



June 16, 2015

Future Operating and Maintenance Considerations for Existing Coal-Fired Power Plants

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on behalf of

NETL's Strategic Energy Analysis & Planning Division



Disclaimer

The analysis presented and conclusions drawn herein represent solely those views of the authors, and do not represent the views of the United States Department of Energy.

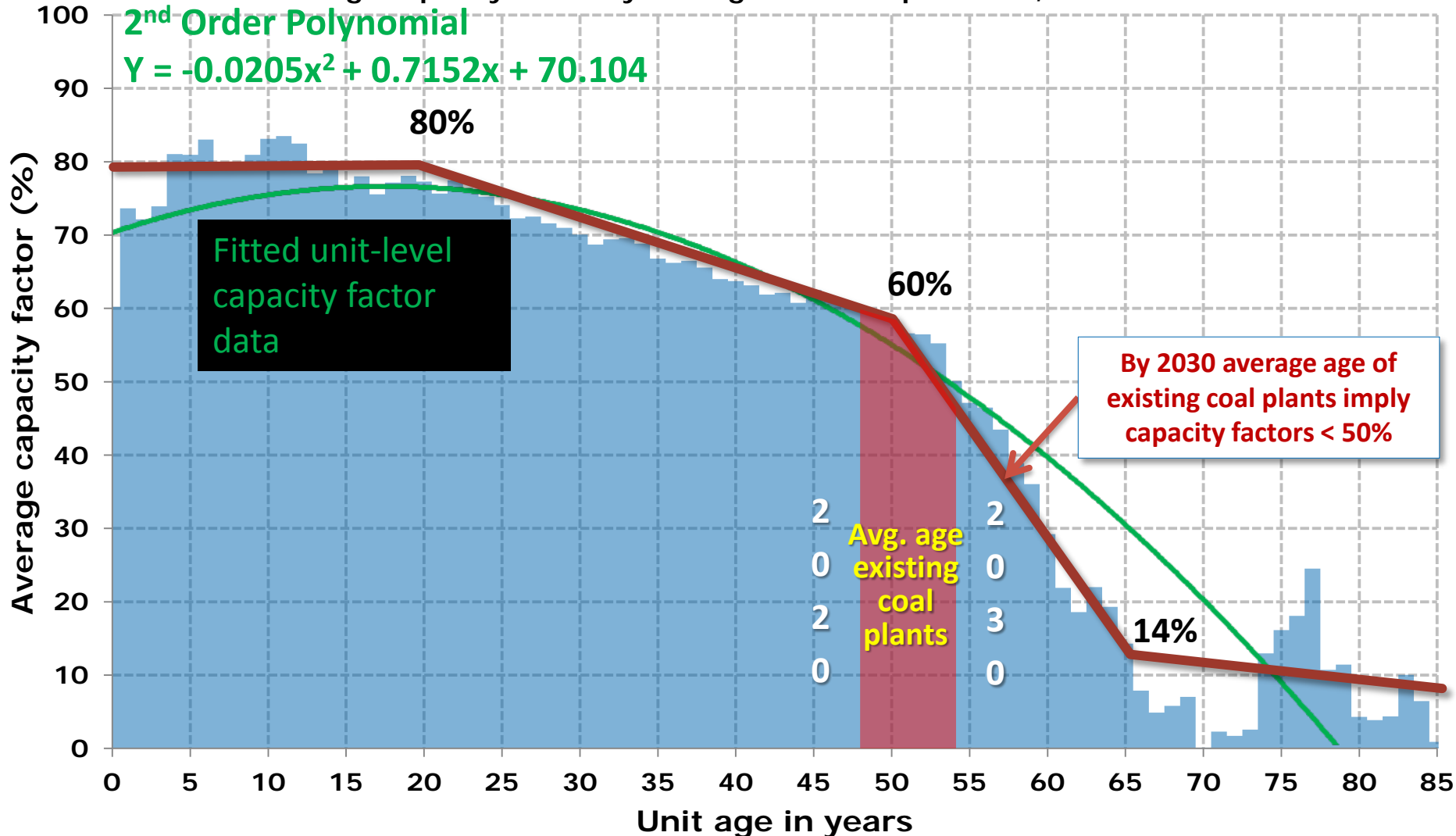
Key Areas of Discussion

- 1. EIA's \$17/kW/year (for capital upgrades) close to NETL estimate, but these investments tend to be “lumpy” instead of a charge applied annually**
- 2. Due to age of existing coal fleet, these major upgrades should be happening now if high CF's are expected**
- 3. New NETL study quantifies the cost associated with cycling existing coal units**

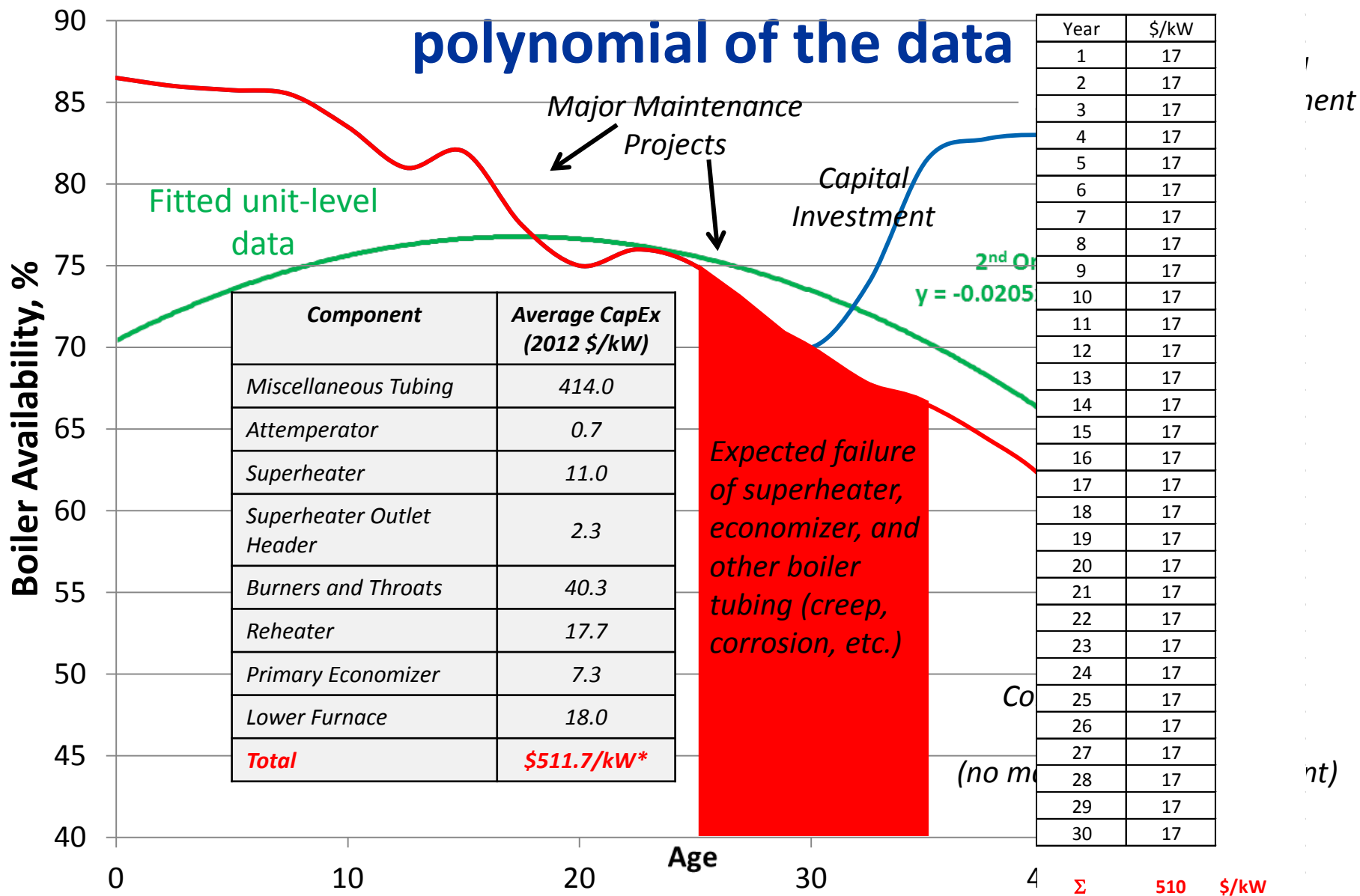
Examining Historic Coal Unit Capacity Factors

Unit Capacity Factors Drop Off as they Age

Average capacity factor by unit age for coal operations, 1998-2013

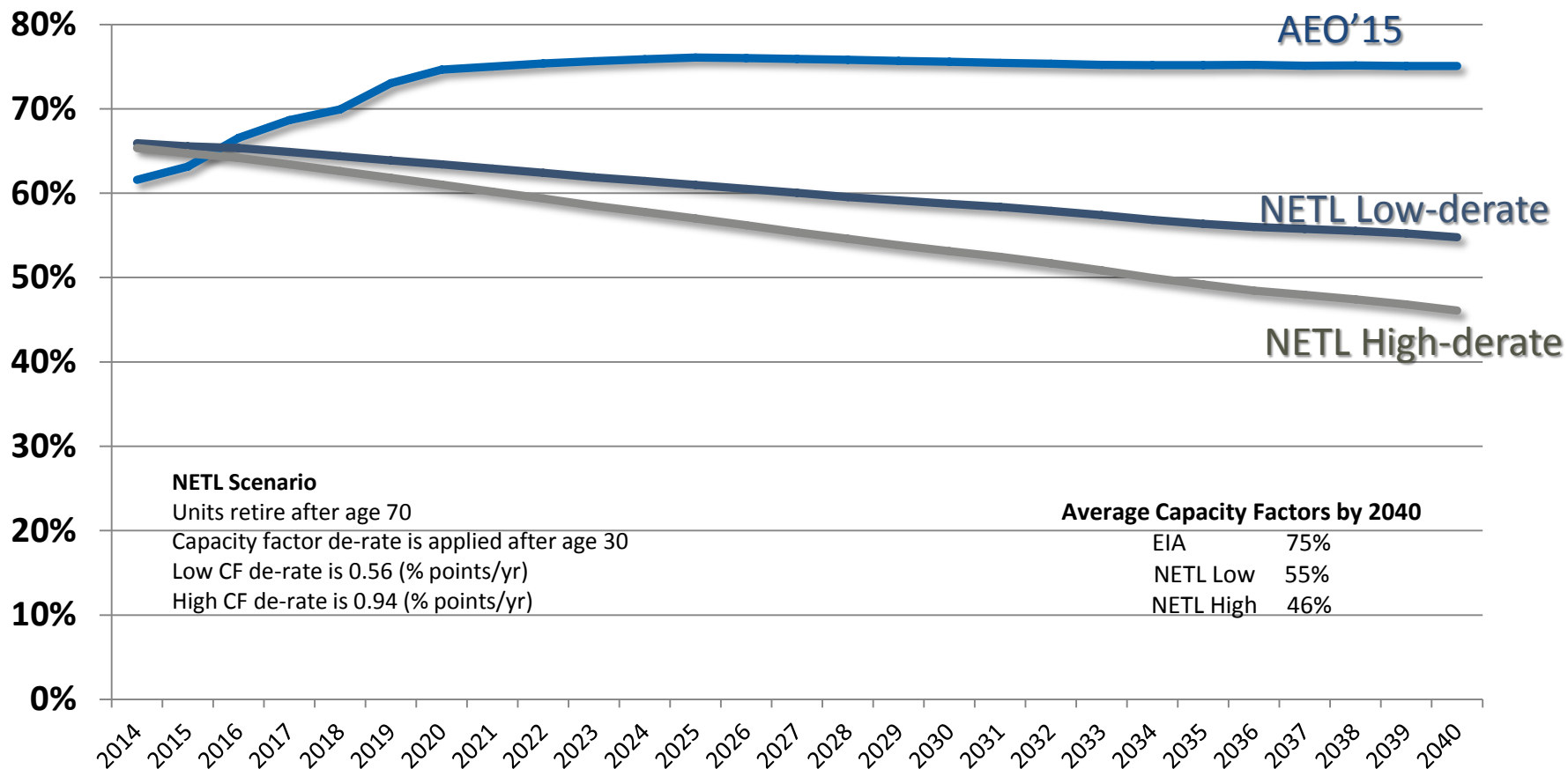


Availability Curve for Aging Units vs. fitted polynomial of the data



* Value is ±60% based on site-specific considerations

Implied U.S. Coal Capacity Factors



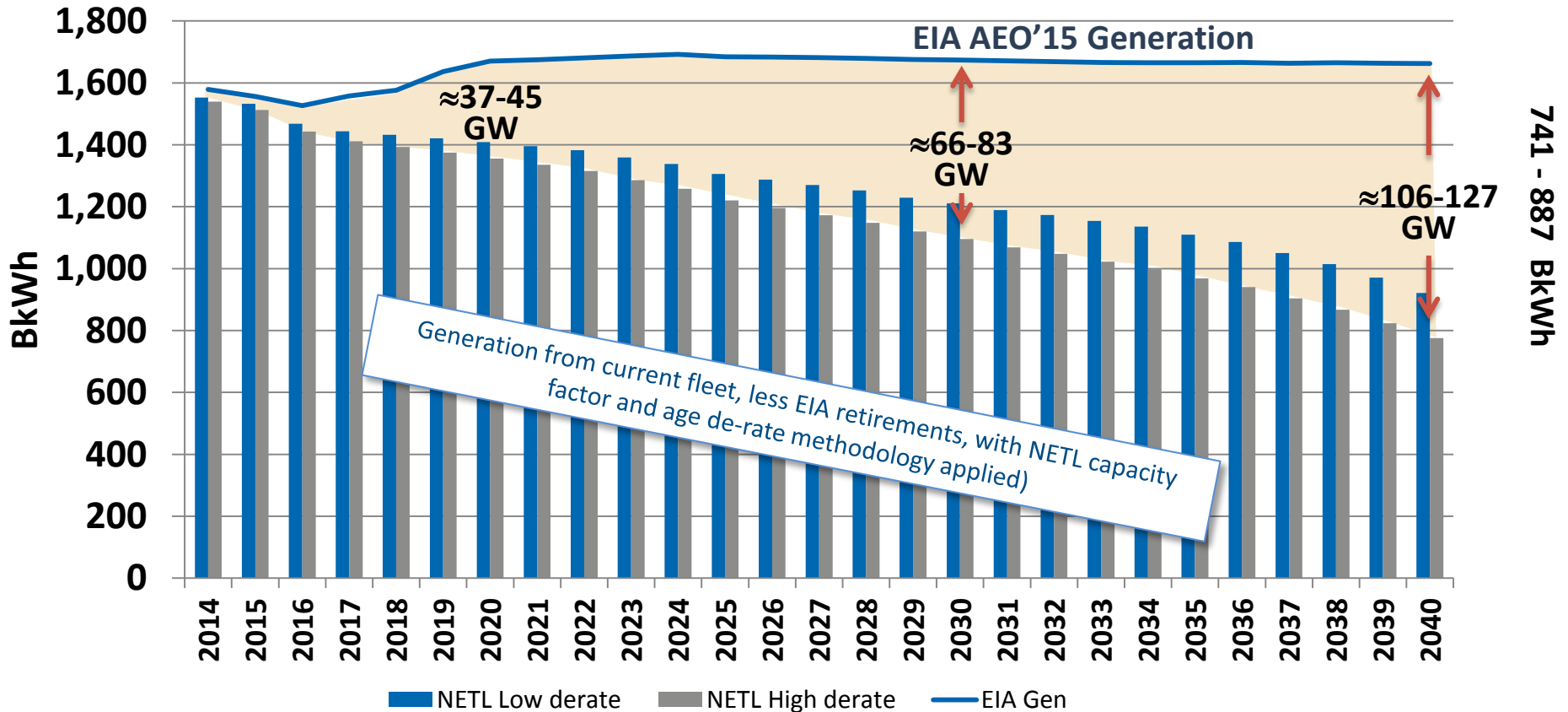
NETL Scenario

Units retire after age 70
 Capacity factor de-rate is applied after age 30
 Low CF de-rate is 0.56 (% points/yr)
 High CF de-rate is 0.94 (% points/yr)

Average Capacity Factors by 2040

EIA	75%
NETL Low	55%
NETL High	46%

Future U.S. Coal Generation Scenarios



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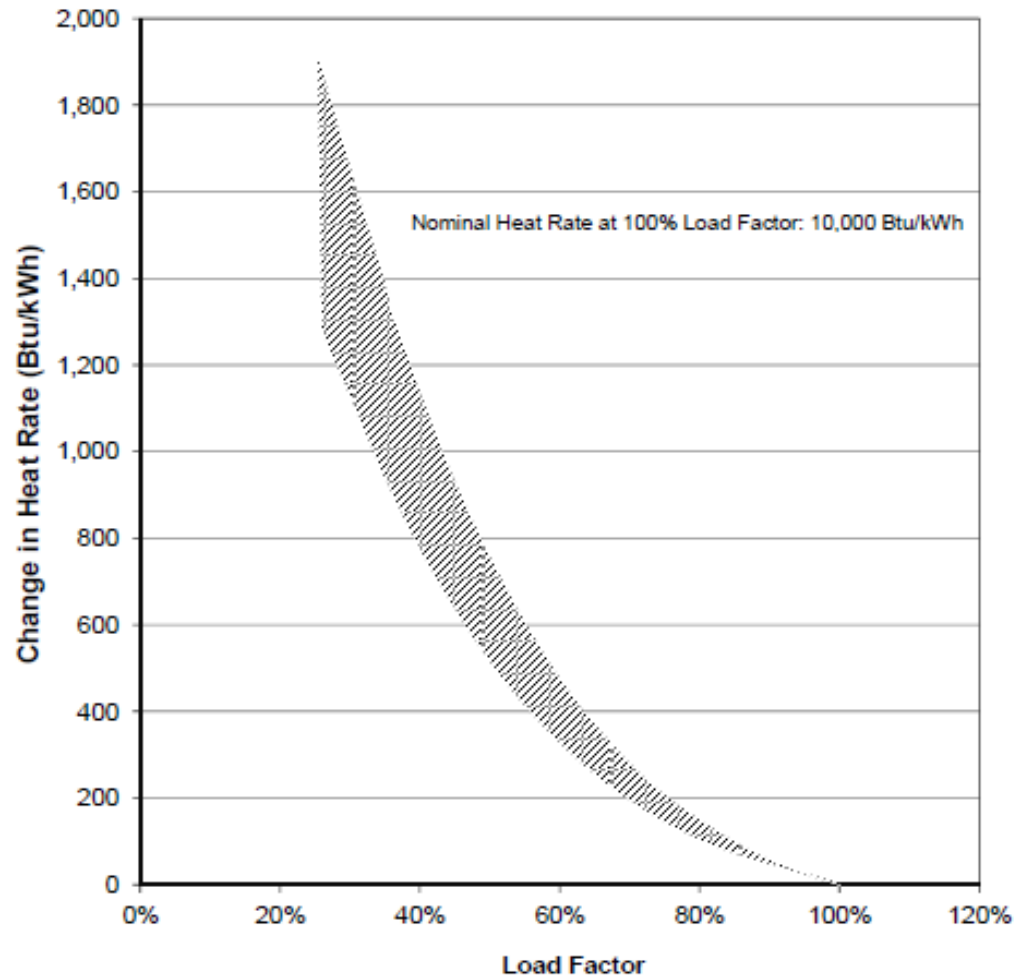
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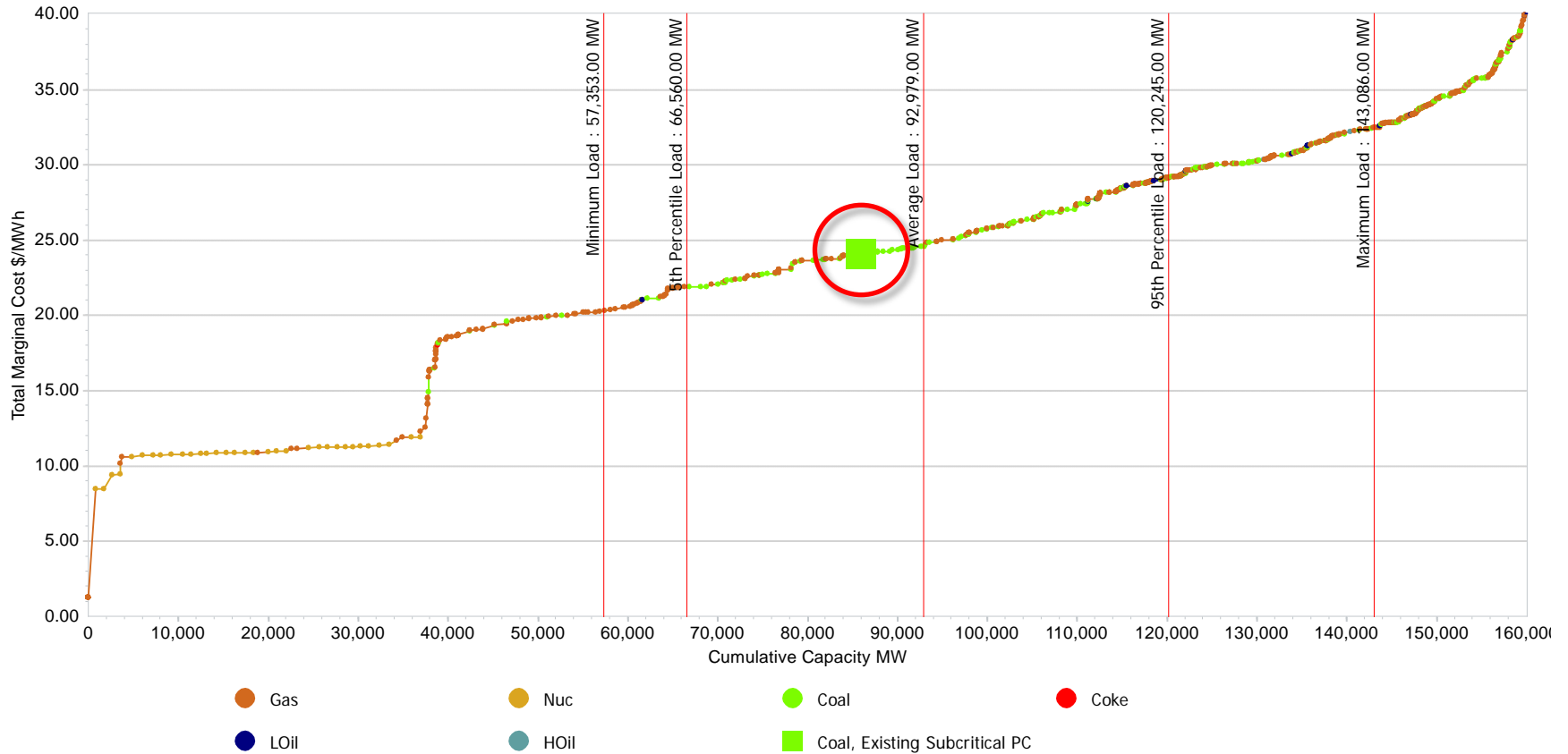
Component	Time Between Replacement/Major Repair			Replacement/ Major Repair Cost (1000\$/MW)	Annual (Routine) Maintenance and Inspection Cost		
	Repair				Inspection Cost		
	(Years)				(1000\$/MW/year)		
	1 Start	6 Starts	12 Starts		1 Start	6 Starts	12 Starts
Coal Pulverizer	6	5	4	1.33	0.92	1.0	1.0
Steam Drum	Annual maint. only	Annual maint. only	Annual maint. only	N/A	1.8	2.2	2.2
Boiler Refractory	Annual maint. only	Annual maint. only	Annual maint. only	N/A	1.0	1.5	1.5
Superheater/Headers/Tubes	10	9-10	8-10	8-30.6	0.067	0.080	0.080
Reheater Tubes	10	9-10	8-10	10-23.3	0.067	0.080	0.080
Economizer Tubes	9	8-9	7-8	5.0-10.0	0.067	0.080	0.080
Lower Furnace Tubes	8-10	7-9	6-8	0.15-1.05	0.067	0.080	0.080
Windbox Supports	8-10	7-9	6-8	0.33-0.50	0.067	0.080	0.080
Feedwater Heaters	15-20	18	15	0.67-4.33	0.25	0.25	0.25
Boiler Feed Pumps	8-10	7-9	6-8	0.50	0.25	0.30	0.30
Steam Turbine Generator (STG)					0.030	0.030	0.030
Minor Overhaul	2-4	2-3	2-3	0.53	N/A	N/A	N/A
Major Overhaul	5-10	5-8	5-8	10	N/A	N/A	N/A
Admission Valves	2-4	2-3	2-3	Incl. in minor overhaul cost	Incl. in STG cost	Incl. in STG cost	Incl. in STG cost
Turbine Rotor	5-10	5-8	5-8	Incl. in major overhaul cost	Incl. in STG cost	Incl. in STG cost	Incl. in STG cost
LP Turbine Blades	5-10	5-8	5-8	Incl. in major overhaul cost	Incl. in STG cost	Incl. in STG cost	Incl. in STG cost
Generator	5-10	5-8	5-8	Incl. in major overhaul cost	Incl. in STG cost	Incl. in STG cost	Incl. in STG cost

Heat Rate Impacts of Off-Design Operation



PJM Dispatch Curve (5-22-15)

Average gas price: ~\$2.50/MBtu



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