

## Nuclear Capacity Uprates

### Summary:

This work plan focuses on capacity uprates at existing nuclear plants in PA. Using data from the PJM planning queue and data from the EIA's 860 database, DEP estimates 551 MW of additional potential capacity at PA nuclear power plants (Limerick, Peach Bottom, Susquehanna, Three Mile Island), as compared to nameplate capacities in 2008. The data also suggests that since the year 2000, the baseline year from which GHG reductions are being compared in the Pennsylvania action plan, a total of 1,000 MW may be online before 2020.

### Other Involved Agencies:

Not applicable.

### Possible New Measure(s):

Nuclear Uprates—To increase the power output of a reactor, typically a more highly enriched uranium fuel is added. This enables the reactor to produce more thermal energy and therefore more steam, driving a turbine generator to produce electricity. To accomplish this, such components as pipes, valves, pumps, heat exchangers, electrical transformers, and generators must be able to accommodate the conditions that would exist at the higher power level. For example, a higher power level usually involves higher steam and water flow through the systems used in converting the thermal power into electric power. These systems must be capable of accommodating the higher flows.

In some instances, facilities will modify and/or replace components to accommodate a higher power level. Depending on the desired increase in power level and original equipment design, this can involve major and costly modifications to the plant, such as the replacement of main turbines. All of these factors must be analyzed by the facility as part of a request for a power uprate, which is accomplished by amending the plant's operating license. The analyses must demonstrate that the proposed new configuration remains safe and that measures continue to be in place to protect the health and safety of the public. Before a request for a power uprate is approved, the Nuclear Regulatory Commission must review these analyses.

### Potential GHG Reduction:

Avoided emissions are calculated on the basis of known potential uprates displacing a mix of 50 percent coal and 50 percent gas at a combined average of 1,523 lb/MWh.

The costs and GHG reductions for this work plan are estimated in Table 1.

**Table 1. Work Plan Costs and GHG Results**

Annual Results (2020)			Cumulative Results (2013-2020)		
GHG Reductions (MMtCO <sub>2</sub> e)	Costs (Million \$)	Cost-Effectiveness (\$/tCO <sub>2</sub> e)	GHG Reductions (MMtCO <sub>2</sub> e)	Costs (NPV, Million \$)	Cost-Effectiveness (\$/tCO <sub>2</sub> e)
5.4	\$840	\$155.25	30.4	\$3,553	\$117

- Nuclear uprate costs are based on FPL Energy's proposed uprate of its Florida-based Turkey Point and St. Lucie pressurized water reactor units. Pressurized water reactors exist at the Beaver Valley and Three Mile Island plants.

- The generation resources that are assumed to be avoided under this work plan are 50 percent existing pulverized coal, and 50 percent existing natural gas. The weighted-average cost of generation for the avoided mix is \$92.50 in 2020. The avoided CO<sub>2</sub> emissions associated with this mix is 0.69 metric tons CO<sub>2</sub>/MWh.

**Table 2: Nuclear Technology Assumptions**

<b>Nuclear Characteristics</b>	<b>For Year 2020</b>	<b>Source</b>
Unit Size MW	varies	Communications with First Energy, PPL and Exelon staff, PJM queue and EIA sources
Capacity Factor	90%	Assumption
Installed Capital Costs \$/kW	\$3,892	Uprate: FPL proposed 2011 uprate for Turkey Point and St. Lucie plants.
O&M Costs \$/kWh	\$3.1	Uprate: FPL proposed 2011 uprate data for Turkey Point and St. Lucie plants.
Fuel \$/MBTU	\$1	Assumption
Net Generation Cost \$/MWh	\$66.20	Calculation
Avoided Price of Power \$/MWh	\$48.73	Calculation based on 50% existing coal and 50% existing gas plant mix.
MW Capacity	949	Described Above
MWh Generation	7,485,070	Calculation

**Implementation Steps:**

- Market forces will drive investments into infrastructure, to uprate capacity. These up-front costs will yield greater energy generation capacity and efficiency, leading to increased sales and, eventually, increased profits.
- The PUC should speak with nuclear power plant operators to better understand what impediments may delay these uprates and what, if any, actions the state can take to facilitate these actions by 2020.
- Some of these actions may currently be being implemented.
- Market-driven initiative
- Are cost savings realized from this initiative?—Not directly. Indirect savings to the commonwealth will accrue subject to in-state low-carbon electricity development (manufacturing, installation, sales and service, etc.). Indirect costs include displaced coal industry jobs and other fossil fuel-related economic production and consumption.

**Potential Overlap:**

None

**Subcommittee Recommendations**