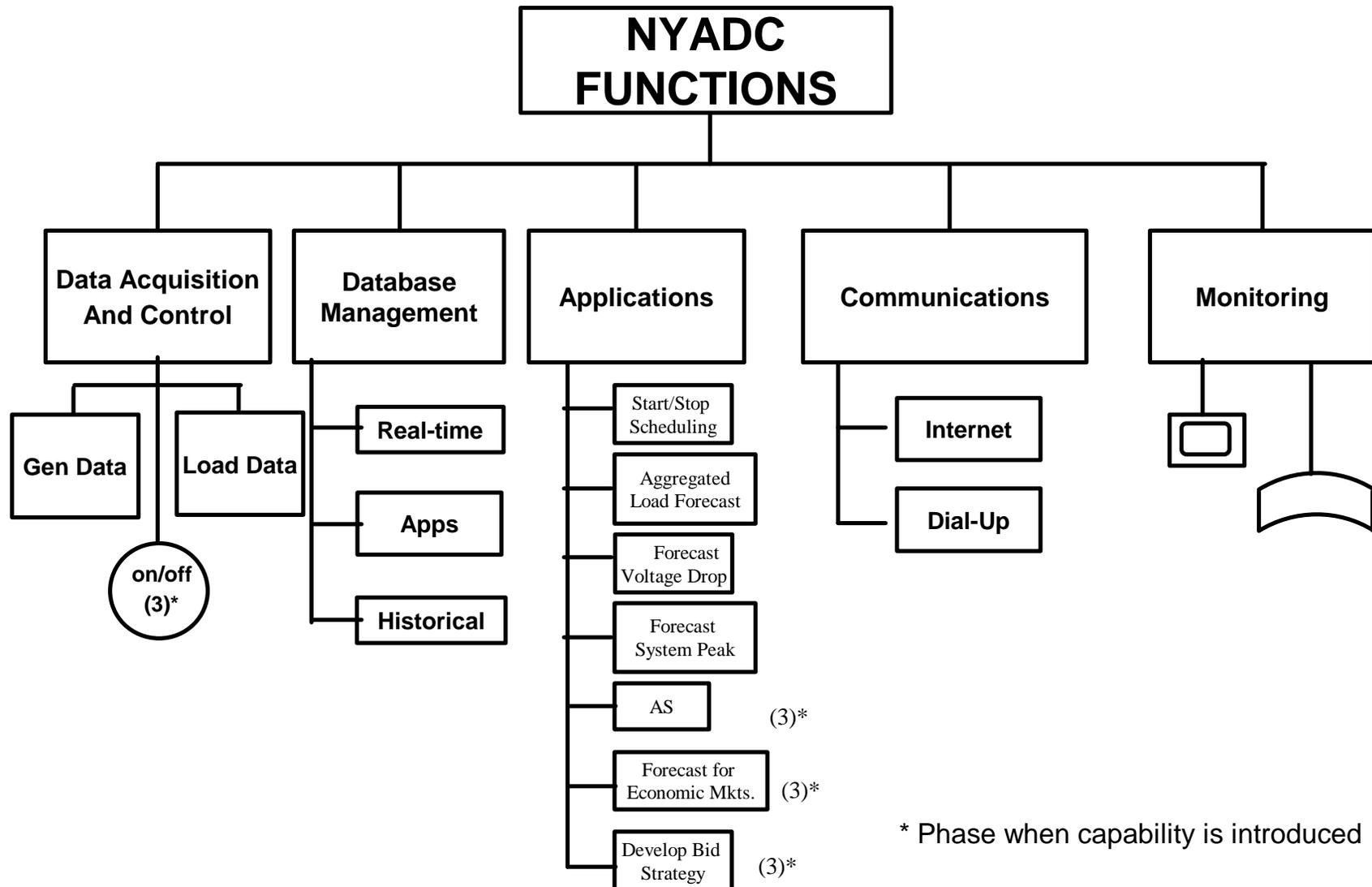
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<b>Org</b>	<b>BUG Cap (MW)</b>	<b>Demand (MW)</b>
Verizon	30	16
Brookhaven NL	8	8*
FE/RC	12	12
LIPA	200	100
Hospitals	25	50
Hotels/Motels	80	50
Universities	60	30
Data Centers (CA)	80	50
Reuters	2	2
County Governments	12	8
<b>Total</b>	<b>509</b>	<b>326</b>

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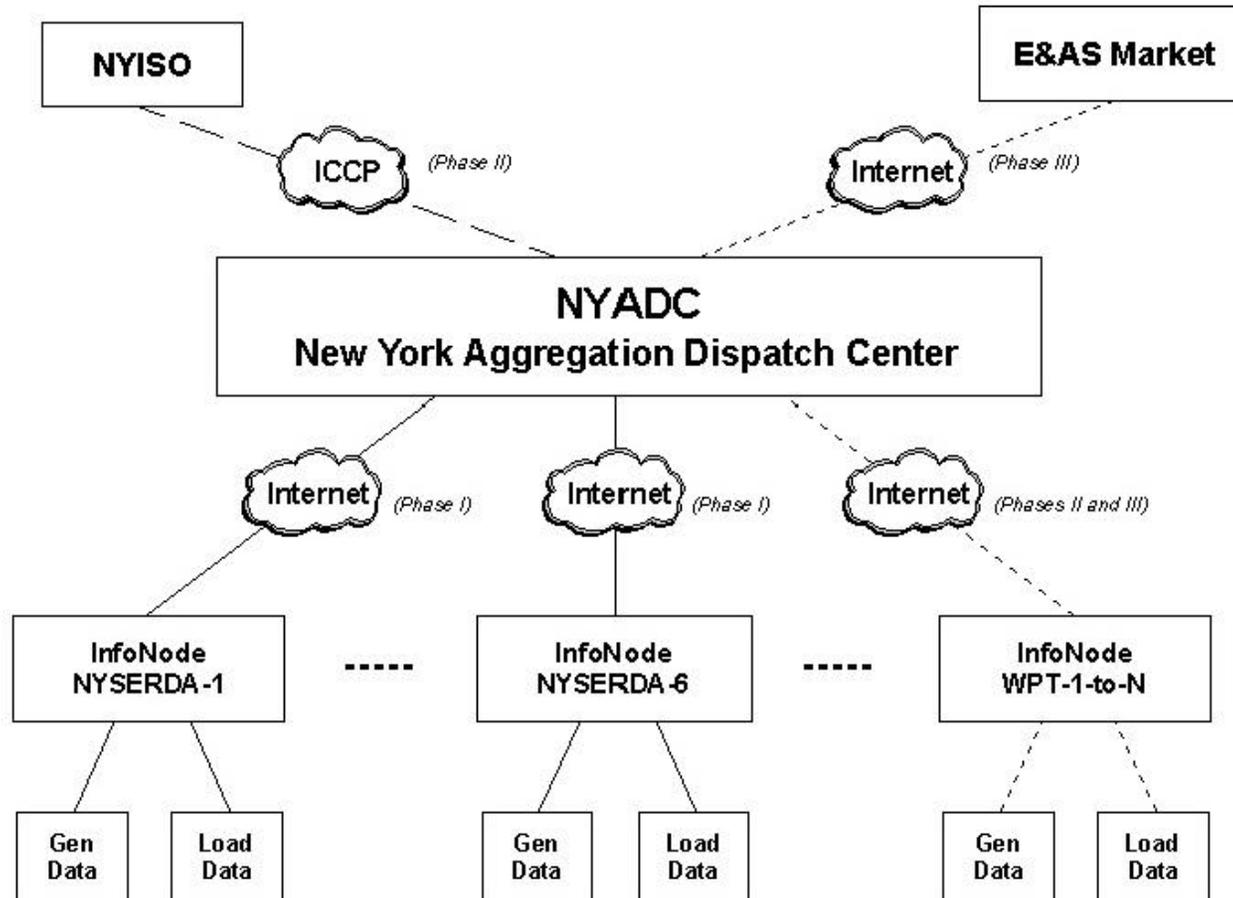
# Design Specifications

## New York Satellite Aggregation Center Functional Architecture



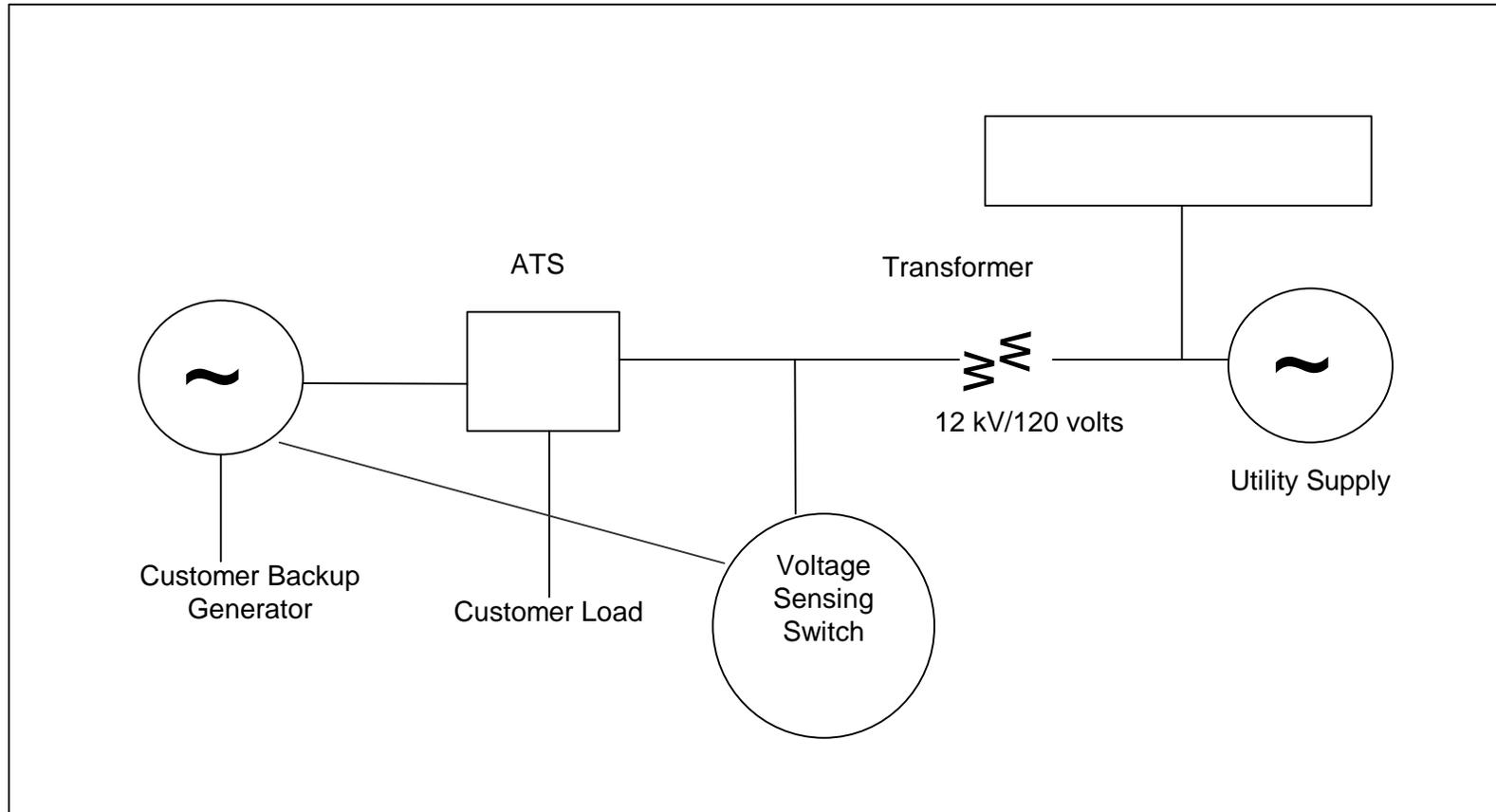
# New York Aggregation Dispatch Center

## Conceptual Architecture

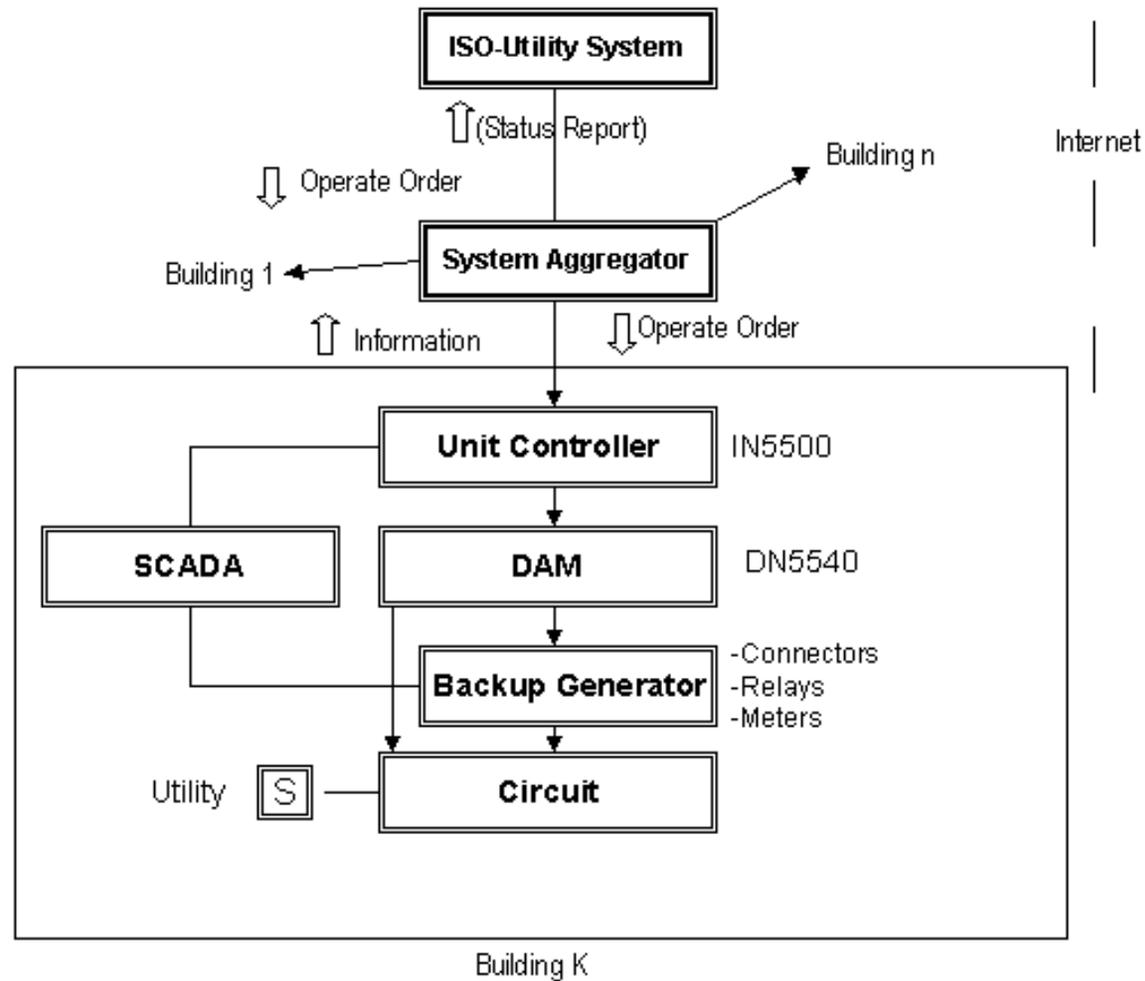


# Backup Generator Connections and Controls

## Typical Backup Generator Installation

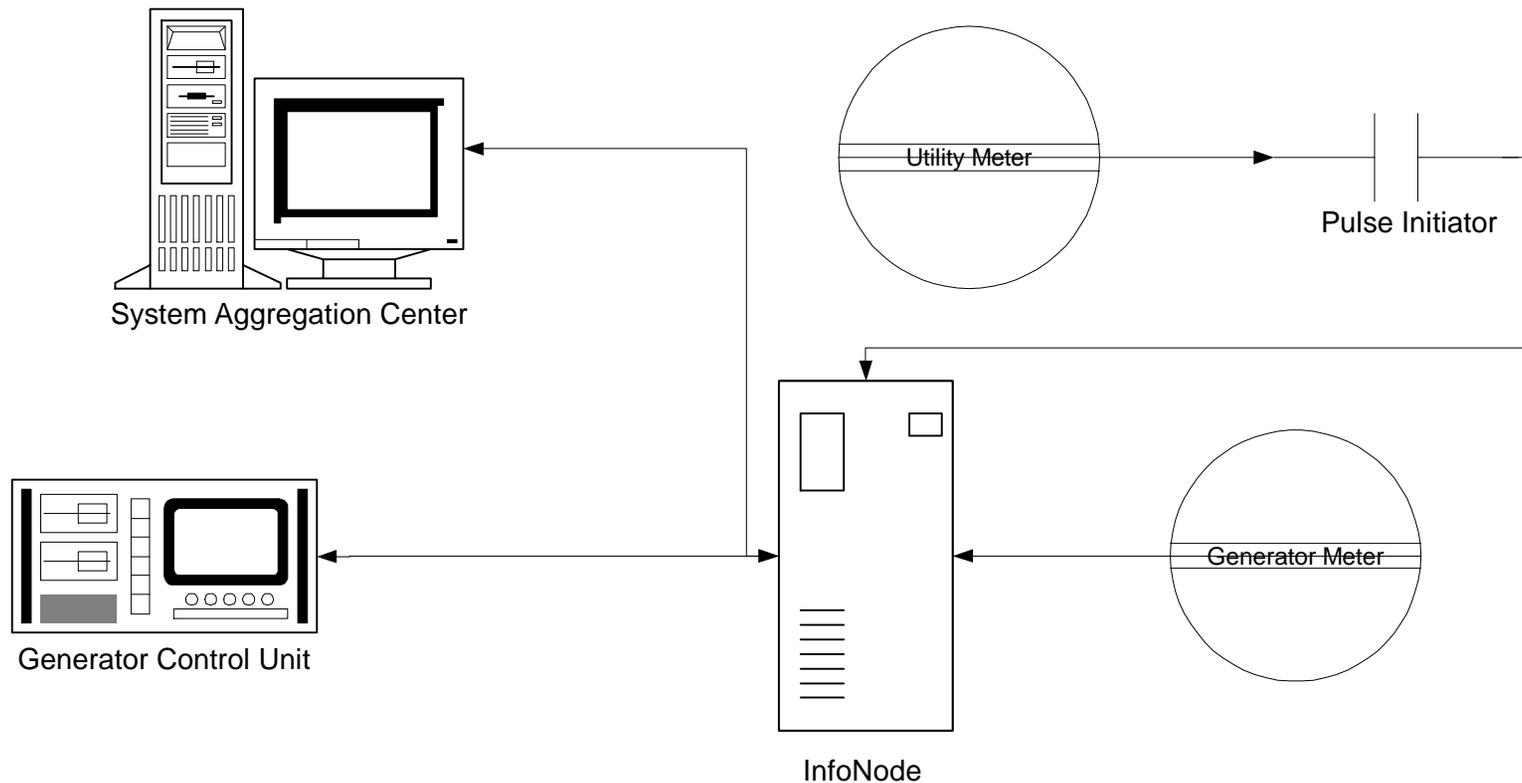


# Local Monitor / Control Equipment



# On-Site Metering/Communications/Control

Figure 3-2  
On-Site Metering/Communications Configuration



## *Incremental Costs of Utility Interconnection Requirements for BNL Generator in Building 604*

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Equipment/Service Costs	LIPA Interconnection Requirements	BNL Interconnection
1 Signature System Controls	\$4,500	\$4,500
2 LIPA Approved Metering Package	\$3,500	\$3,500
3 Generator governor and voltage regulator modifications	\$5,600	\$5,600
4 Equipment testing	\$2,000	\$2,000
5 Startup and commissioning of equipment by factory technician.	\$2,500	\$2,500
6 Engineering package	\$35,000	\$10,000
7 Contingency (Optional installation of directional current relay)	\$6,500	\$6,500
8 480V breaker modifications	\$15,500	
9 LIPA RTU for generator control	\$25,000	
<b>Totals</b>	<b>\$100,100</b>	<b>\$34,600</b>

# Interconnection Requirements

	LIPA Int. Requirements		"BNL" Int. Requirements	
	New Equipment Required		New Equipment Required	
	Material	Installation	Material	Installation
Signature System Controls	\$4,500		\$4,500	
LIPA approved metering package	\$3,500		\$3,500	
Hathaway RTU	\$25,000			
Interconnect relay cabinet	\$40,000	\$10,200	\$40,000	\$10,200
15 KV, 600 amp, substation type vacuum circuit breaker	\$22,000	\$12,000	\$22,000	\$12,000
15 KV, 600 amp, 3-pole load interrupted switch mounted on a NEMA 3R outdoor enclosure	\$13,000	\$5,500	\$13,000	\$5,500
1500 KVA, 3 phase, 60 Hz, 13.8 KV/480 volt wye/delta pad mount type transformer	\$15,000	\$12,000		
10 KVA, 1 phase, 60 Hz, 480/120-240 V grounding transformer	\$1,100	\$700		
Potential transformer(s), 13.8 KV/120 V, outdoor type	\$5,300	\$3,000		
Current transformer(s), 15 KV rated outdoor type	\$6,400	\$3,000		
Lightning arrestors for grounded 13.8 KV system	\$1,200	\$1,000		
Station ground mat	\$4,000	\$10,000		
Security fencing with equipment and gates		\$9,000		
Station battery	\$6,100			
Concrete foundations		\$22,500		
Engineering package	\$35,000		\$10,000	
<b>SubTotal</b>	<b>\$182,100</b>	<b>\$88,900</b>	<b>\$93,000</b>	<b>\$27,700</b>
<b>Total</b>		<b>\$271,000</b>		<b>\$120,700</b>

# *Design Field Test*

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- Technical design for isolated and parallel operation:
  - \* Monitoring/aggregation; Interconnection; Protection; Communication; Controls
- “Rules of engagement”:
  - \* Permitting; Marketing capacity /energy; Labor issues;

# *Design Field Test*

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- **Brentwood/Hicksville/Smithtown**; isolated operation to support distribution system.
- **Brookhaven**; Inter-connected operation, within BNL distribution planning area.
- **Verizon/System Resource**; multiple office operation; aggregate loads & aggregate DG units; participate in wholesale markets; support transmission system.

# *System Resource (SR)\**

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## Long Island

Hempstead

Bayshore

Sag Harbor

Huntington

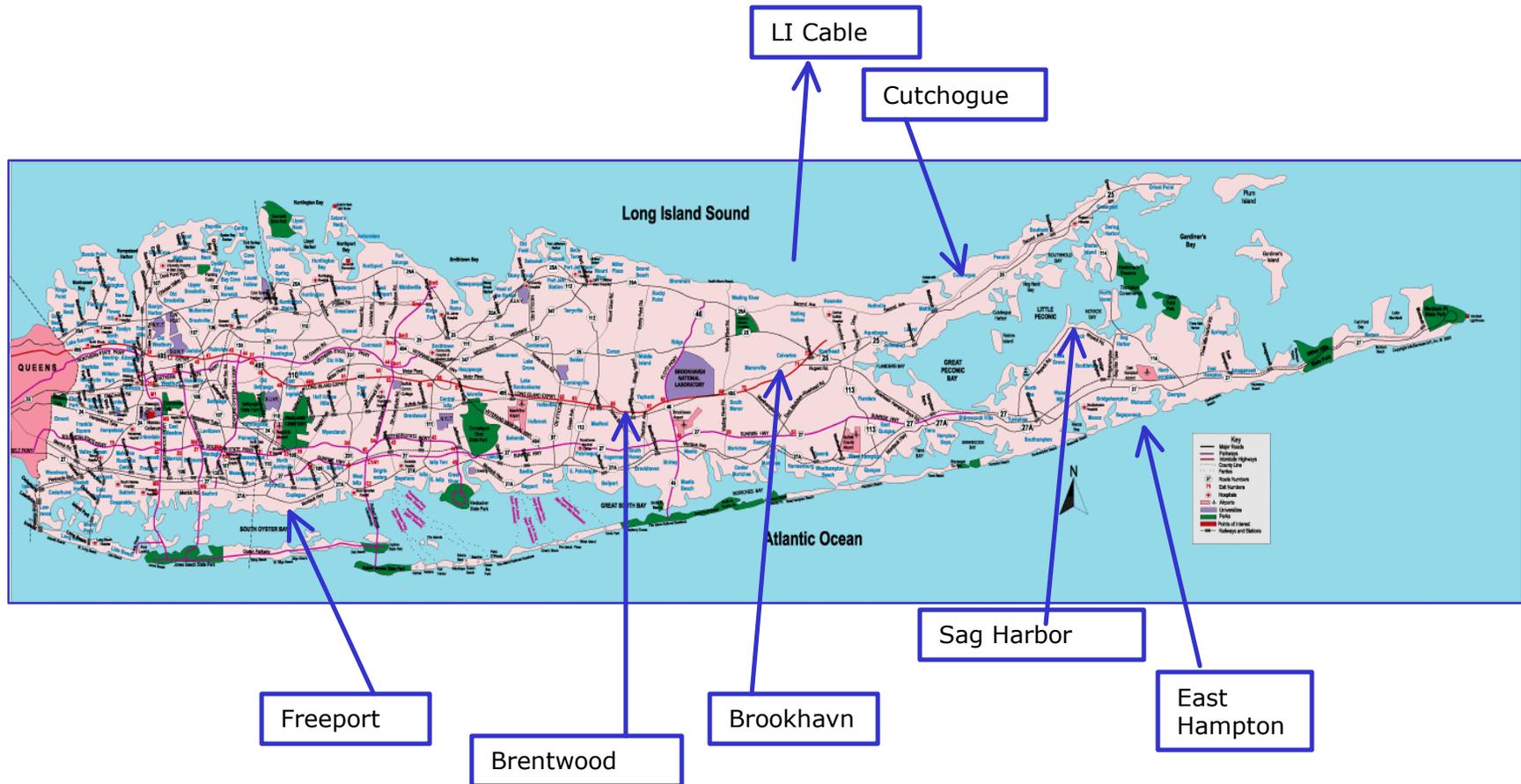
Roslyn

Cutchogue

East Hampton

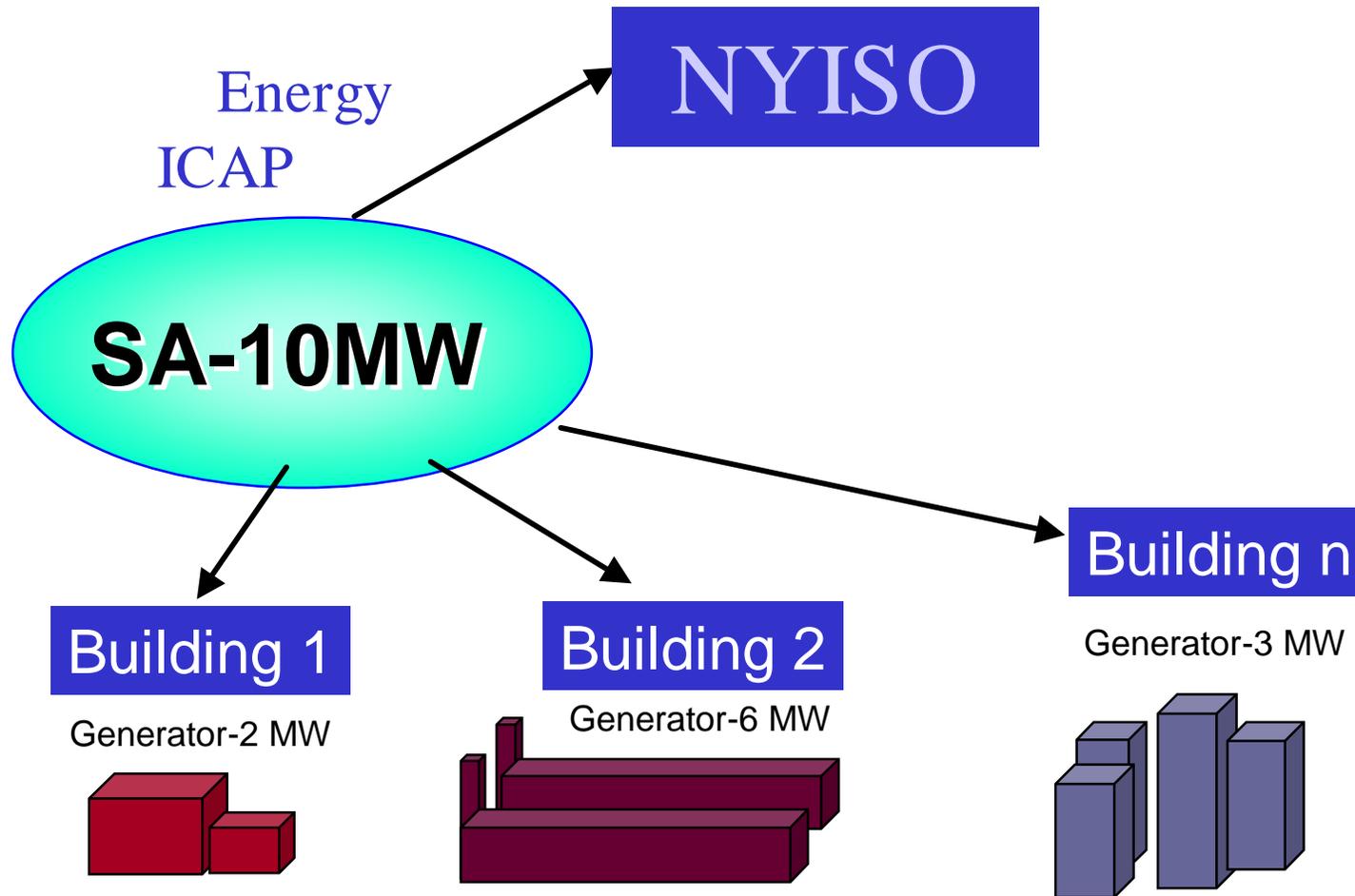
\* SR is a collection of dispersed DG units, normally not recognized by the NYISO. SR is treated by the NYISO as a virtual power plant (VPP); that is, it is recognized and characterized as any single large generator that is participating in the competitive generation markets.

# Locating Participating DG Installations



# Managing SR

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# Benefits Analysis

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- Today,

$$\text{Coe} = 0.4 \times \$35/\text{MWH} + 0.05 \times \$350/\text{MWH} + 0.55 \times \$50/\text{MWH} + \$25/\text{MWH}(\text{ICAP}) + \text{Insurance} + \text{delivery}$$

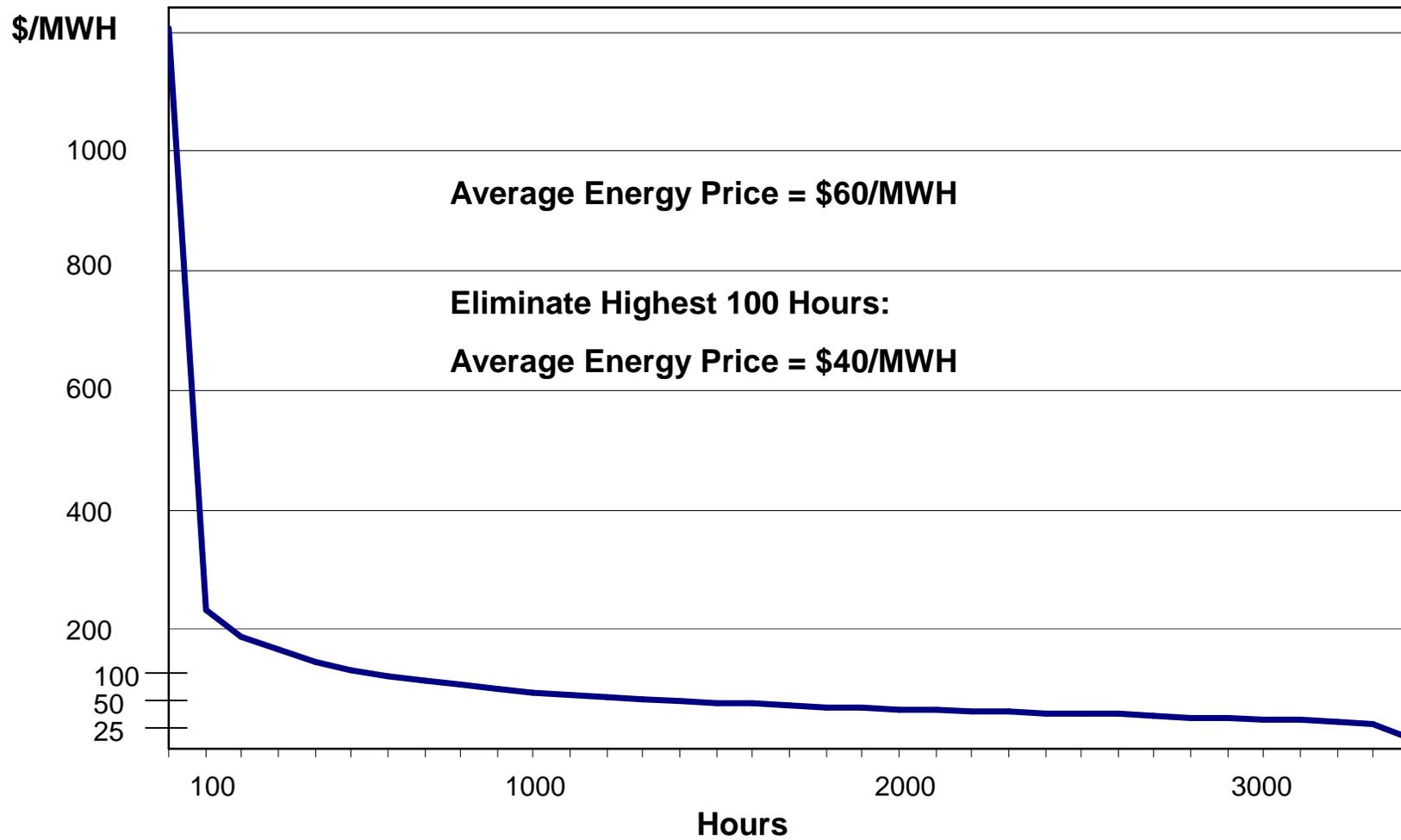
$$\text{COE} = \$ 84/\text{MWH} + \text{delivery}$$

- To be demonstrated in field test,

$$\text{Coe} = 0.4 \times \$35/\text{MWH} + 0.55 \times \$50/\text{MWH} + 0.9 \times \text{delivery}$$

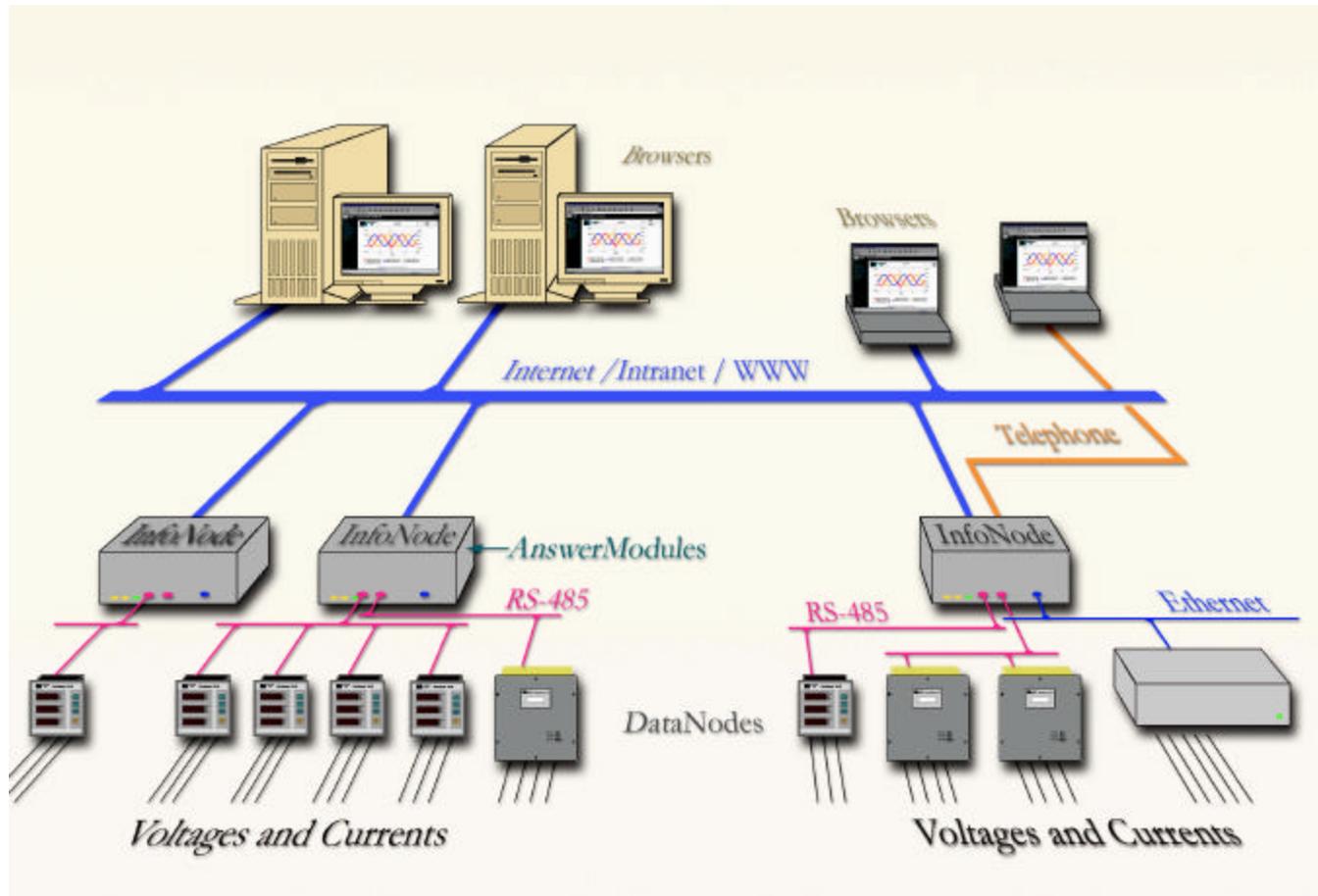
$$\text{Coe} = \$ 42/\text{MWH} + 0.9 \text{ delivery}$$

# Benefits Analysis



# Signature System Architecture

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# ***SUMMARY***

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- **Project has been approved for Option year 1; conduct field test.**
- **Field Test is scheduled to begin May 2002.**

# Locating Where Voltage Drop is High

