Stretching Purchasing Power through Improved Escalation Methods

Keywords: *Data-Driven, Regression, Escalation*

Technomics
Better Decisions Faster

NNSA
National Nuclear Security Administration

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Technomics/NNSA Papers at ICEAA

Stretching Purchasing Power through Improved Escalation Methods

Updating escalation methodology for programmatic equipment across the Nuclear Security Enterprise (NSE)

Portfolio Analysis Made Effective and Simple

Documents a flexible and repeatable process for analyzing projects across a portfolio to assist decision makers.

The Nuclear Option: Avoiding Critical Delays with Advanced Constraints Analysis

Documents the methodology used to analyze how funding constraints impact construction project schedules and phasing

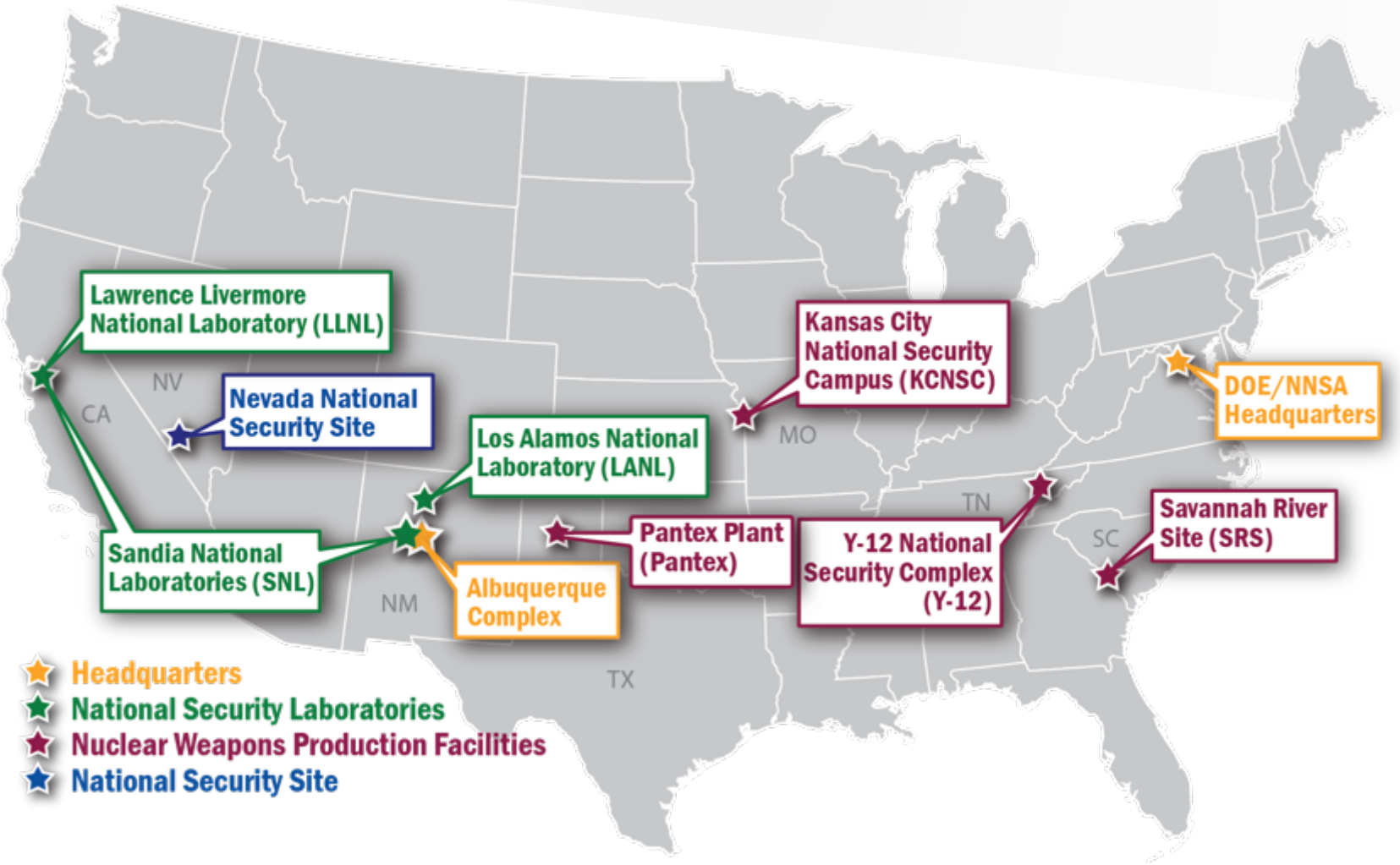
All this work directly impacts the NNSA by increasing their data and modeling capabilities for making funding decisions across portfolios in a resource constrained environment

Agenda

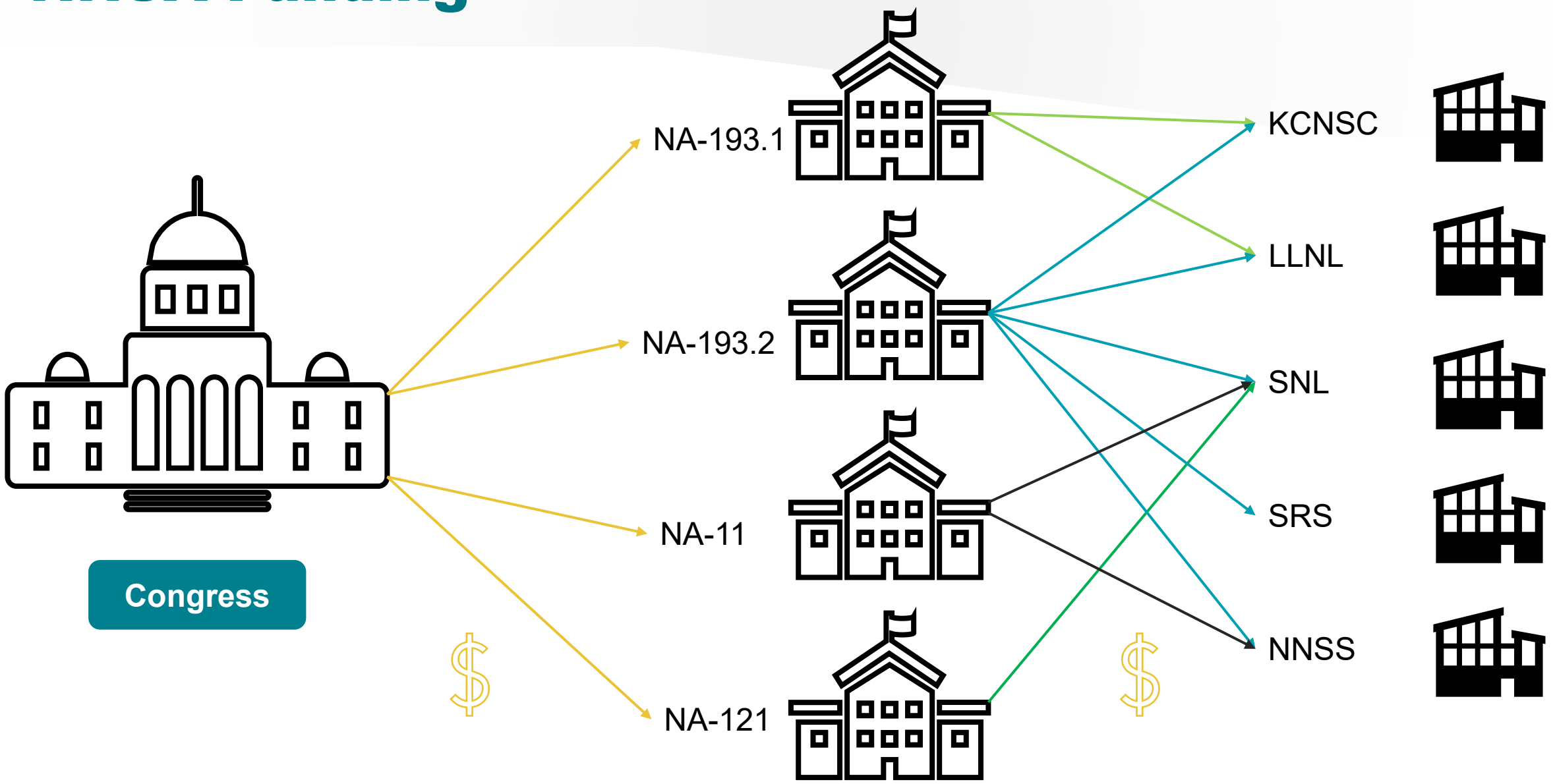
- NNSA/Programmatic Recapitalization Working Group (PRWG) Overview
- Inflation vs. Escalation Overview
- Previous Escalation Methodology
- Empirical Methodology
- Category Specific Index Methodology
- Impacts/Future Analysis

NNSA/PRWG Overview

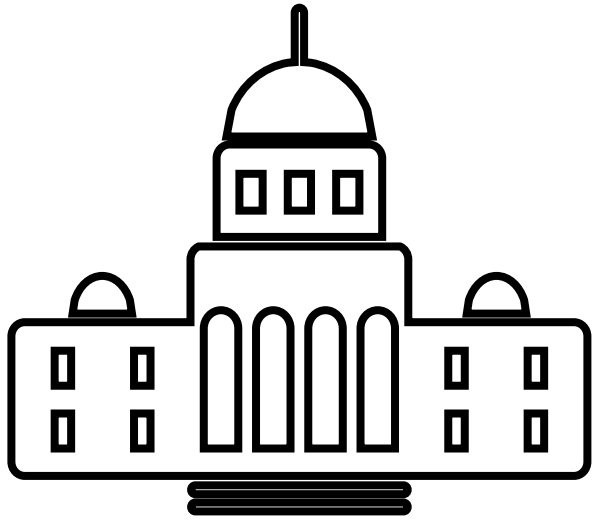
National Nuclear Security Administration (NNSA)



NNSA Funding



Before PRWG



Congress

NNSA Program Offices

NA-193.1

NA-193.2

NA-11

NA-121

Labs, Plants, and Sites (LPS's)

KCNSC

LLNL

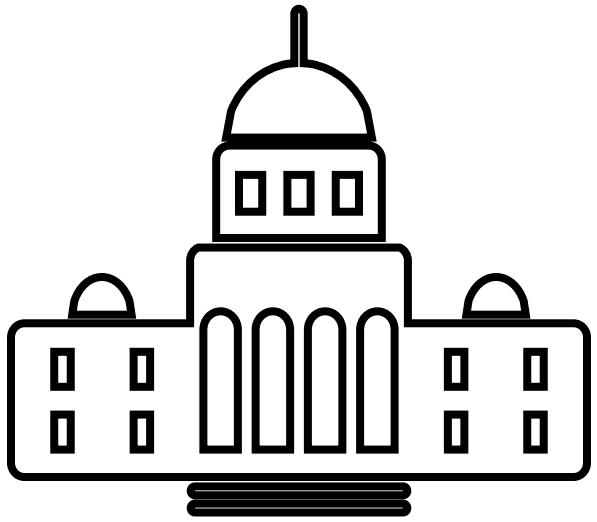
SNL: "Our scanning electron microscope broke!"

SRS

NNSS

$?

PRWG Influence on NNSA Funding Process



Congress

Creation of the ***(PRWG) enables data driven procurement planning*** based on risk metrics and equipment health

NNSA Program Offices

NA-193.1

NA-193.2

NA-11

NA-121

Input: Equipment Data from sites to PRWG

PRWG

Output: Data Metrics and Prioritization Models

Labs, Plants, and Sites (LPS's)

KCNSC

LLNL

SNL

SRS

NNSS

Programmatic Equipment

Real Property – includes land/improvements on the land

- Not collected by the PRWG
- Equipment or fixtures, such as plumbing, electrical, heating, built-in cabinets, and elevators, that are installed in a building in a permanent manner usually are held to be part of the real property.

Programmatic Equipment – directly supports or is integral in the delivery of weapon activity deliverables.

- Collected by the PRWG
- Tangible item that is functionally complete for its intended purpose, can theoretically be removed from a facility and placed in another

The PRWG uses escalated equipment costs to understand recapitalization needs for programmatic equipment.

AI Generated: Scanning Electron Microscope

Inflation vs. Escalation

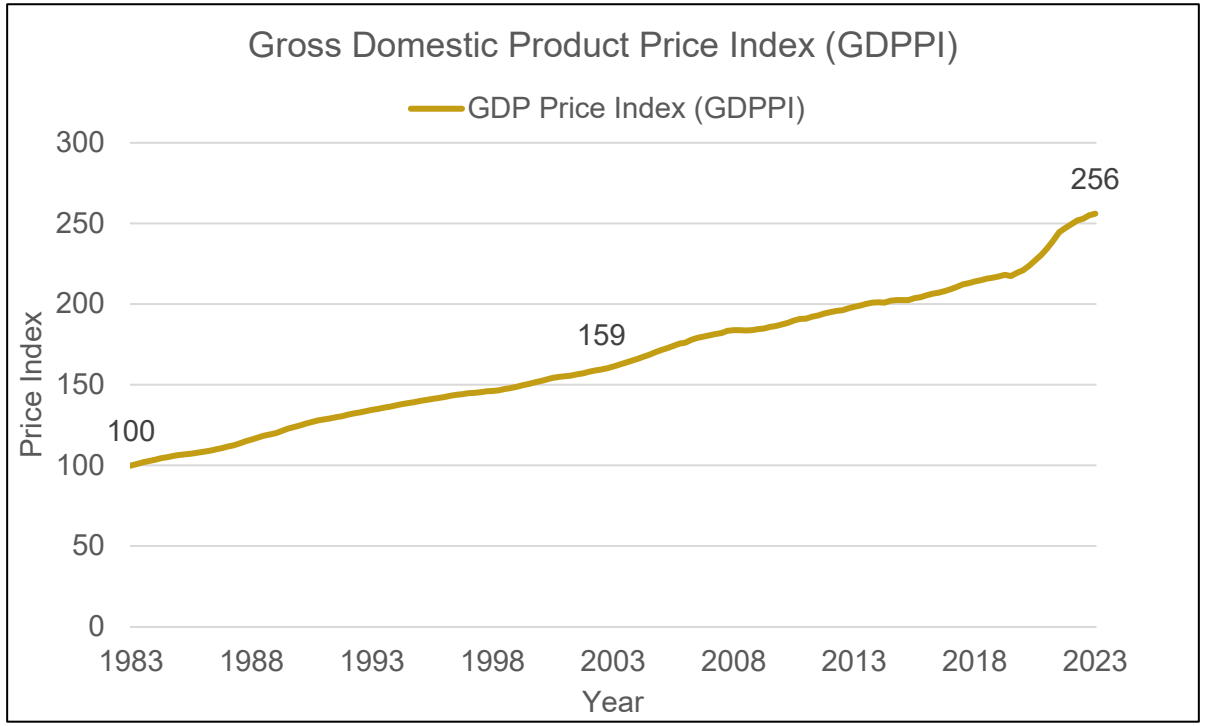
Inflation vs Escalation

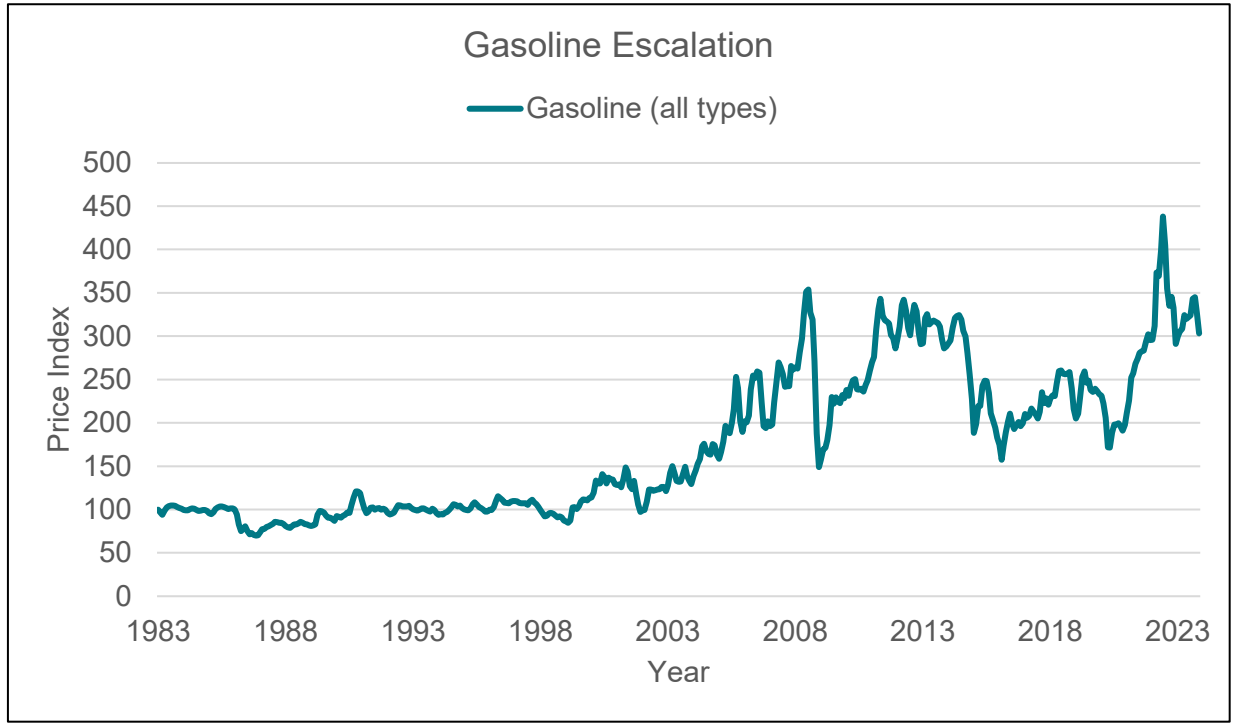
Inflation

- The macro level price changes for a *broad market basket* of goods and services over time
- A measure of “purchasing power” or “real value”

Cost Escalation

- The change in cost or price of specific goods or services over time
- May have a completely different trend than inflation

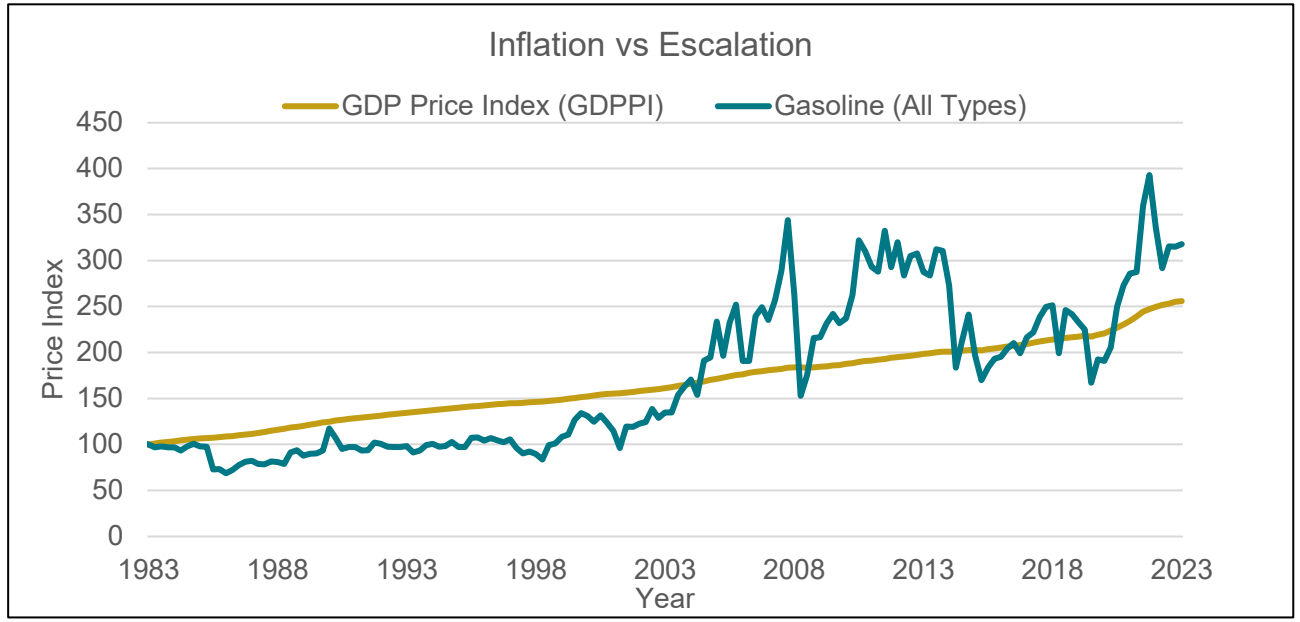


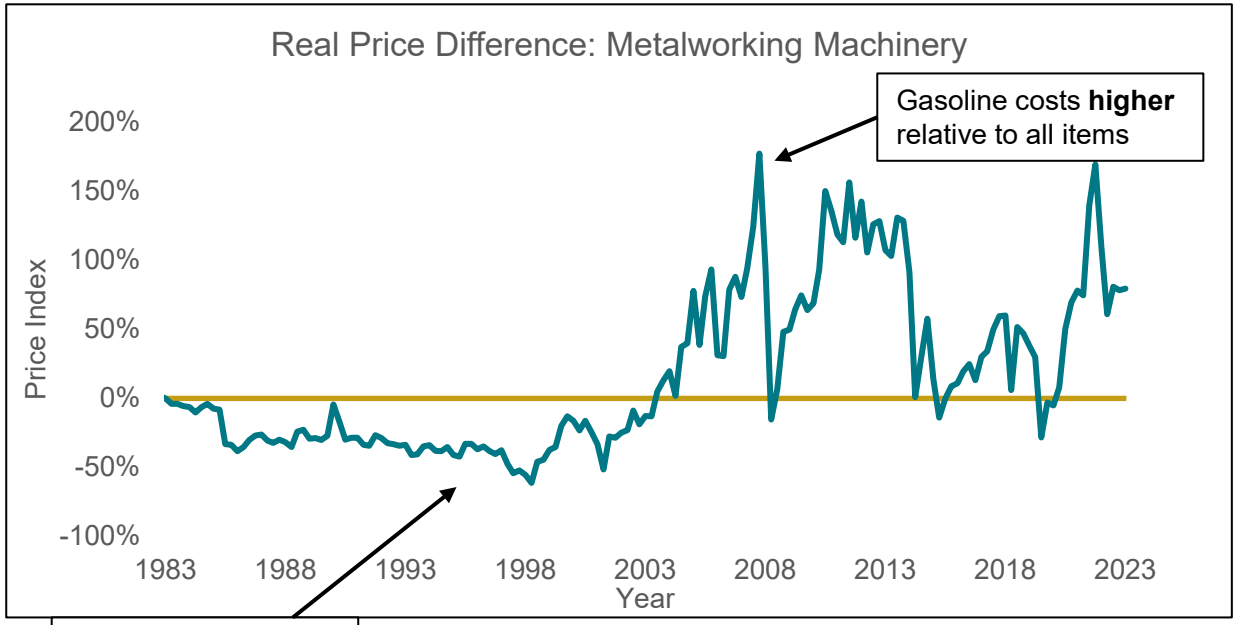


Inflation vs Escalation

Real Price Difference

- The difference between escalation and inflation
- A positive real price difference means costs for a specific item are increasing relative to inflation (all items)
- Real price gives context to costs of historical prices and purchases





Escalation Methodologies

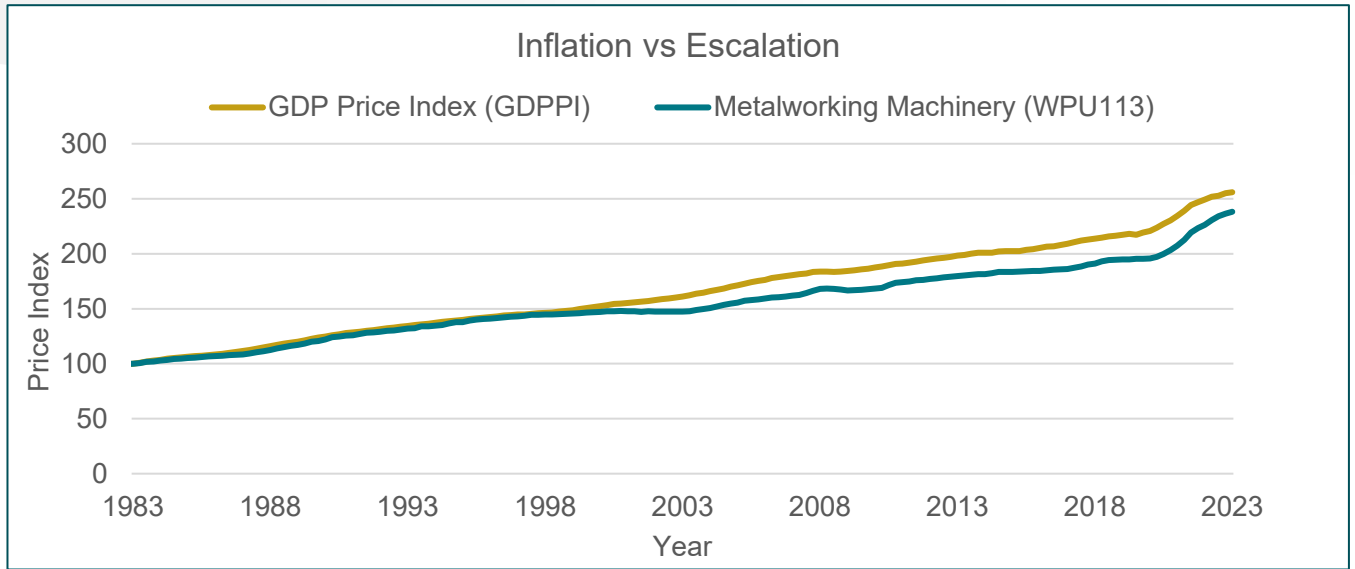
Escalating Programmatic Equipment

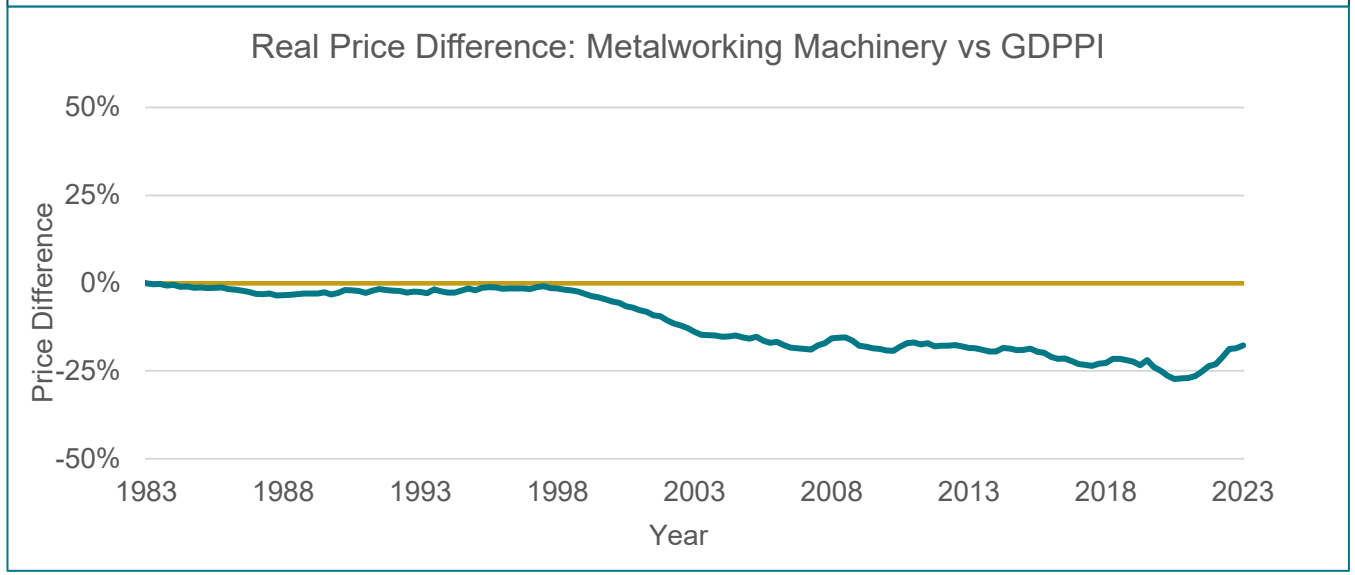
- Accurately escalating equipment costs is critical to proactive decision making on a portfolio level throughout the planned budget years.
- The following key attributes from the PRWG data can be used for calculating escalation:
  1. **Purchase Price** – dollar amount spent solely for the equipment itself. This does *not* include the costs related to installation, facility modification, and/or shipping the equipment (to name just a few additional expenditures).
  2. **First Day of Operation** – date the equipment was entered into service..
  3. **Lead Time to Procure** – time between the date of the purchase order to the first day of operation (includes time related to shipping, installation, tooling, testing, etc.).

Previous Methodology

Single Index – Producer Price Index WPU113

- Previously, the PRWG used the Producer Price Index for Metalworking Machinery (WPU113) to escalate all equipment costs.
- Producer price indices (PPIs) are derived from listed prices of domestically produced goods and services.
- PPIs are organized by industry following the distinctions outlined in the North American Industry Classification System (NAICS).
- The real cost of metalworking machinery has remained at or below GDPPI for the past 40 years.





Previous Methodology

Previous Method

- Used WPU113 (Metalworking Machinery) Index to escalate ***all*** PRWG equipment
- PRWG data used to primarily fit into the metalworking machinery category (lathes, welders, mills, etc.)
- The PRWG data has evolved over time and now houses a wide variety of programmatic equipment such as lab equipment, furnaces, high performance computers, and electrical equipment.
- These categories of equipment follow different trends than metalworking.
- See the example below for how an x-ray would be escalated using the previous methodology.

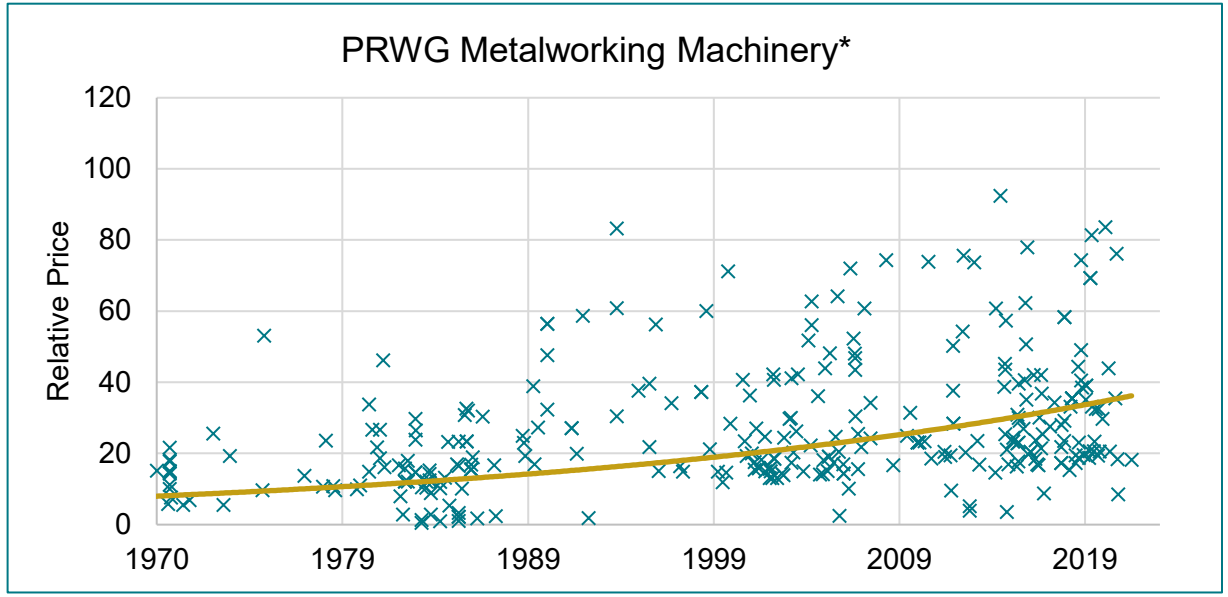
PRWG Collected Data				Previous Escalation
Equipment Name	First Day of Operation	Year	Purchase Price ($TY)	BY2023$ Purchase Price
North Star Imaging X3000	11/30/2019	2019	$925,280	$1,041,251
North Star Imaging X3000	9/21/2022	2022	$856,229	$894,460

Based on the previous methodology, the older equipment would cost MORE to replace than the newer equipment. Whereas the x-ray should cost LESS.

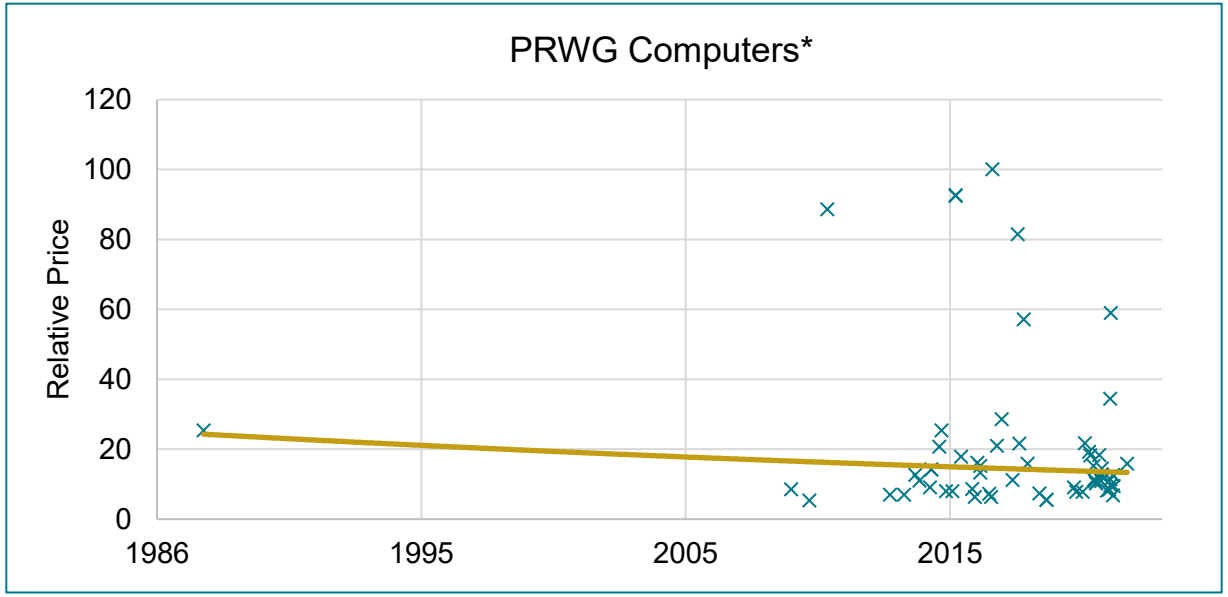
Previous Methodology

Issues with Single Index Escalation

- Different types of equipment are subject to unique cost drivers and will experience cost escalation at different rates.
- Using a single index to escalate all types of equipment removes the impact of inherent cost driver differences.
- Empirical analysis of equipment collected by the PRWG shows divergent behavior between different types of equipment. The charts below show the differences between two types of equipment: Metalworking Machinery and Computers.



Annal Escalation = 2.9%



Annal Escalation = -1.7%

*Charts exclude outliers

Empirically Derived Escalation Rates

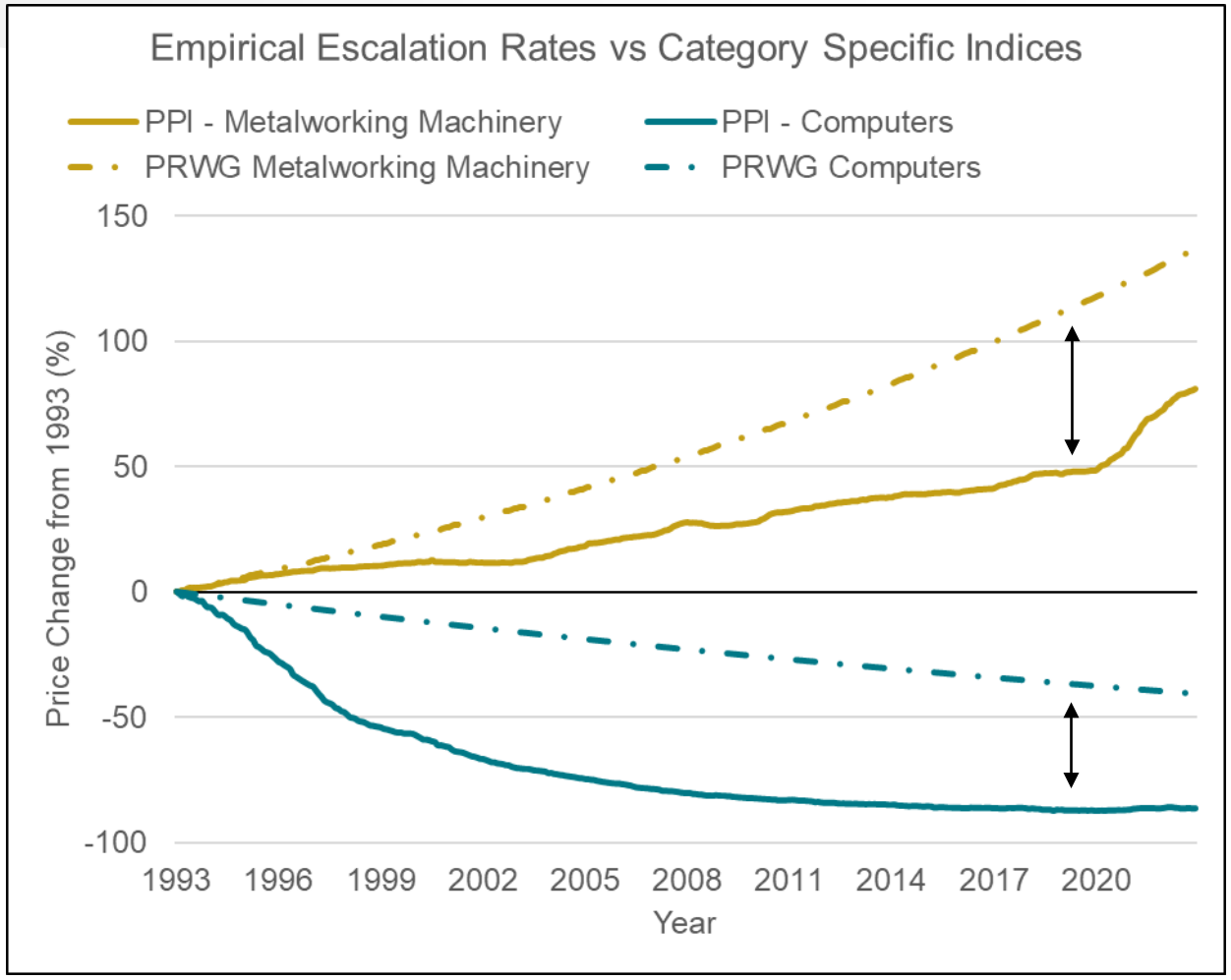
- Cost trends vary across major equipment categories.
- Shop and lab equipment are **increasing** in cost.
- Computerized equipment are **decreasing** in cost.
- Interestingly, microchip fabrication equipment is increasing in cost (+1.6%), while computers, which are reliant on microchips, are decreasing in cost (-1.7%).

Major Category	Cost Escalation / Year
Metalworking Machinery	**2.9%**
Furnaces	2.2%
Lab Equipment	1.9%
Microelectronic Fabrication	1.6%
Misc. Equipment	1.5%
Vehicles	1.3%
Measuring and Lenses	0.6%
Electrical Equipment	-0.1%
Alignment Equipment	-1.0%
Computers	**-1.7%**

New Methodology

Index-Based Empirical Escalation by Equipment Category

- Using **category specific indices** to escalate equipment costs preserves the impact of cost drivers unique to the equipment type.
- The dashed lines in the figure show the empirically derived annual cost changes of metalworking machinery and computers.
- The solid lines show the respective producer price indices for each machinery category.
- Category specific indices show similar trends to empirically derived cost changes.

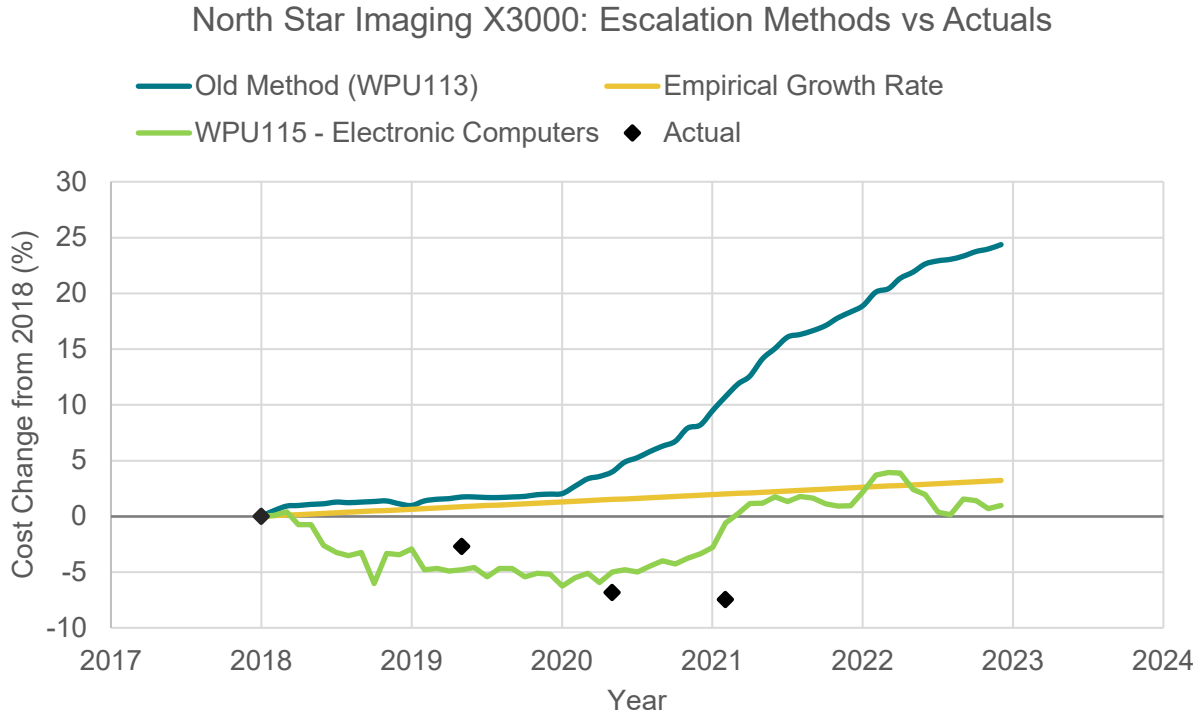


Gap between the index line and the empirically derived line could be representative of additional "NNSA Cost"

New Methodology

Index-Based Empirical Escalation by Equipment Category

- Comparing identical pieces of equipment purchased over time allows us to determine which escalation methodology is the best fit.
- For the North Star Imaging X3000, the index that best fit the observed escalation is the PPI for Electronic Computers (WPU115).



Escalated Cost Compared to Actuals (% difference)

Date	Previous Method	Empirically Derived	Index-based Empirical
4/1/2020	4.54%	3.64%	-2.16%
4/1/2021	11.58%	8.93%	1.95%
1/1/2022	19.66%	10.24%	7.44%

Impacts on Total Equipment Costs

- The new methodology, using a **category-specific index,** results in a small decrease in total escalated equipment costs.
- Older, computer-based equipment experienced the largest change.
- Escalated price changes can have a significant impact on optimization models that use budgets as a constraint.
- Better cost estimates allow decision makers to minimize cost overruns and identify cost-effective recapitalization opportunities.

Escalated Equipment Cost Impacts

Major Category	$BY23 Change % (New - Old)
Microelectronic Fabrication	23.4%
Electrical Equipment	22.3%
Vehicles	11.0%
Metalworking Machinery	2.2%
Furnaces	-6.6%
Measuring and Lenses	-7.6%
Computers	-8.6%
Alignment Equipment	-17.4%
Lab Equipment	-19.1%
Misc. Equipment	-32.1%
All Equipment	**-3.77%**

Limitations

Identifying Identical Pieces of Equipment

Equipment identified by the PRWG with the same make/model were assumed to be *identical.*

Optional manufacturer features or NNSA-required custom modifications (e.g., shielding or enclosures) are not noted in the equipment description.

Indices = COTS Equipment

Indices utilized in this analysis are based solely on commercial-off-the-shelf equipment.

This is not representative of all the customized equipment that NNSA often requires to accomplish its mission.

Purchase Date Estimated

The date used in the analysis is an estimate based on the equipment's **first day of operation** and the **lead time** required to procure it.

For the more volatile indices, a difference of just one month can impact the accuracy of the escalated price estimate.

Purchase Price vs. Listed Price

BLS producer price indices rely on listed prices for equipment, whereas PRWG estimates are based on the actual purchase price.

NNSA prices are generally greater due to the complicated nuances in the qualification process to sell to an agency supporting nuclear weapon safety and modernization.

Assuming a One-For-One Replacement

Most limiting assumption is that equipment will always be replaced with an identical piece of equipment.

As technology ages and scope evolves, new equipment will often incorporate significant upgrades and increased capabilities in comparison to the legacy equipment it replaces.

Conclusion

- Accurately escalating equipment costs is a critical input in the tools and models needed for proactive equipment recapitalization.
- A single index approach to equipment cost escalation obscures the effects of cost drivers unique to individual equipment categories.
- Empirical analysis of equipment costs demonstrated a difference in escalation by equipment category.
- The best approach to equipment escalation is using a **category-specific index** based on empirical data.
- Future analysis – escalation by supplier, evolving capability needs, NNSA specific cost drivers

Is there an opportunity to improve your escalation methodologies to improve fidelity in cost estimating?

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Thank You