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

Project Summary

May 1, 2024

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

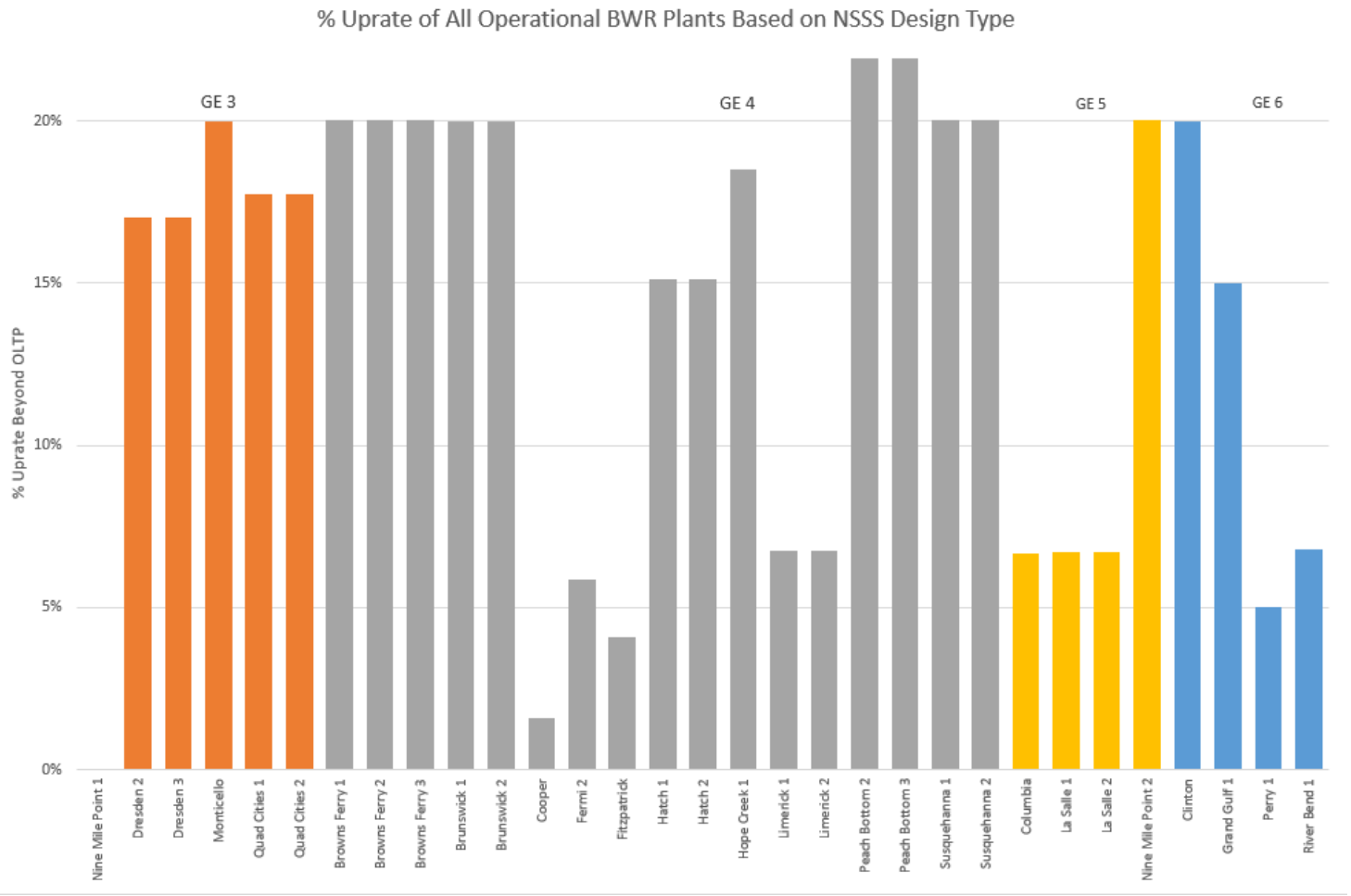
- **Objective:** Establish the potential for increasing output from existing fleet along with potential for hydrogen co-generation considering the IRA

- **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

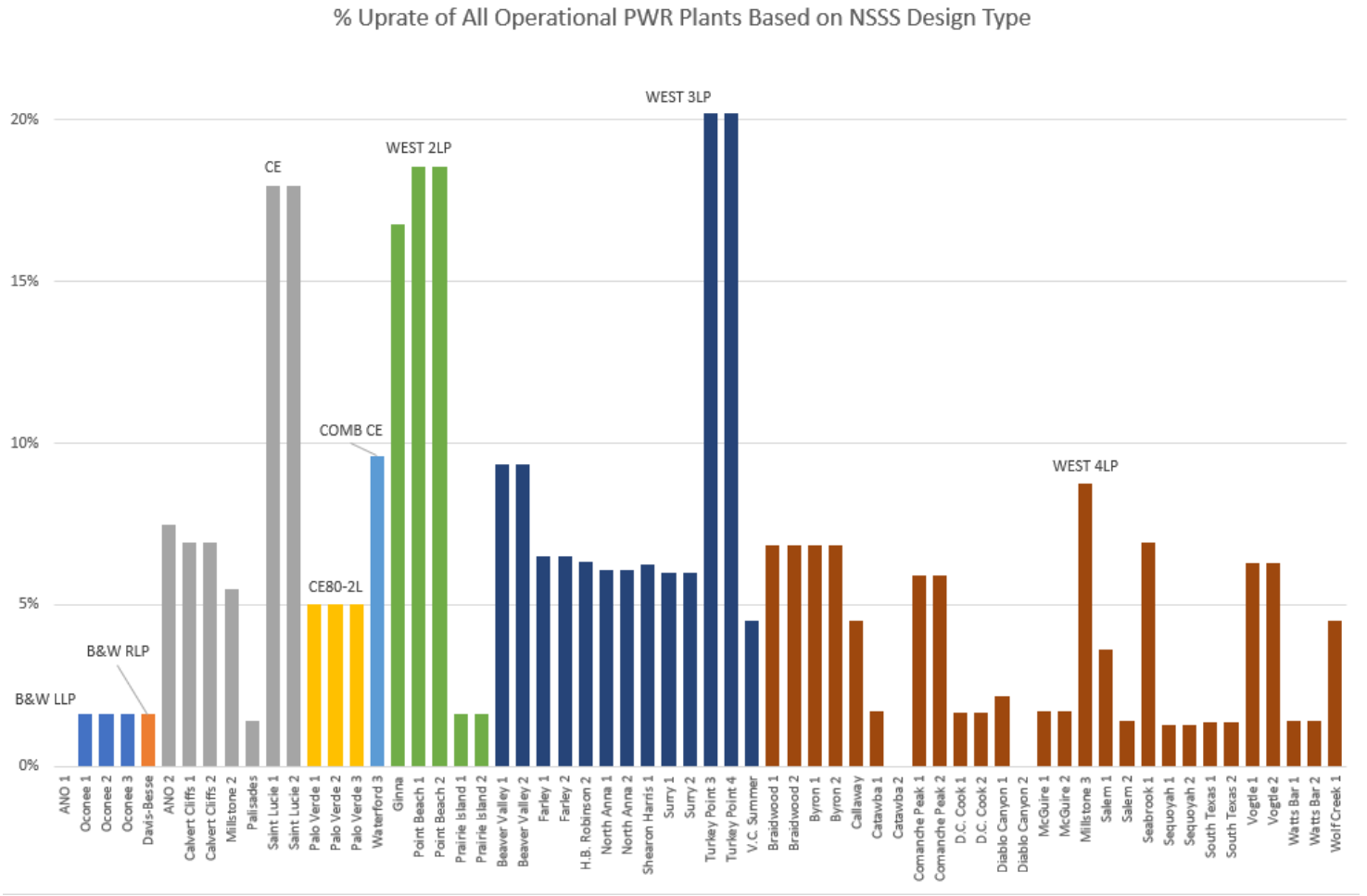
Task 1: Inflation Reduction Act Overview

- **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

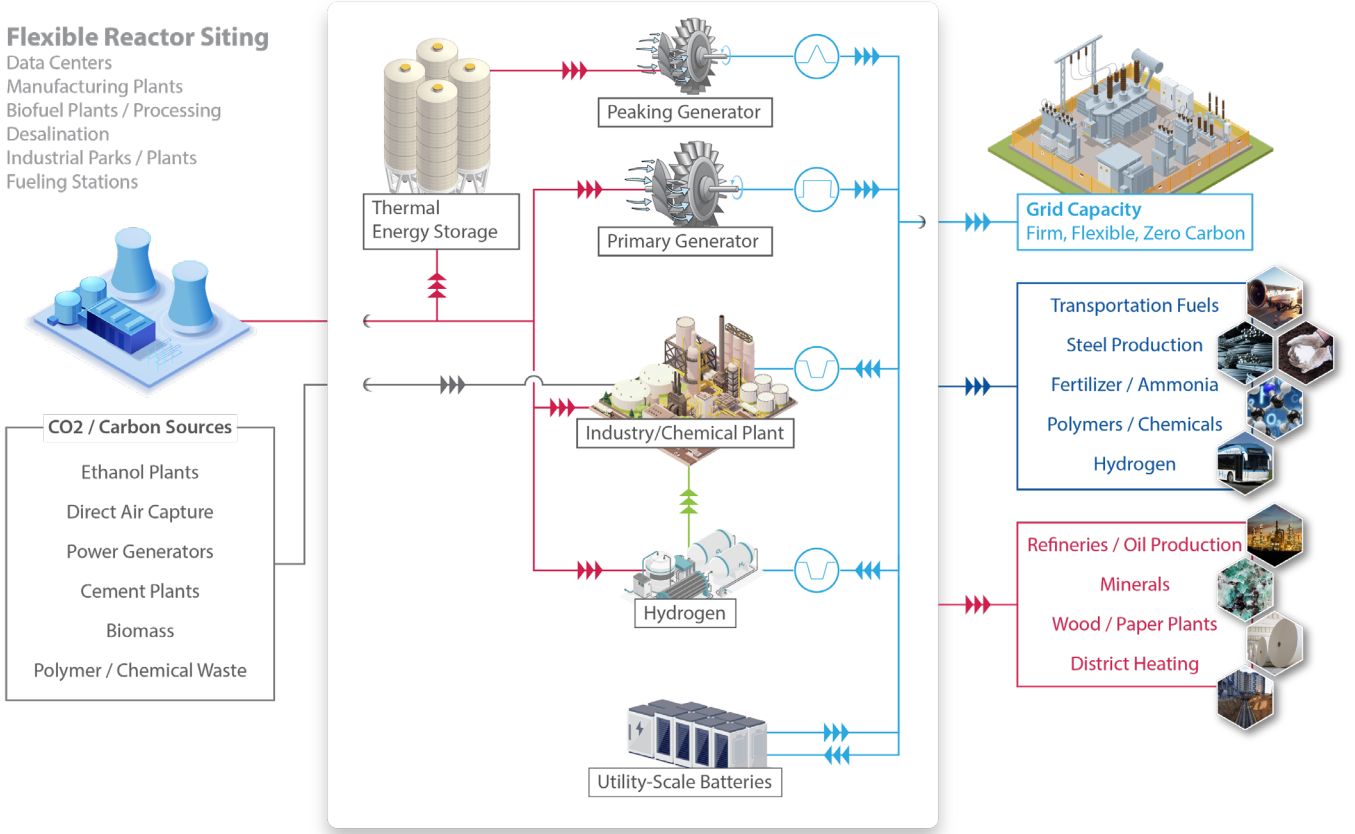
Task 1: Uprate Market Overview



Task 1: Uprate Market Overview



Task 1: Hydrogen Market Overview



- 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 (EPUs) and subsequent modifications

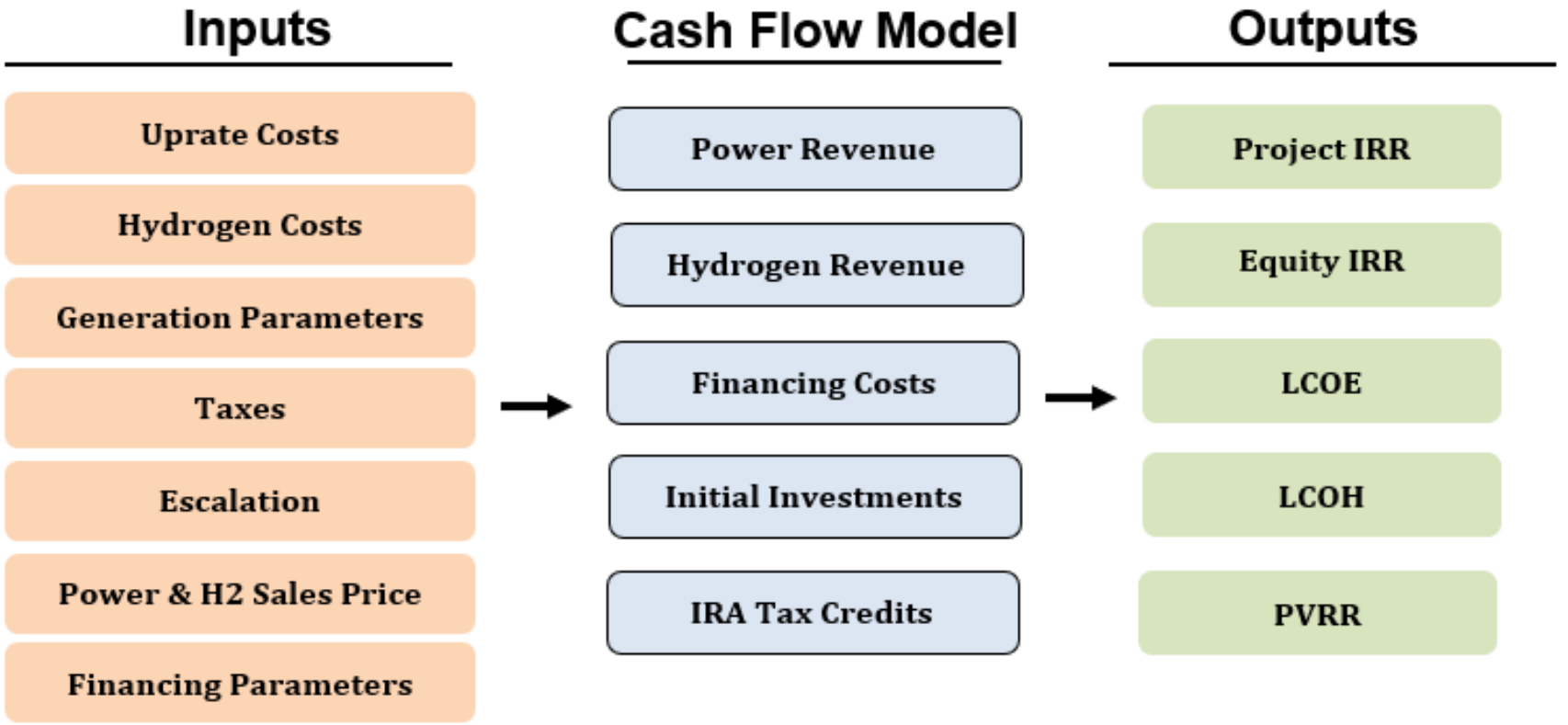
Task 2: Conduct SSCs Capability Assessment

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	All condensate and condensate booster pump impellers changed and larger motors installed Reactor feedwater pumps replaced with higher capacity pumps Reactor feedwater pump turbine enhancements Re-rate of reactor recirculation pumps and motors	All condensate pump impellers changed and larger motors installed (six total) Reactor feedwater pump turbines retrofitted	Condensate pump impellers enlarged and larger motors installed (replaced 4KV motors with new 13.8KV motors) Reactor feedwater pumps replaced with larger pumps and motors (replaced 4KV motors with new 13.8 KV motors)	Reactor feedwater pump turbines retrofitted

Task 3: Business Case Development

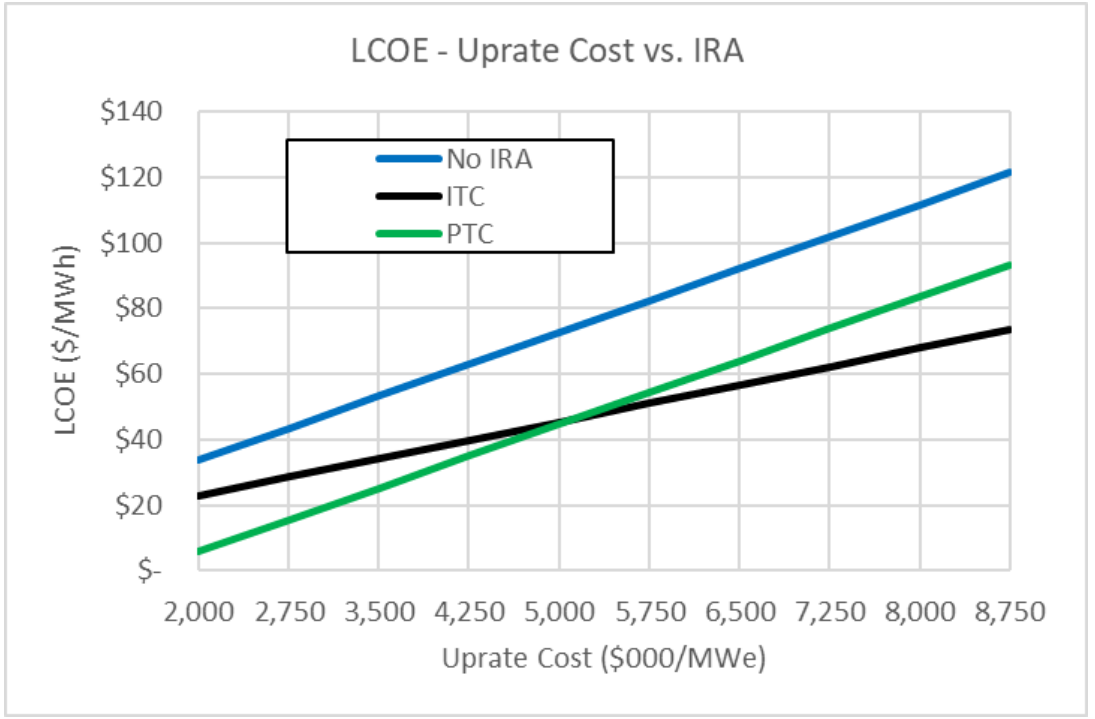
Objective: Develop high-level financial model to assess impact of IRA on power uprates with and without hydrogen cogeneration

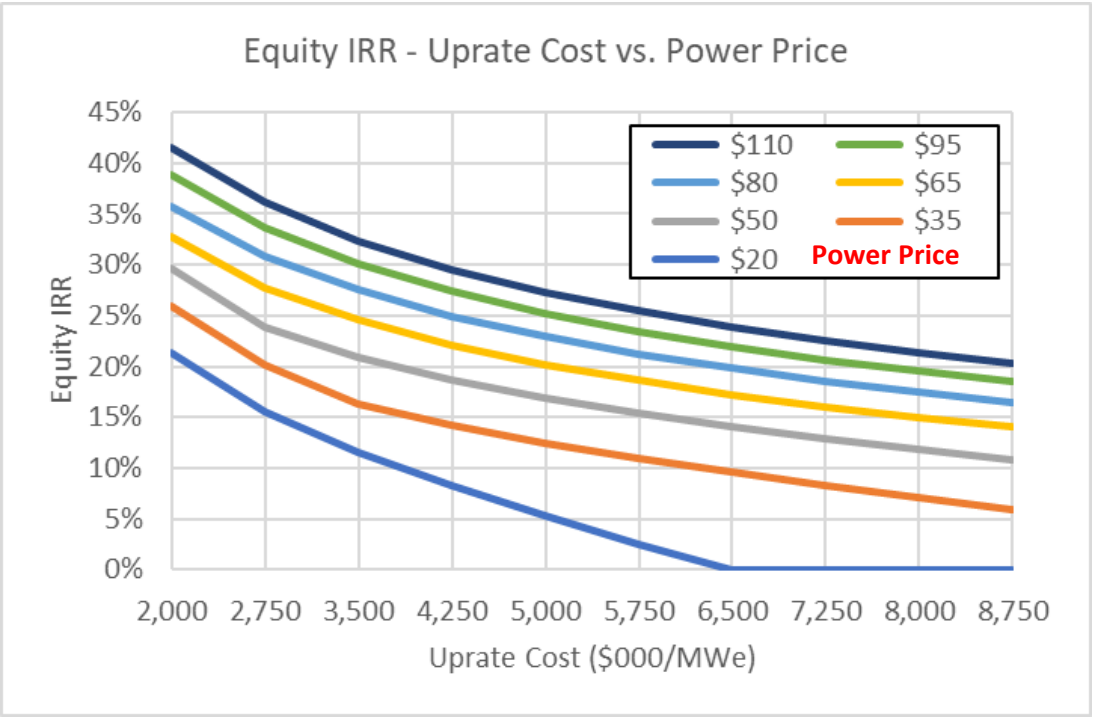


Task 3: Results Summary Example

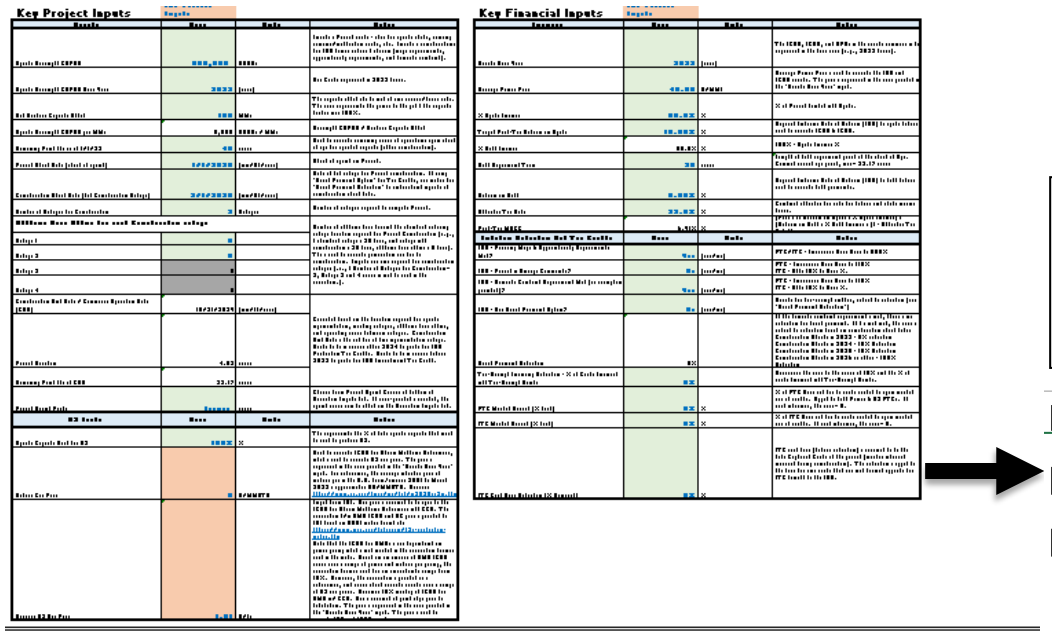
	Total Capital Costs		Project IRR	LCOE ($/MWh)	LCOH ($/kg)
Uprate Only	$631,568	No IRA	5.1%	$72.69	No H2 Gen
		ITC	8.3%	$45.40	No H2 Gen
		Power PTCs	8.2%	$44.66	No H2 Gen
Uprate + LTE	$775,466	No IRA	1.1%	NA	$5.31
		ITC + H2	9.8%	NA	$1.34
		Power PTCs + H2	9.5%	NA	$1.30
Uprate + HTE	$847,483	No IRA	2.0%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

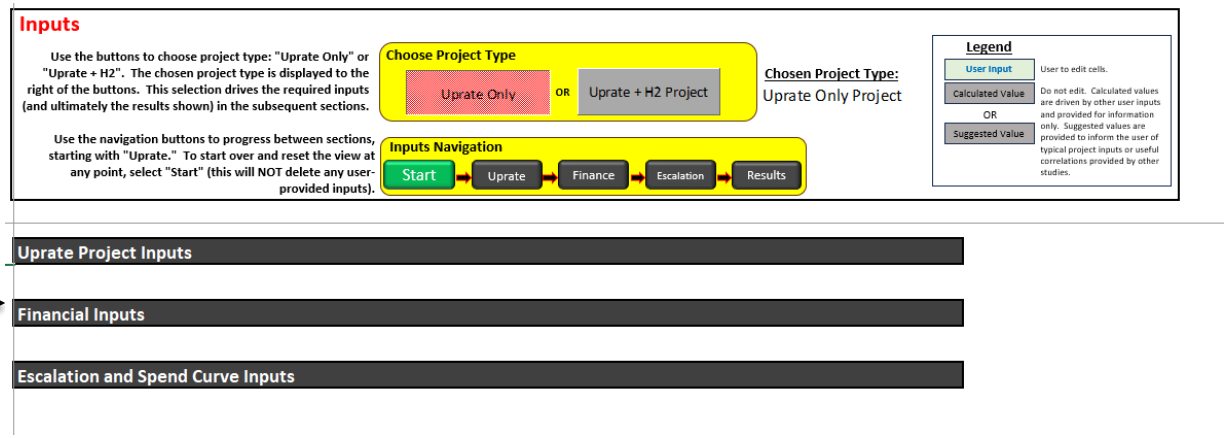
Task 3: Output Sensitivity Examples

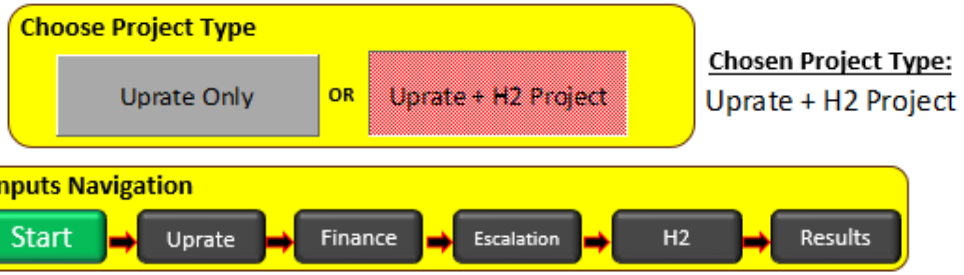




Task “4”: Refined User Interface and User Guide





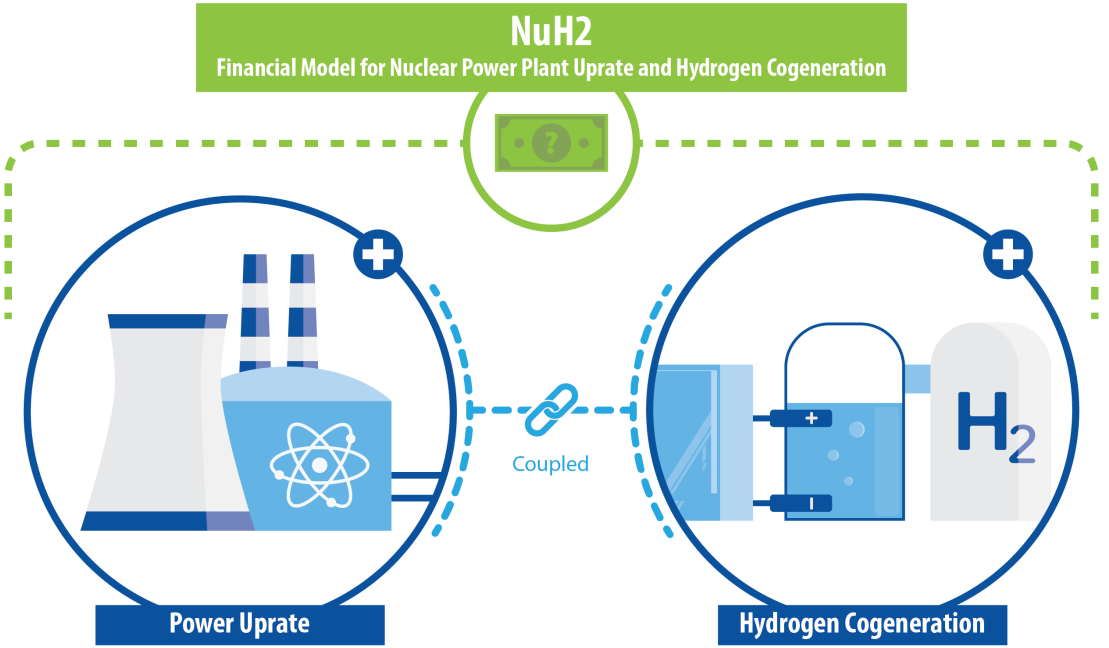


Process to Acquire the Uprate Model

- 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?