End Use Energy Storage and Renewable Integration

PLMA
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Hypothesis

End-use controllable loads with thermal/chemical storage can provide :

- intra-hour load following (System Operator),
- load shifting, and demand reduction (Utility).

Results

1. Understand drivers and DR alternatives for renewable integration
2. Residential - program and install costs high
3. C&I – Refrigeration, HVAC, water mgmt good choices
4. Control systems can AutoDR direct to operator
5. Program design should allow flexibility of load capabilities

PNW DR Needs

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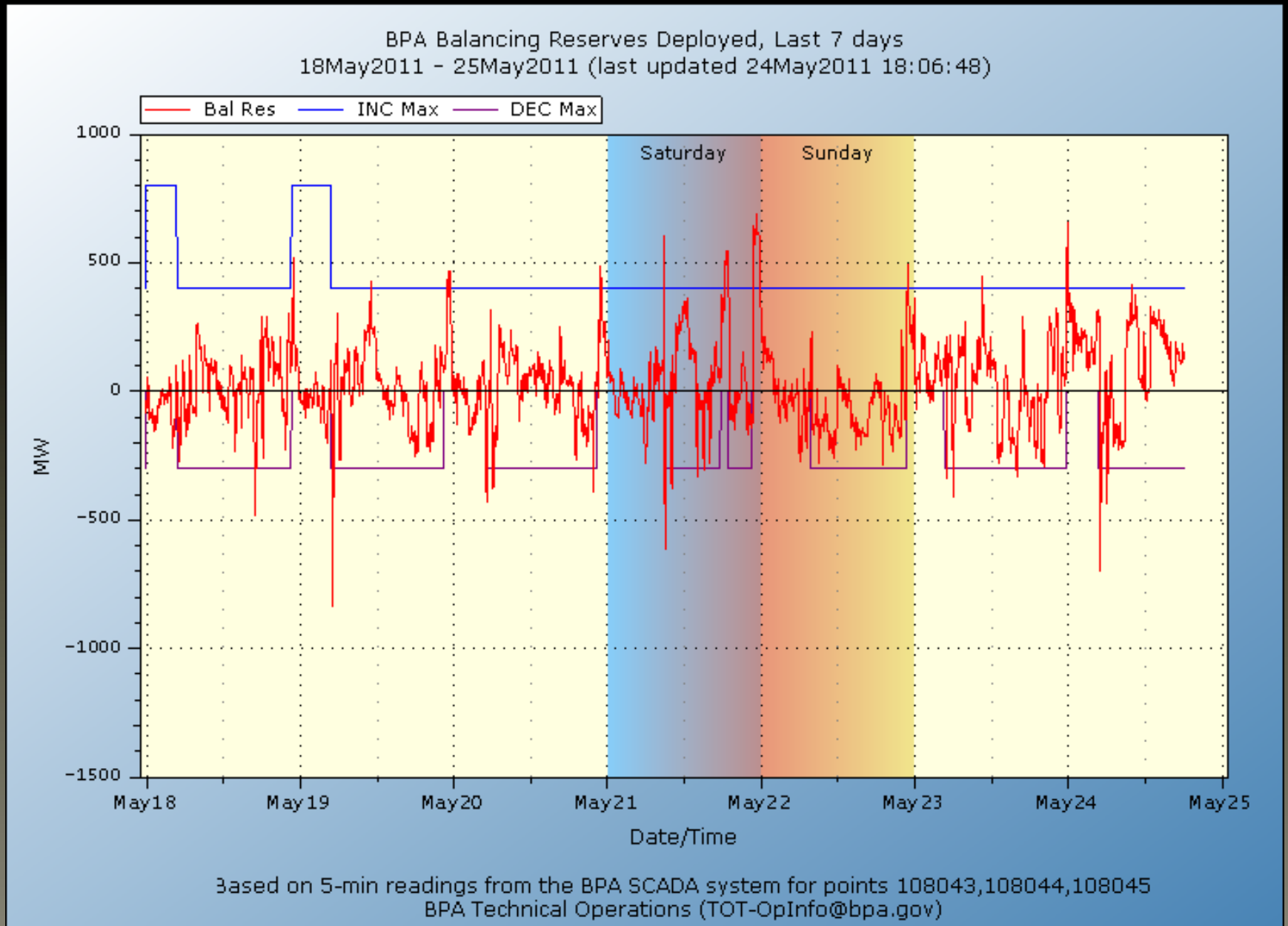

Alternatives

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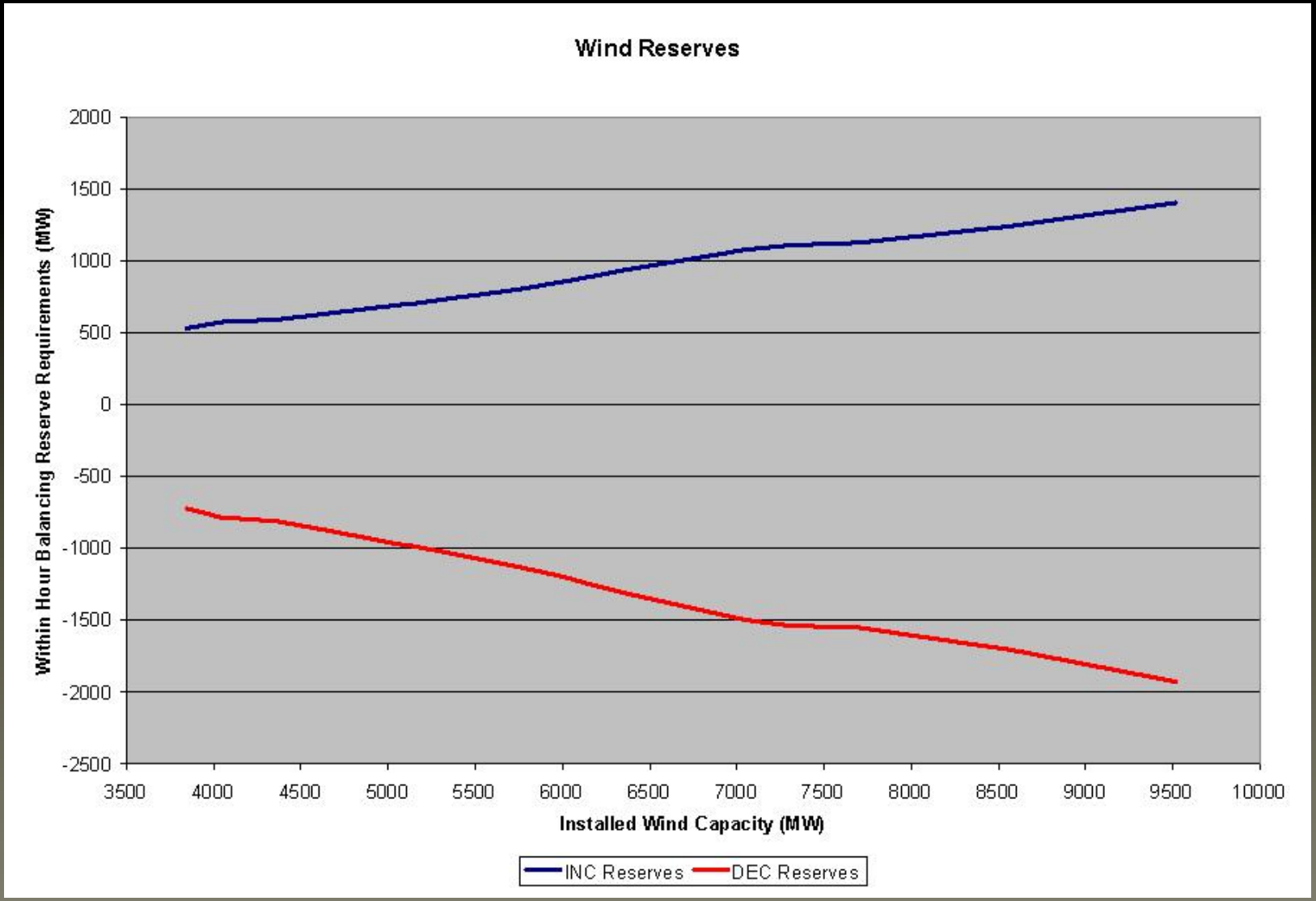
1. Improved wind forecasting
2. Intra-hour scheduling
3. Wind integration Self Supply Pilot >> buying hydro reserves
4. NW Power Pool Combined Reserve Task Force
5. Third party supplied balancing reserves
6. WSPP Ancillary Service Schedule Filing
7. WECC Energy Imbalance Market (EIM)
8. Dynamic Transfer Capability Study Group
9. Shut down 1,1150 MW Nuclear plant every spring
10. SmartGrid/Demand Response

* Wind Energy Task Force 6/6/11

Balancing Reserve Forecast



Residential

Steffes controller on 105 gal. water heater with a mixing valve.

26 kWh cost $2,000, $77/kWh

Car Battery 1 kWH, $100

$100/kWh

EV Car Battery

24 kWH $9,500

$395/kWh

Carina controller – on existing 50 gallon

13 kWh $500

$38/kWh

ETS Furnace "Rock Box"

240 kWh $6,000

$26/kWh

Steffes

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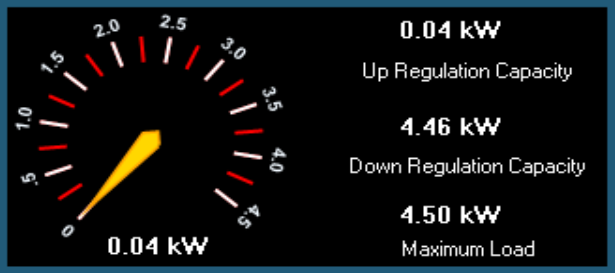
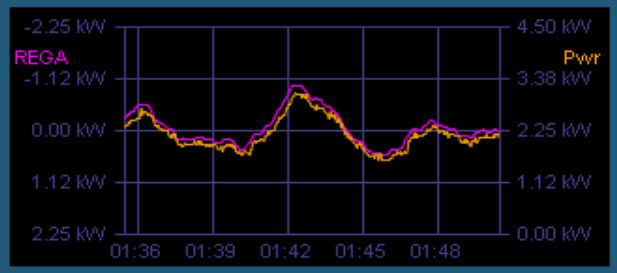
STEFFES CORPORATION

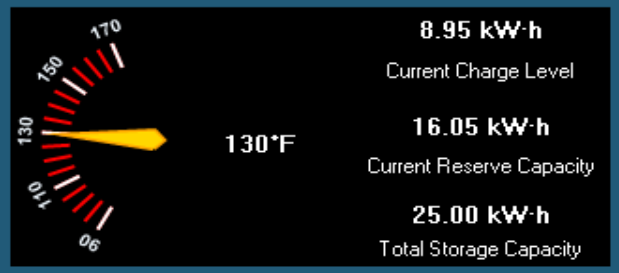
Grid Interactive Heater Control

Enhance reliability, Reduce cost, and Protect the Environment for Everyone

BPA



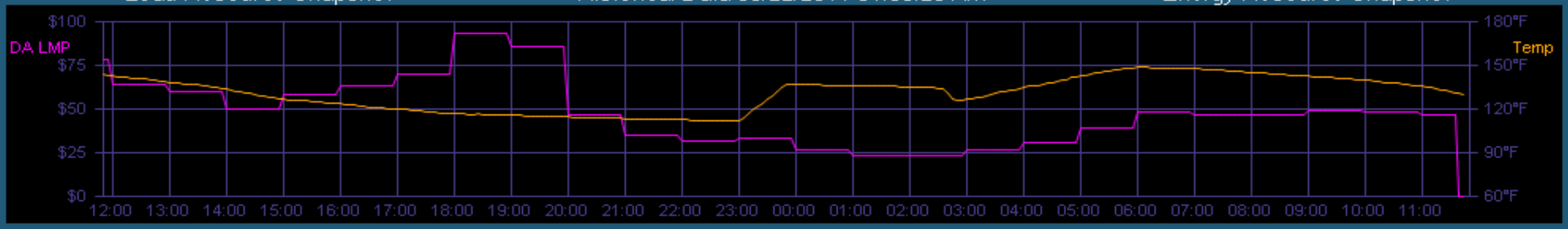


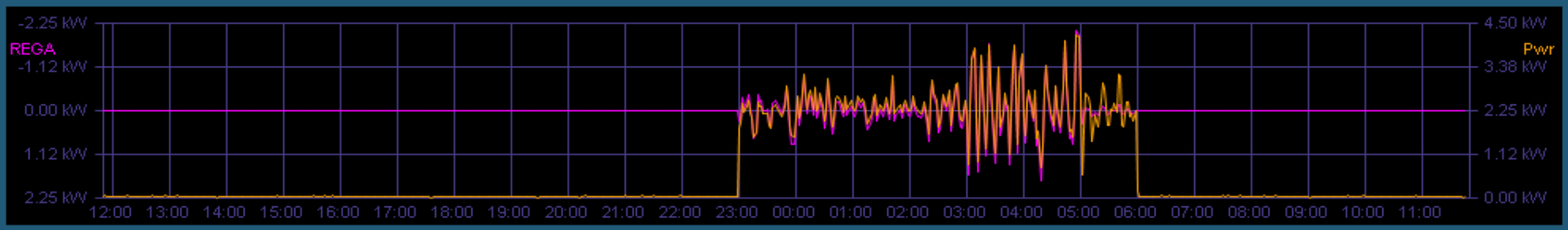


Load Resource Snapshot

Historical Data 03/22/2011 01:50:29 AM

Energy Resource Snapshot





Technology Cost

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	Device	Manufacturer	Energy Storage	Charging Capacity	Notes	Device Cost	Storage Cost	Capacity Cost
			(kWh)	(kW)		$	$/kWh	$/kW
Residential								
	Car Battery	Lead Acid	1	1		$100	$100.00	$100
	EV Cars	Nissan Leaf	24	3.3	1	$9,500	$395.83	$2,879
	Hot Water Heater	Steffes controls on a 105 gal Marathon tank	26	4.5	2	$1,500	$57.69	$333
		Steffes on 50 gall	13	4.5		$750	$57.69	$167
		Carina	13	1.9		$300	$23.08	$158
	ETS Furnaces	**Steffes Model #**	**240 V**					
	Room heating	2105	33.75	7.5		$1,988	$58.90	$265
	Forced Air	4120	120	19.2		$4,312	$35.93	$225
	Hydronic	5140	240	42		$6,165	$25.69	$147
Commercial								
	Cold Storage	new	2,190,000	250		$140,000	$0.06	$560
	Cold Storage	upgrade	2,190,000	250		$30,000	$0.01	$120
Supply Side								
	Keys Pumped Storage	INC		314,000		$300,000,000		$151 to $489
		DEC		614,000		$300,000,000		$151 to $489
	SCCT	PGE IRP						$1,200

OpenADR Cold Storage

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Balancing Authority (BPA)

1

Application Programming Interface

2

DRAS

DRBizNet

5

OpenADR over Internet

6

Operation agreement

$

3

Application Programming Interface

4

IC Systems

INDUSTRIAL INTERNET CONNECTIVITY SYSTEMS

Modbus/ RTU

7

8

Utility

Forest Grove

$

Operation agreement

Henningsen

LOGIX

HECO Fast DR Event Frequency & Duration

- Program will be called no more than:
  - 2 hours per event
  - 40 events per year
  - 80 total hours per year
  - Weekdays only
    - Excluding holidays
- Events may be called anytime between 7am - 9pm, year round
- Consistent underperformance can result in adjusted enrollment levels or suspension from program

Conclusions

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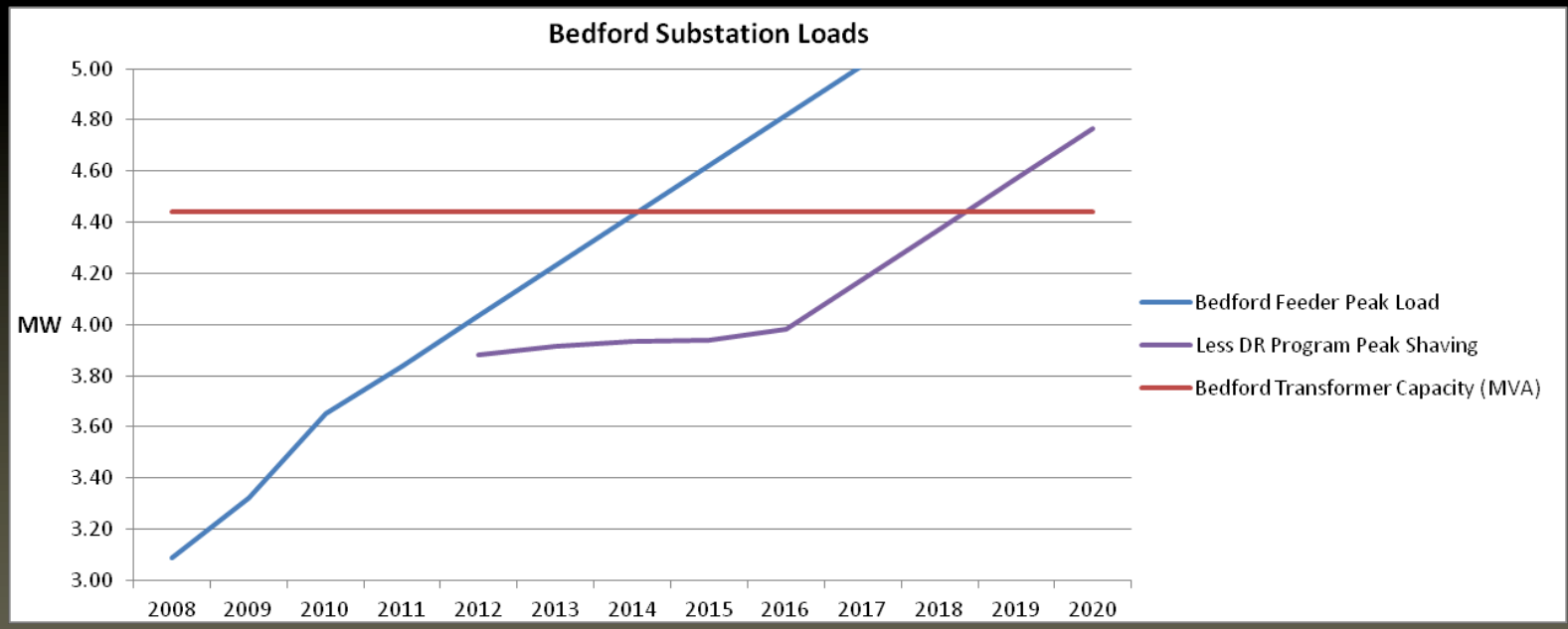
1. Understand alternatives for FastDR and DR for renewable integration
2. Residential – retrofits –NO, New – develop standards and vendors
3. C&I – Refrigeration, HVAC, water mgmt good choices
4. Control systems AutoDR direct to DRAS
5. Program design should allow flexibility of load capabilities

Defer T&D

- NPV of deferring purchase of transformer by 5 years is $135,000, even when DR program has negative NPV



- NPV Program = NPV Deferral + NPV DR costs&benefits
- $135,000 = $152,000 + (-$17,000)