

Assessing the Impact of the Inflation Reduction Act on Power Uprate and Hydrogen Cogeneration

Project Summary



Background

- The Department of Energy (DOE) tasked the Light Water Reactor Sustainability (LWRS) Program with an effort to demonstrate the value of increased power output for the current fleet with consideration of the Inflation Reduction Act (IRA) tax credits
 - Section 45Y – Clean Electricity PTC
 - Section 48E – Clean Electricity ITC
 - Section 45V – Clean Hydrogen PTC
- The report was developed in 2023 by the Nuclear Energy Institute (NEI), MPR Associates Inc. (MPR), and Idaho National Laboratory (INL) with assistance from an industry uprate working group
 - <https://www.osti.gov/biblio/2007297>
 - In late 2023, follow-on effort initiated to refine user interface and develop brief user guide

Overall Project Scope

- **Project Objectives**

- Develop business cases that demonstrate the value of implementing the tax incentives of the IRA
- Provide insights and information to the domestic nuclear fleet which can be used to support assessing the financial impact of power uprate with the IRA

- **Project Tasks**

- Task 1: Market Overview
- Task 2: System, Structures, Components (SSCs) Capability Assessment
- Task 3: Business Case Development

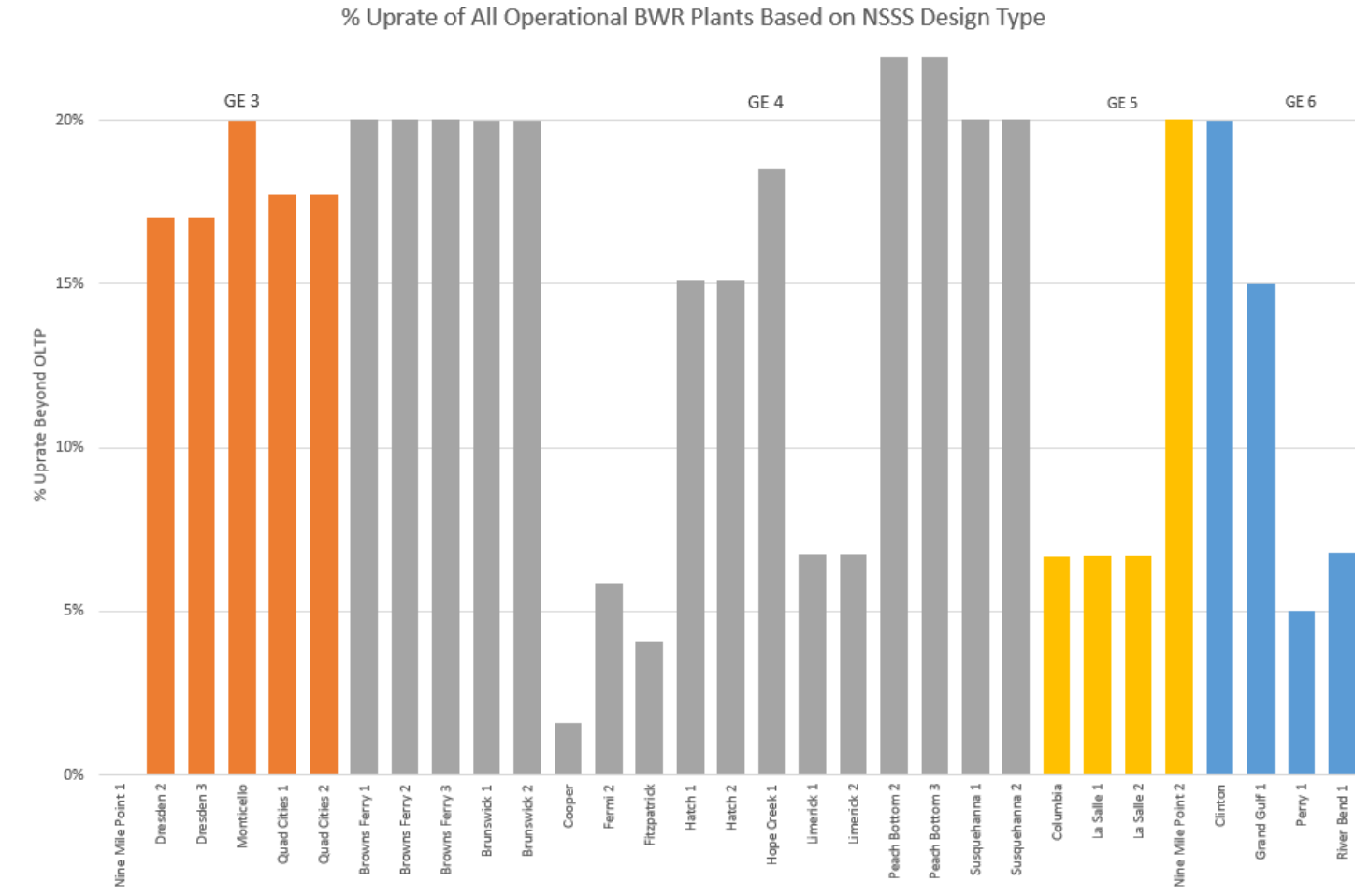
Task 1: Market Overview

- **Objective:** Establish the potential for increasing output from existing fleet along with potential for hydrogen co-generation considering the IRA
- **Activities:**
 - **IRA Policy Overview** – Detailed description of the relevant IRA tax credits including applicability criteria, financial benefits, and other insights
 - **Power Uprate Market Overview** – Overview of power uprate process, current industry uprate status, assessment of potential opportunity for further power uprates
 - **Hydrogen Market Overview** – Overview of incentive to generate hydrogen from nuclear power plants, summary of current industry efforts, and assessment of potential opportunity of hydrogen co-generation going forward

Task 1: Inflation Reduction Act Overview

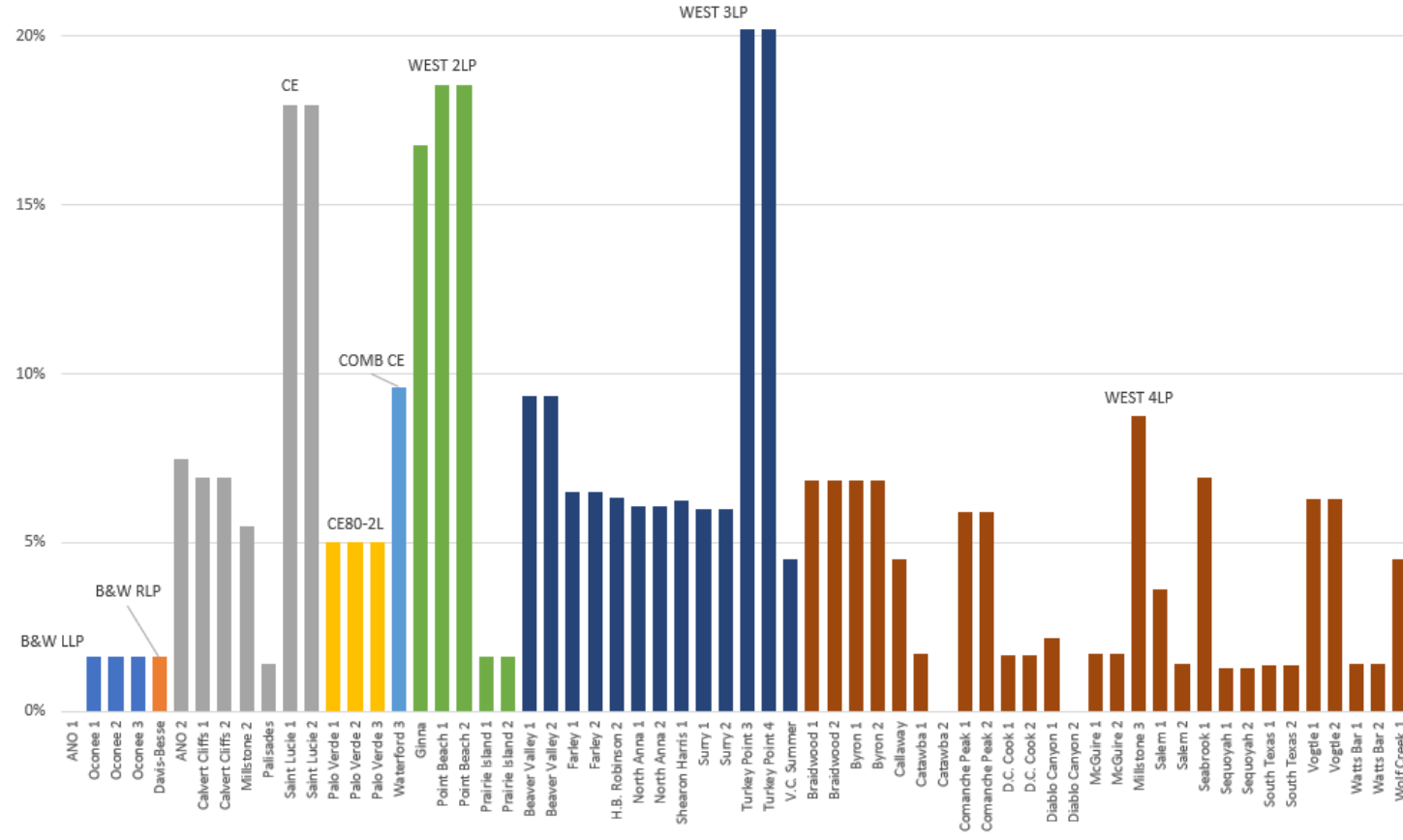
- **Power Uprate**
 - Section 45Y – Clean Electricity PTC
 - Expected base of \$30 MWh for 10 years indexed to inflation if wage requirements met
 - Opportunity to increase 10% for energy communities and 10% for domestic content requirements
 - Capacity added between 2025 and later of 2032/CO2 emissions 75% below 2022 levels
 - Section 48E – Clean Electricity ITC
 - Expected base of 30% of construction expenses if wage requirements met
 - Same adders and dates as PTC
- **Hydrogen Cogeneration**
 - Section 45V – Clean Hydrogen PTC
 - \$3/kg base for 10 years of operation if wage requirements met
 - Size of credit based on emission intensity
- Other considerations such as direct payments, transfers for all credits
- Model utilizes latest available information at time of publication – NEI has requested guidance from Treasury to confirm assumptions

Task 1: Uprate Market Overview



Task 1: Uprate Market Overview

% Uprate of All Operational PWR Plants Based on NSSS Design Type



Task 1: Hydrogen Market Overview

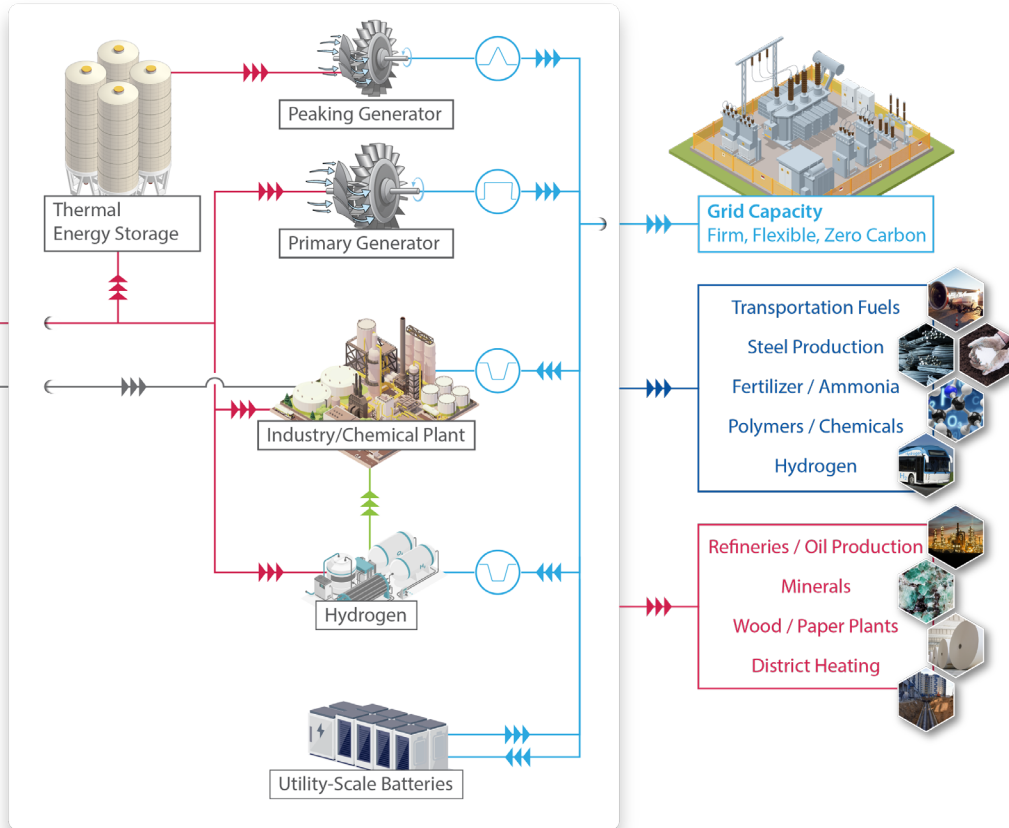
Flexible Reactor Siting

Data Centers
 Manufacturing Plants
 Biofuel Plants / Processing
 Desalination
 Industrial Parks / Plants
 Fueling Stations



CO₂ / Carbon Sources

Ethanol Plants
 Direct Air Capture
 Power Generators
 Cement Plants
 Biomass
 Polymer / Chemical Waste



- Current US hydrogen consumption is ~10 million metric tonnes per yr
- Hydrogen demand is projected to increase by 10+ million metric tonnes per year by 2030

Task 2: Conduct SSCs Capability Assessment

- **Objective:** High-level overview of historical impact of power uprate on existing plant SSCs to demonstrate viability of further power uprates
- **Activities:**
 - List historical SSCs impacted by power uprate and common modifications
 - Utilize and reference available information from previous industry efforts (e.g., NEI, IAEA, EPRI)
 - Develop summary table of most recent Extended Power Uprates (EPU) and subsequent modifications

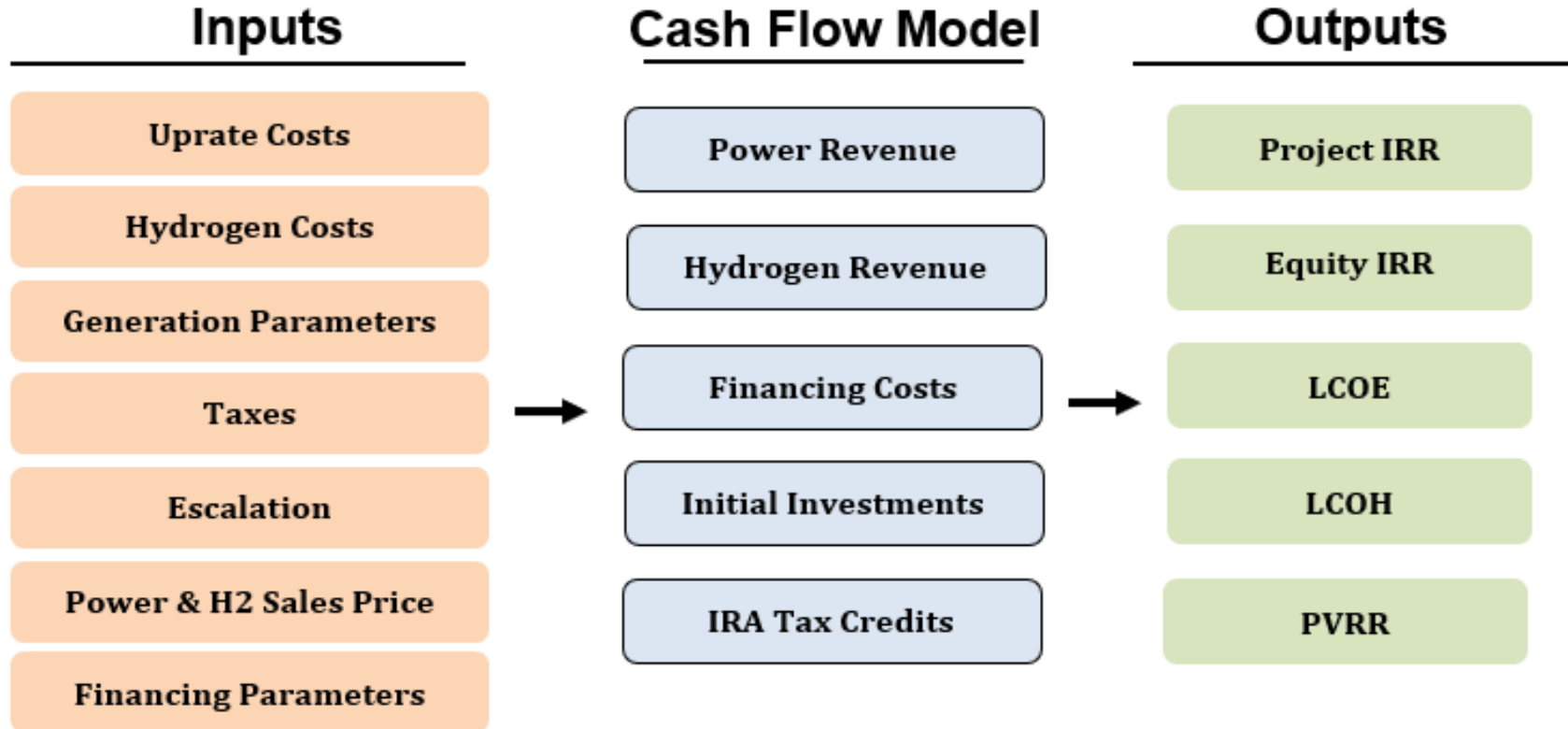
Task 2: Conduct SSCs Capability Assessment

Table 4-2. Survey of Recent EPU Experience for BWRs

Parameter or Modification	Plant			
	Browns Ferry	Peach Bottom	Monticello	Grand Gulf
Thermal Power Increase	494 MWt	437 MWt	229 MWt	510 MWt
NRC Approval Date	August 2017	August 2014	December 2013	July 2012
Steam Dryer Modifications	Replaced	Replaced	Replaced	Replaced
Pump and Prime Mover Modifications	<p>All condensate and condensate booster pump impellers changed and larger motors installed</p> <p>Reactor feedwater pumps replaced with higher capacity pumps</p> <p>Reactor feedwater pump turbine enhancements</p> <p>Re-rate of reactor recirculation pumps and motors</p>	<p>All condensate pump impellers changed and larger motors installed (six total)</p> <p>Reactor feedwater pump turbines retrofitted</p>	<p>Condensate pump impellers enlarged and larger motors installed (replaced 4KV motors with new 13.8KV motors)</p> <p>Reactor feedwater pumps replaced with larger pumps and motors (replaced 4KV motors with new 13.8 KV motors)</p>	<p>Reactor feedwater pump turbines retrofitted</p>

Task 3: Business Case Development

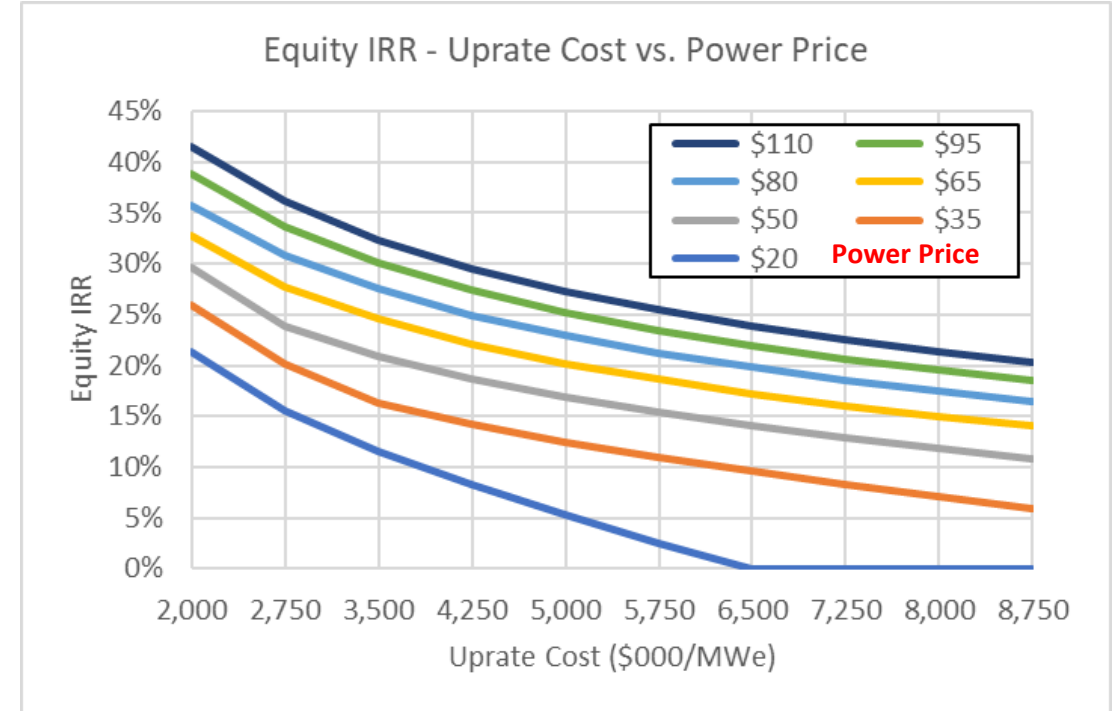
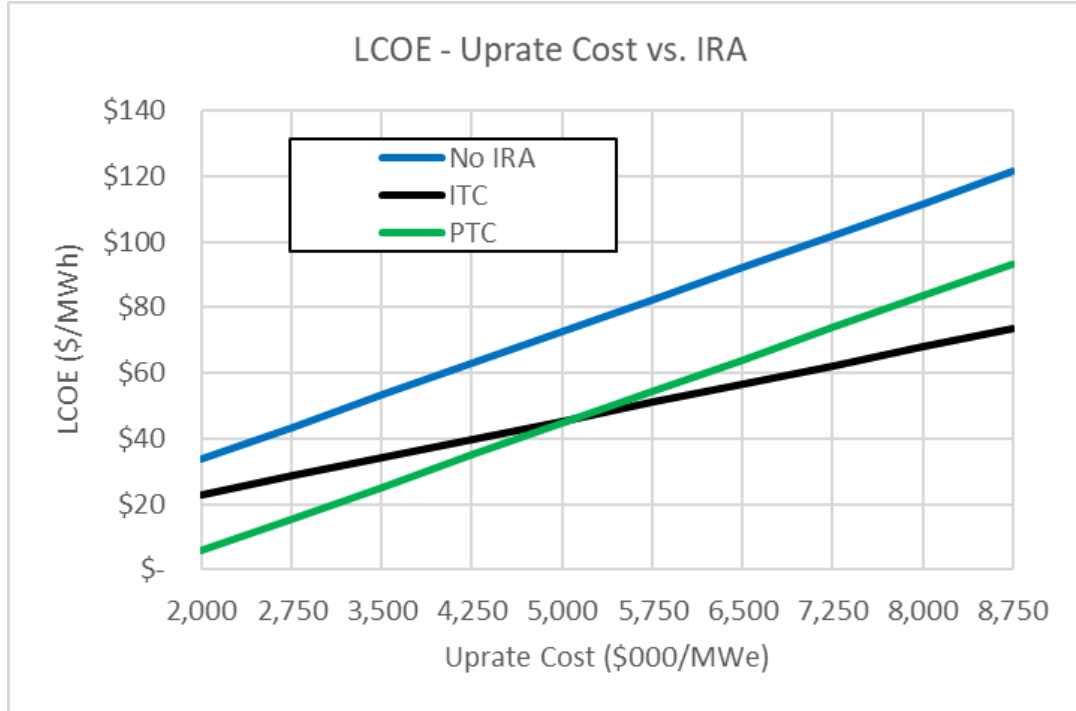
Objective: Develop high-level financial model to assess impact of IRA on power uprates with and without hydrogen cogeneration



Task 3: Results Summary Example

Total Capital Costs		Project IRR		LCOE (\$/MWh)		LCOH (\$/kg)	
Uprate Only	\$631,568	No IRA	5.1%	↑	\$72.69	↑	No H2 Gen
		ITC	8.3%		\$45.40		No H2 Gen
		Power PTCs	8.2%		\$44.66		No H2 Gen
Uprate + LTE	\$775,466	No IRA	1.1%		NA		\$5.31
		ITC + H2	9.8%		NA		\$1.34
		Power PTCs + H2	9.5%		NA		\$1.30
Uprate + HTE	\$847,483	No IRA	2.0%		NA		\$4.46
		ITC + H2	11.8%		NA		\$0.88
		Power PTCs + H2	11.2%	↓	NA	↓	\$0.85

Task 3: Output Sensitivity Examples



Task "4": Refined User Interface and User Guide

Key Project Inputs		Inputs	Units	Description
Project Budget (CPBR)	Inputs	\$MM	\$MM	Enter Project Budget. This is the total amount of money available to spend on the project. It is the sum of the Project Budget (CPBR) and the Contingency Budget (CB).
Project Budget (CPBR) Base Rate	Inputs	%	%	Enter Project Budget Base Rate. This is the percentage of the Project Budget that is used to fund the Project. It is the sum of the Project Budget (CPBR) and the Contingency Budget (CB).
Project Budget (CPBR) Contingency Budget	Inputs	\$MM	\$MM	Enter Project Budget Contingency Budget. This is the amount of money set aside to cover unexpected costs. It is the sum of the Project Budget (CPBR) and the Contingency Budget (CB).
Project Budget (CPBR) per MW	Inputs	\$MM	\$MM/MW	Enter Project Budget per MW. This is the amount of money required to build one MW of capacity. It is the sum of the Project Budget (CPBR) and the Contingency Budget (CB).
Project Budget (CB) per MW	Inputs	\$MM	\$MM/MW	Enter Project Budget (CB) per MW. This is the amount of money required to build one MW of capacity. It is the sum of the Project Budget (CPBR) and the Contingency Budget (CB).
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Construction Unit Rate (CU Rate) Excluding Rels	Inputs	\$/kW	\$/kW	Enter Construction Unit Rate (CU Rate) Excluding Rels. This is the cost per kW of capacity. It is the sum of the Project Budget (CPBR) and the Contingency Budget (CB).
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Inputs

Use the buttons to choose project type: "Uprate Only" or "Uprate + H2". The chosen project type is displayed to the right of the buttons. This selection drives the required inputs (and ultimately the results shown) in the subsequent sections.

Choose Project Type

Uprate Only

Uprate + H2 Project

Chosen Project Type:
Uprate Only Project

Legend

User Input	User to edit cells.
Calculated Value	Do not edit. Calculated values are driven by other user inputs and provided for information only. Suggested values are provided to inform the user of typical project inputs or useful correlations provided by other studies.
OR	
Suggested Value	

Inputs Navigation



Use the navigation buttons to progress between sections, starting with "Uprate." To start over and reset the view at any point, select "Start" (this will NOT delete any user-provided inputs).

Uprate Project Inputs

Financial Inputs

Escalation and Spend Curve Inputs

Choose Project Type

Uprate Only

Uprate + H2 Project

Chosen Project Type:
Uprate + H2 Project

Inputs Navigation



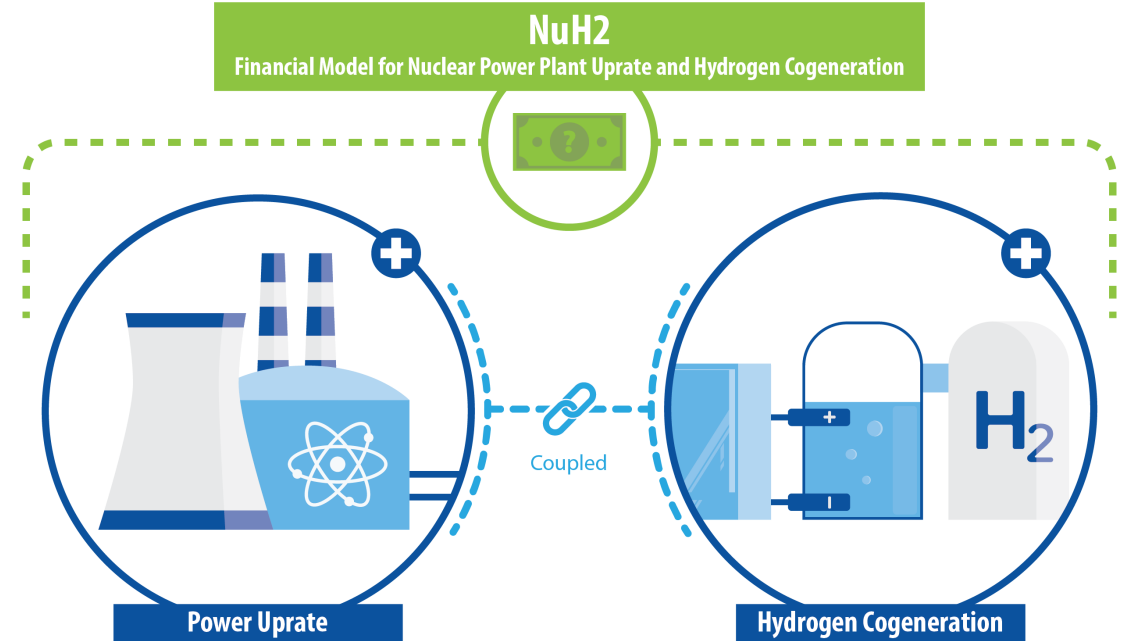
Process to Acquire the Uprate Model

- Email a request for the “NuH2” model to the INL Tech Development group -> agradmin@inl.gov
- Follow tech developments guidance to officially request a license agreement
- Sign the license agreement and return it to INL

Note: The model is free. No fees or costs will be incurred with the license agreement or model acquisition.

• **Upon License Execution, User Will Receive:**

- Excel based uprate model for economic analysis of nuclear reactor capacity uprate and hydrogen production integrated with a nuclear reactor
- A “How to” manual for the model operation



QUESTIONS?
