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Executability Modeling to Support Improved Federal Budgeting

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Abstract–The Office of Program Analysis and Evaluation (PA&E) within the National Nuclear Security Administration (NNSA) is charged with leading programmatic cost estimating and associated analytical support throughout the federal budgeting process. Part of PA&E's support of NNSA leadership includes an assessment of individual program requests when resources are constrained, ensuring resources are allocated appropriately so that programs are ultimately neither over- nor under-funded.

To provide a more data-driven assessment, PA&E created an executability model. PA&E analyzed prior NNSA budgets against actual execution profiles, identified and grouped programs that follow similar executability profiles, and defined health metrics for assessing proposed budget scenarios. The executability model will help inform overall NNSA budgeting decisions, enable the rapid analysis of various budget scenarios, and promote effective portfolio management.

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Introduction

The NNSA is a semi-autonomous agency within the DOE that was established by Congress in 2000. NNSA is responsible for enhancing national security through the military application of nuclear science. The agency maintains and enhances the safety, security, and effectiveness of the U.S. nuclear weapons stockpile; works to reduce the global danger from weapons of mass destruction; provides the U.S. Navy with safe and militarily effective nuclear propulsion; and responds to nuclear and radiological emergencies in the U.S. and abroad [1].

The planning, programming, budgeting, and evaluation (PPBE) process serves as the annual resource allocation process for the Department of Energy (DOE) and is modeled after the process developed by the Department of Defense (DOD). The goal of this process is to provide a mechanism for making centralized resource allocation decisions to determine the most effective mix of forces, equipment, manpower, and support attainable within fiscal constraints [2]. With the help of PA&E, NNSA's core program management capabilities continue to improve through the centralization of budget processes, allowing the organization to make more informed decisions based on holistic data-driven information. The executability model seeks to provide the mechanism by which programmatic execution data can be categorized, analyzed, and translated into useful decision-making conclusions.

The executability model analyzes prior NNSA budgets against execution data generated from the DOE's primary accounting system, the Standard Accounting and Reporting System (STARS), to assess budget execution at various levels. This study focuses largely on the relationship between budget authority and the execution of budget authority in the form of costed funds, which can be affected by many program-specific variables. The executability model was developed to make comparable observations between programs' abilities to execute their spend plans at a high level. The model does not account for unique program or project factors that may affect performance, such as project schedule delays or site-specific staff turnover. While historic annual NNSA execution data provides important performance-related information, our team was limited in our ability to define program performance in a way that encompassed every factor. As such, our team sought to define the word "Executability" to capture the spirit of performance in a comparable manner, focusing heavily on the high-level execution of program-established spend plans.

Executability can be defined many ways. For the purpose of this study, the analysis team broadly defines executability as a function of two main drivers: change in the amount of funds a program requests from Congress (budget authority) and a program's actual execution of obligated funds (costs). Increasing the budget plan (and obligations) without correspondingly increasing the rate of execution leads to an excess of uncosted obligations (carryover).

The DOE receives its primary source of direct new budget authority through appropriation acts. Appropriation acts specify the period of obligational authority, of which there are three common periods: annual authority, multi-year authority, and no-year authority [3]. Unlike many Federal agencies, the DOE receives no-year authority for all of its activities, which refers to appropriations that do not restrict the time by which funds must be obligated. With no-year funding, the DOE is

able to request the reallocation of unobligated funds indefinitely while carrying over uncosted obligations into the next fiscal year [4]. The government's fiscal year starts in October and ends in September of the following year. For instance, fiscal year (FY) 2020 began on October 1, 2019 and ended on September 30, 2020. Congress passes appropriations legislation to fund the government for every FY.

Over time, inefficient execution of obligations over multiple years can cause carryover to compound, which can lead to larger budget management issues within the organization. Large carryover balances can also create risk, since Congress could reduce future obligated funds or alter future appropriations to DOE initiatives. Therefore, optimizing and managing execution in connection with the budget plan is essential for successful program management within the NNSA.

Background

In May 2020, PA&E initiated the executability analysis study to expand their suite of data-based assessments available for use in the PPBE process. This effort included understanding and developing potential programming scenarios and execution profiles for all NNSA program offices and improving the viability of program budget requests before they are submitted to Congress. The goal of this data-based effort is to provide PA&E additional budget justification materials and tools to support realistic and executable budget requests. Data-based assessments also help limit inaccuracies and improve decision-making reliability in the PPBE process.

Execution is increasingly becoming a topic of interest when discussing budget submissions. Over the past six years, some NNSA programs have struggled to execute obligation plans at an efficient level, resulting in large excess carryover balances throughout the NNSA budget. Carryover limits the ability to spread funding to other areas of the budget and reflects poorly on the programs that carry large amounts of unexecuted dollars. With future program requirements in mind, the analysis team developed various performance indicators and models to provide PA&E with meaningful, data-based approaches to reducing carryover balances and improving program execution.

Data Normalization Efforts

In February 2020, the DOE Office of the Chief Financial Officer presented the FY 2021 budget request in a new structure that consolidates various funding sources, better aligns with current and future workload, and improves transparency to the U.S. public and Congress. This restructuring introduced a number of major appropriation changes, including the renaming, consolidating, and regrouping of various elements within the organization [5].

The first phase of the study involved the normalization and restructuring of historic NNSA execution data. In August 2020 (and again in November 2020), the analysis team utilized the DOE Corporate Business Systems (CBS) Oracle Business Intelligence system (commonly referred to as

iPortal) to access and export historic NNSA budget data from the STARS database. Since the newly-introduced budget structure had yet to be implemented in STARS, the data remained organized in the budget structure from previous years. Through communication with PA&E and program offices, the analysis team leveraged current work breakdown structures to restructure the historic budget and reporting (B&R) codes within the new NNSA budget structure. The team verified these changes with PA&E with a high degree of confidence. The results of this effort will allow PA&E to use historic, data-based information to plan and predict future budget operations at an improved level.

The analysis team then restructured the historic data to match the NNSA's official FY 2020 budget stat table by aligning historic budget and reporting (B&R) codes with existing B&R codes within the current program budget structure. Additionally, the team compared and matched program, sub-program, project, and sub-project titles, descriptions, and locations to validate our mapping efforts. Approximately 2 percent of data lines included unavailable, undesignated, or incomplete data within STARS, which can be caused by the entry of new budget activities using previously-used budget codes or the retention of budget codes that are no longer in use.

Executability Analysis

The Executability Analysis Model is constructed in the official NNSA work breakdown structure (WBS), which defines and groups a project's discrete work elements in a way that helps organize and define the total work scope of the project [6]. The program attribute terms mentioned throughout this paper align with the language used in STARS. The STARS system language utilizes the term GPRA title to describe the groupings of activities conducted by NNSA programs. Conversely, the DOE Annual Congressional Budget Request uses the term "Program" to describe this same grouping of activities. Because our analysis uses the term "Program Office" to describe the offices within NNSA (such as Office of Defense Programs (NA-10)), we aligned our language with STARS to limit confusion and remain consistent with our data. The table below explains our team's use of these terms to describe the budget hierarchy in the context of our study.

WBS Hierarchy	STARS WBS Term	Description in Executability Analysis	Attribute Example
Level 1	Agency	The highest budget level analyzed in the Executability Analysis study.	*NNSA*
Level 2	Appropriation	An appropriation is an act of congress providing an agency or program with a specified amount of budget authority. There are four major appropriations within the current NNSA work breakdown structure (WBS).	*Weapons Activities, Defense Nuclear Nonproliferation, Federal Salaries and Expenses, Naval Reactors*
Level 3	Government Performance and Results Act (GPRA) title	GPRA title (also referred to as Program) is the term used to describe the aggregation or consolidation of similar program activities or initiatives within the NNSA WBS at one level below appropriation.	*Stockpile Management, Production Modernization, Global Material Security, etc.*
Level 4	Sub-program	The specific program activities or initiatives which combine to form a GPRA title (or Program). Sub-programs are one level below GPRA title (or Program) within the NNSA WBS hierarchy.	*Stockpile Major Modernization, Primary Capability Modernization, International Nuclear Security, etc.*

Table 1–Executability Analysis WBS Hierarchy

The analysis team focused on the funding attributes that particularly affect budget execution. These funding attributes, listed below, are defined as follows:

Budget Authority Available is authority provided by law to enter into obligations that will result in outlays of federal funds.

Obligated funds are binding agreements that result in payment to contractors. They reflect the amounts of orders placed, contracts awarded, services received, and similar actions requiring payments.

Costed (Current Year [CY] Costs) funds are the price or cash value of the resources used to produce a program, project, or activity. Current year costs refer to funds costed within a single fiscal year. Costed funds have been obligated to a contract and goods or services have been received by the contractor in exchange for the funds.

Uncosted funds have been obligated to a contract and goods or services have not been received by the contractor in exchange for the funds. This study refers to uncosted funds as "carryover."

- ***BEG Obs Uncosted*** refers to the beginning-of-year balance of cumulative uncosted obligations carried over from prior years.
- ***YTD Obs Uncosted*** refers to the end-of-year (EOY) balance of uncosted obligations for a given year.

Total Funds Available to Cost (TAC) is the sum of the following:

- Total uncosted obligations from prior FYs.
- Current FY obligations.
- Current FY deobligations (funds removed from the contract).

Threshold means a benchmark over which a balance carried over at the end of an FY should be given greater scrutiny by Congress. In the context of uncosted obligations, the threshold will be a percentage of TAC in a given year [7].

The execution rate of a program is the ability of the program to spend (cost) its obligated funding in a given year.

$$Execution\ Rate = \frac{\text{Costed Funds}}{\text{Obligated Funds}} \qquad \textbf{Equation 1}$$

There are cases in which conditions change and funds are no longer needed on particular contracts. As funds are removed from the contract (deobligated), a downward adjustment is recorded and reported to prior year unpaid obligations and are not available for obligation. Prior year deobligations with unexpired accounts require reapportionment by the Office of

Management and Budget (OMB) before being reissued for future obligation by the Office of Budget, Funds Distribution and Control Team [8].

Obligated funds that are not costed are added to the program's YTD Obs Uncosted (also referred to as "EOY carryover"). A program's carryover balance may be costed in subsequent years in a similar manner to a program's available budget authority. NNSA's total budget authority available has grown approximately 46 percent since 2015 while costed funds grew only 42 percent. While that five-year growth difference is only about 4 percent, the cumulative sum of annual differences creates a "carryover growth" problem.

NNSA	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	Overall Growth
Budget Authority Available	11.48 M	12.54 M	13.06 M	14.72 M	15.24 M	16.71 M	▲ 45.5%
		▲ 9%	▲ 4%	▲ 13%	▲ 4%	▲ 10%	
Current Year Costs	11.09 M	11.90 M	12.34 M	13.24 M	14.63 M	15.72 M	▲ 41.8%
		▲ 7%	▲ 4%	▲ 7%	▲ 11%	▲ 7%	
YTD Obligations Uncosted (Carryover)	4.59 M	5.25 M	5.93 M	7.22 M	7.76 M	8.56 M	▲ 86.6%
		▲ 14%	▲ 13%	▲ 22%	▲ 8%	▲ 10%	

Table 2–NNSA Overall Budget Authority Available, Current Year Costs, YTD Obs Uncosted

From FY 2015 to FY 2020, the total NNSA carryover balance grew 87 percent, partially due to compounding budget differences in each FY. To illustrate, budget authority in FY 2016 grew 9 percent while costs only grew 7 percent. That difference resulted in an EOY carryover increase of 14 percent. In FY 2017, NNSA increased execution by 4 percent to match the 4 percent increase in budget authority. However, to correct this issue, NNSA would need to raise execution above budget authority growth to reset the carryover effect from the prior year. This sharp increase in NNSA carryover balance from FY 2015 to FY 2020 could have been influenced by additional factors, such as an increase in capital construction projects, which were outside the scope of this study.

Defining Spending Efficiency

The analysis team developed a spending efficiency metric to measure a program's ability to spend (cost) all available funding (including obligated and carryover funds) within a given year.

$$Spending\ Efficiency = \frac{\text{Costed Funds}}{\text{TAC}} \qquad \textbf{Equation 2}$$

While NNSA does not have a required or recommended spending efficiency rate, the analysis team recommends that programs seek to increase their future spending efficiency. As shown in **Table 3**, spending efficiency varies across programs. Between 2015 and 2020, NNSA program offices averaged a spending efficiency rate of 71 percent with a maximum efficiency of 88 percent. A lower spending efficiency rate can be attributed to factors that affect a program's ability to spend funds, such as non-linear project cost schedules. (*Note:* Bolded NNSA

percentages at the bottom refer to the sum of all program offices and are weighted by relative program size in the spending efficiency calculation.)

Spending Efficiency (%) by Program Office	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	Average SE (%)	Volatility (%)
Program Office 1	86%	85%	88%	84%	86%	87%	86%	4%
Program Office 2	79%	77%	78%	76%	76%	71%	76%	8%
Program Office 3	54%	56%	56%	54%	52%	55%	54%	4%
Program Office 4	80%	78%	78%	71%	65%	65%	73%	15%
Program Office 5	85%	83%	74%	80%	81%	78%	80%	11%
Program Office 6	63%	59%	50%	46%	52%	55%	54%	16%
Program Office 7	77%	73%	70%	69%	69%	68%	71%	9%
Program Office 8	75%	72%	75%	73%	69%	64%	71%	11%
NNSA	**71%**	**69%**	**68%**	**65%**	**65%**	**65%**	**67%**	**6%**

Minimum: 46%	**Average:** 71%	**Maximum:** 88%

(percentages are shown in whole numbers for simplicity)

Table 3–NNSA Program Office Spending EfficiencyRrates

Analyzing Spending Efficiency

Spending efficiency is helpful to understand the amount of funding a program spends in a year relative to the amount that was available to the program in that year. By analyzing spending efficiency percentages across multiple years, programs can identify areas for improvement. High volatility in spending efficiency percentages over time indicates a need for greater control over the program portfolio(s) to reduce the likelihood of generating further excess carryover. More consistent spending efficiency percentages across consecutive years indicate the ability to execute funds as obligated in a given year. **Table 3** includes spending efficiency rates for the past six years for NNSA program offices. Specific budget line activities within a program portfolio can significantly impact the spending efficiency rates for a program portfolio. For example, Program Office A has budget lines X, Y and Z that all have a TAC of $3 million each. If budget lines X and Y both have 80 percent spending efficiency rates but budget line Z has a 50 percent spending efficiency rate, budget line Z's performance would bring the overall spending efficiency rate for Program Office A down to 70 percent.

For the purposes of this study, the analysis team did not evaluate spending efficiency rates as "good" or "bad," but rather, established spending efficiency as a measure within our framework to allow PA&E to make such assessments during the PPBE process. We did not examine *how* programs spent their funds, but instead examined whether they *did* or *did not* spend their funds

as a part of assessing the feasibility of new program budget requests. By including spending efficiency in the overall assessment of a program's executability, PA&E is able to facilitate stronger discussions with program managers regarding their ability to spend future funds.

Driving Spending Efficiency

There are four strategies for a program to increase spending efficiency. First, a program could increase its costed funds more than its TAC in a future year. For example, from 2016 to 2017, Program Office 2's spending efficiency rate increased by 1 percent because costed funds increased by over $300,000 while TAC only increased by $284,000:

$$Spending\ Efficiency\ = \frac{\text{Costed Funds}}{\text{TAC}} \qquad \textbf{Equation 2}$$

Spending efficiency increased from $\mathbf{77}\ \% = \frac{\$5.36\ \text{M}}{\$7.00\ \text{M}}$ in 2016 to $\mathbf{78}\ \% = \frac{\$5.67\ \text{M}}{\$7.28\ \text{M}}$ in 2017.

Increasing costed funds may be difficult for specific programs, since this requires program managers to prioritize how and where to spend funds among different program activities and projects within their organizations and sub-organizations.

Second, a program could reduce its TAC to increase its spending efficiency. Since TAC is the sum of total uncosted obligations from prior FYs (carryover) and current FY obligations, a program can reduce TAC by reducing either of those funding attributes:

$$TAC = \text{Carryover} + (\text{CY Obligations}) \qquad \textbf{Equation 3}$$

a. ***To reduce carryover in the CY,*** a program must cost more funds in the CY than obligated.

$$Carryover = \ Obligated\ Funds - Costed\ Funds \qquad \textbf{Equation 4}$$

The additional costed funds would pull from the prior year's carryover. Reducing carryover may be difficult for programs in the same way it is difficult for programs to increase costed funds. Costing more funds requires program managers to evaluate how and where to spend funds between different activities and priorities within their organizations. In the short term, programs may find it difficult to quickly ramp up their spending of funds. They may need to evaluate long-term approaches to increasing costed funds among activities.

b. ***To reduce FY obligations in the CY***, a program must request fewer funds in the following year than requested for the CY. Reducing FY obligations may pose a different set of challenges to programs, as program managers would likely have to reduce funding in one or more of their initiatives or projects, creating the possibility for schedule or contract delays. In practice, new initiatives within a program may affect the program's portfolio, but there may still be risk in a program's inability to receive the same level of funds in future years for initiatives that are similar or new to the existing program portfolio.

Since there are challenges associated with reducing obligations, the analysis team recommends that the best method for increasing a program's spending efficiency is to spend a greater percentage of the program's obligated funds. With the following metrics and tools, PA&E will help programs identify how much carryover is available to its programs so that program managers may better understand how much more they should plan to cost in the CY compared to FY obligations. These metrics and tools also display likely and possible paths to increasing spending efficiency above its current level.

Funding Category Performance

Each program performs a unique mix of functions within the NNSA organization, and as such, judging program performance can become a complex task. Each line in the NNSA budget is assigned a budget execution funding category based on the type of activity associated with the obligation. There are six established funding categories: Line-Item Construction Projects, Grants and Cooperative Agreements, Federal Operating Activities, Site/Facility Management Contracts (SFMC), Capital Equipment/General Plant Project/Accelerator Improvement Projects (CE/GPP/AIP)[1], and Life Extension Programs (LEPs)[2]. Funding categories are assigned an appropriate EOY carryover balance threshold. These thresholds are calculated as a percentage of the TAC in that year.

Funding Category	Carryover Threshold
Line Item Construction Projects	50%
Grants/Coops	45%
Federal Operating	17%
SFMC	13%
CE/GPP/AIP	50%
LEPs	45%

Table 4–Funding Category Thresholds

To illustrate using a simplified example, the maximum appropriate EOY carryover balance for a Line-Item Construction Project budget line with a CY TAC value of $10 million would be $5 million (50 percent). Any amount over the $5 million threshold is considered excess carryover. It is important to note that these thresholds apply to individual budget execution lines at the B&R sub-project task code level and not at the program or funding category level. The task is a further refinement of the sub-project level including single projects, a set of projects, or activities that are managed and coordinated as one unit with the objective of achieving outcomes and benefits that support the mission outlined in the program, sub-program, project, and/or the sub-project level [9] and are defined by a nine-digit classification code. These nine-digit classification codes provide a greater level of detail when assessing budget components and their execution rates.

[1] General Plant Projects (GPPs) and Accelerator Improvement Projects (AIPs) are minor construction projects not specifically authorized by law for which the total cost does not exceed the minor construction threshold (currently $20 million) [10].
[2] Life Extension Programs (LEPs) seek to extend the lifespan and ensure the continued safety, reliability, and effectiveness of weapons that have reached the end of their original design [11].

The analysis team used the budget execution funding category data field to identify the number of budget lines and dollar values within each funding category. The analysis team then identified the number of budget lines holding carryover balances above the threshold and the number of budget lines with above-threshold balances of $1 million or more. This allowed the analysis team to understand the relative significance of each category and the number of instances in which carryover was maintained by the activity. This allows PA&E to capture the quantity of excess carryover occurrences and areas in which high-value activities impact the budget.

	Number of Budget Lines		
	Non-zero	Over Threshold	Over Threshold (by $1M or more)
Line Item Construction Projects	**232**	166	100
Federal Operating	**3,800**	2,390	329
SFMC	**8,117**	5,551	1,340
Grants/Cooperative Agreements	**358**	205	60
CE/GPP/AIP	**972**	418	135
LEPs	**476**	186	57

Table 5–Number of Budget Lines per Funding Category

The analysis team observed funding category performance against the relevant threshold by taking the YTD Obs Uncosted as a percentage of the total available to cost in each year. With the exception of LEPs, funding categories held an EOY carryover balance exceeding the threshold in almost every year.

	(EOY Carryover / Total Available to Cost)					
	2015	**2016**	**2017**	**2018**	**2019**	**2020**
Line Item Construction Projects (50% threshold)	54%	51%	56%	65%	66%	59%
Federal Operating (17% threshold)	24%	28%	25%	28%	25%	32%
SFMC (13% threshold)	25%	26%	26%	27%	25%	27%
Grants/Cooperative Agreements (45% threshold)	47%	50%	66%	59%	52%	44%
CE/GPP/AIP (50% threshold)	52%	43%	56%	58%	52%	54%
LEPs (45% threshold)	-	30%	28%	30%	33%	35%

Table 6–Funding Category FY 2015 to 2020 Performance (%)

Executability Tool in the PPBE Process

The analysis team developed an executability tool for use by PA&E to model funding attributes, spending efficiency, and the relationships between funding attributes and spending efficiency by program portfolio and GPRA title. The tool also allows users to input a unique future projection of funding attributes to customize possible future budget execution scenarios.

All tabular and graphic output is filtered by either program office portfolio (such as NA-10) or GPRA title (such as Stockpile Management). This organizes and filters executability information by program and sub-program activities and streamlines comparisons between different programs and GPRA titles.

Unique Scenario Generator Tool

The scenario generator tool was created to help manage future carryover balances and establish more robust expectations for NNSA program execution. It provides users the ability to use historic program, appropriation, and execution data to make more informed decisions about future budget requests and the associated cost and obligation requirements. Budget managers can input tentative budget request figures at a detailed level to generate a reasonable range of impacts to beginning of year and EOY carryover for their program. The program office view allows budget managers to view the aggregation of their program's activities at a macro level when generating requests and evaluating possible impacts.

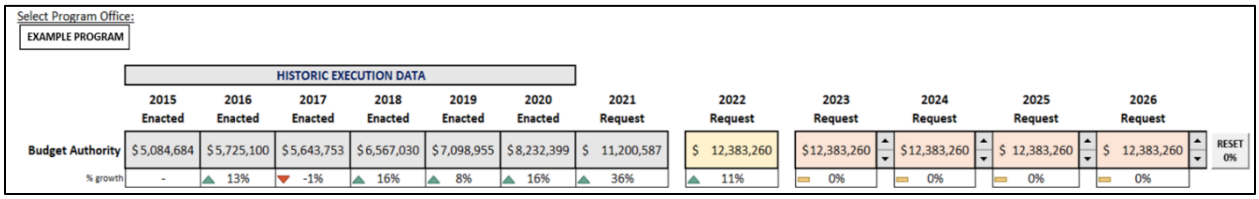

Figure 1–Scenario Generator: Budget Authority

The generator default values for FY 2023 onward begin at 0 percent (i.e., the identical budget request submission to FY 2022). For each year in the Future-Years Nuclear Security Program (FYNSP), these values can be increased or decreased by 1 percent increments using the up/down arrows. Changes in prior year budget authority are included as references to historic funds enacted.

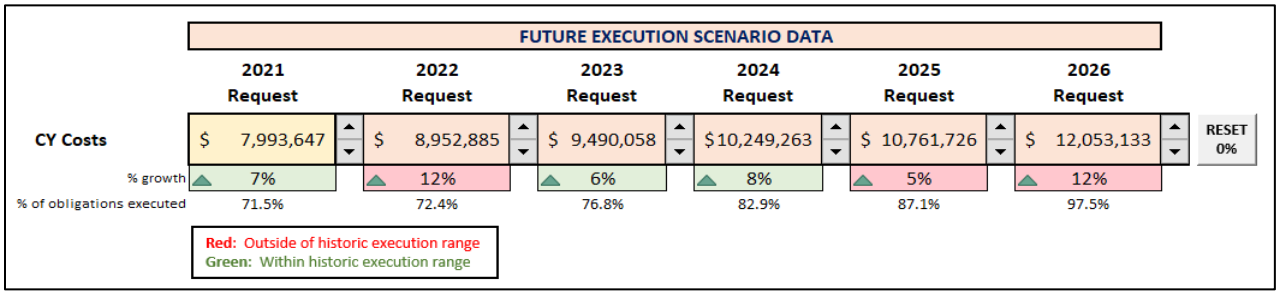

Figure 2–Scenario Generator: Future Cost Scenarios

The generator allows the user to change CY costs (execution) by 1 percent increments, simulating an increase/decrease in execution rates. Historic execution data is displayed as a reference for the bounds in which a given program office, appropriation, or GPRA unit was historically able to increase execution. For example, if a program office plans to ramp up execution next FY by 10 percent but its historic execution maximum increase was only 8 percent, the program would be

less likely to achieve that goal. Values outside of the historic execution range are highlighted in red, while values within the historic execution range are highlighted in green in the figures.

The amount of budget authority that a program obligates is dependent on the types of activities within its projects and initiatives. Though it is rare, programs can achieve obligation rates greater than a 100 percent from downward adjustments to prior year obligations. Since the budget authority must be allocated and obligated before it is costed, the scenario generator uses a historical average obligation rate to determine the approximate CY obligations from an inserted budget authority value. The generator calculates projected obligations as the following:

$$Projected\ Obligations = \text{Projected Budget Authority} * \text{Historic Avg Obligation Rate}$$

Equation 5

The historic obligation rates for NNSA programs are shown in **Figure 3**, with the average obligation rate (percent) used in the scenario generator:

Historic Obligation Rates (%)	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	Average Ob Rate (%)
Program Office 1	96.2%	99.1%	98.8%	102.3%	96.8%	99.1%	98.7%
Program Office 2	99.3%	99.5%	100.0%	99.9%	100.3%	99.7%	99.8%
Program Office 3	96.6%	102.0%	95.0%	90.9%	93.5%	91.3%	94.9%
Program Office 4	99.6%	100.4%	100.2%	99.1%	100.6%	99.4%	99.9%
Program Office 5	98.7%	99.8%	97.9%	102.1%	99.0%	90.9%	98.1%
Program Office 6	97.3%	99.5%	101.6%	100.0%	99.1%	100.1%	99.6%
Program Office 7	98.4%	100.5%	98.7%	95.2%	105.0%	100.7%	99.7%
Program Office 8	94.0%	106.5%	107.7%	99.4%	105.1%	98.5%	101.9%

Figure 3–Program Historic Obligation Rates (percent)

After manually setting the budget authority and costs projections, the user is then able to view the impacts to the beginning of year and EOY carryover in future years:

	FUTURE EXECUTION SCENARIO DATA					
	2021 Request	2022 Request	2023 Request	2024 Request	2025 Request	2026 Request
BOY Carryover	$ 2,989,864	$ 6,175,372	$ 9,582,053	$12,451,560	$ 14,561,863	$ 16,159,703
% of TAC	21.1%	33.3%	43.7%	50.2%	54.1%	56.7%
CY Obligations	$ 11,179,155	$ 12,359,566	$12,359,566	$12,359,566	$ 12,359,566	$ 12,359,566
% historic obligation rate						
EOY Carryover	$ 6,175,372	$ 9,582,053	$12,451,560	$14,561,863	$ 16,159,703	$ 16,466,136
% growth	177.9%	220.5%	101.6%	52.0%	29.8%	13.1%

Figure 4–Scenario Generator: Carryover and Obligations

The output of the unique scenario is displayed in a report using the visualizations described in the following section. In each graph, the user's input is distinctively marked to clearly show how likely or realistic the projected scenario is. The goal of this report is to help users incorporate their drafts or planned budget plans with historic and estimated projections to (1) demonstrate their planned budget plans and whether they can execute the funds they request and (2) show users the amount of funds they can use to increase their spending efficiency.

FYNSP Projections and Methodology

The analysis team uses historic (2015 to 2020) data to estimate future (2021 to 2026) funding attributes and spending efficiency by program portfolio and GPRA title. These estimates focus on obligations and costed funds, since these drive the other funding attributes and spending efficiency rate. Future estimates include the maximum historic year-over-year change in obligations (and costed funds) and the linear statistical projection with prediction intervals.

1. ***The Maximum Historic Year-over-Year*** change was calculated by identifying the largest year-to-year changes in historic data (2015 to 2020) in the budget authority (BA) available and costed funds.

$$CY\ Obligations = (\text{Sum of FDS BA Available}) * (\text{Max } \Delta \text{ FDS BA Available}) \quad \textbf{Equation 6}$$

$$CY\ Costs = (\text{Sum of CY Costs}) * (\text{Max } \Delta \text{ CY Costs}) \quad \textbf{Equation 7}$$

   This future estimate portrays the hypothetical growth a program office could execute, if in the future the program executes at the greatest level it has executed at in the past.

2. ***The Linear Statistical Projection and Predication Intervals*** were calculated individually for obligations and costed funds with a 95 percent confidence level. Using these prediction intervals, the analysis team found that future estimated obligations and costs can overlap and alter future spending efficiency.

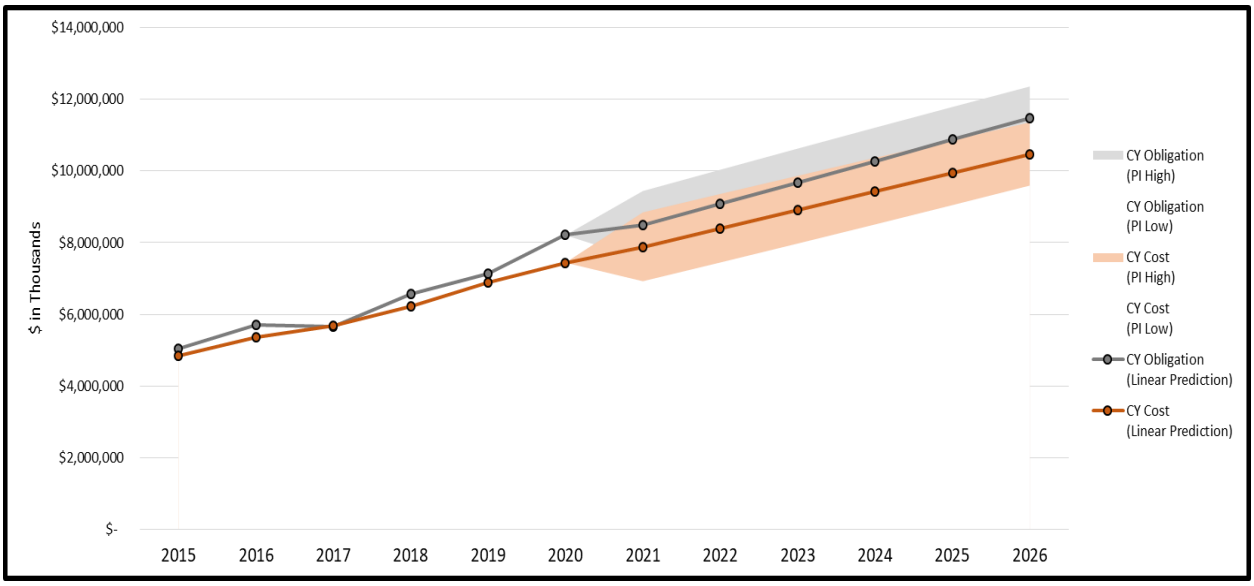

Figure 5–Current Year Obligations and Costs, Program Office 2

Figure 5 shows overlap between projected future obligations and costs. This indicates that it is possible for Program Office 2 to cost more funds than it is obligated and, in turn, increase its future spending efficiency.

Data Visualization

The report output of the executability tool includes six unique graphs of funding attributes and spending efficiency. Each graph includes historic (2015 to 2020) and projected (2021 to 2026) program office or GPRA-specific scenario data. (*Note:* The carryover displayed is beginning year uncosted obligations [i.e., beginning year carryover].) This means that carryover appears to lag by one year in estimated projections (starting in 2022) from other funding attributes, since it is already known at the beginning of 2021 while other funding attributes are not fully known until the completion of 2021.

Figure 6 provides a snapshot of the selected program office or GPRA historic (2015 to 2020) and linear projection (2021 to 2026) of obligations, carryover, and costed funds. Obligations and carryover are shown as a part of a single bar, since

$$TAC = \text{Carryover} + \text{Sum of CY Obligations} \qquad \textbf{Equation 3}$$

(*Note:* Costs are always less than total obligations available to cost each year.)

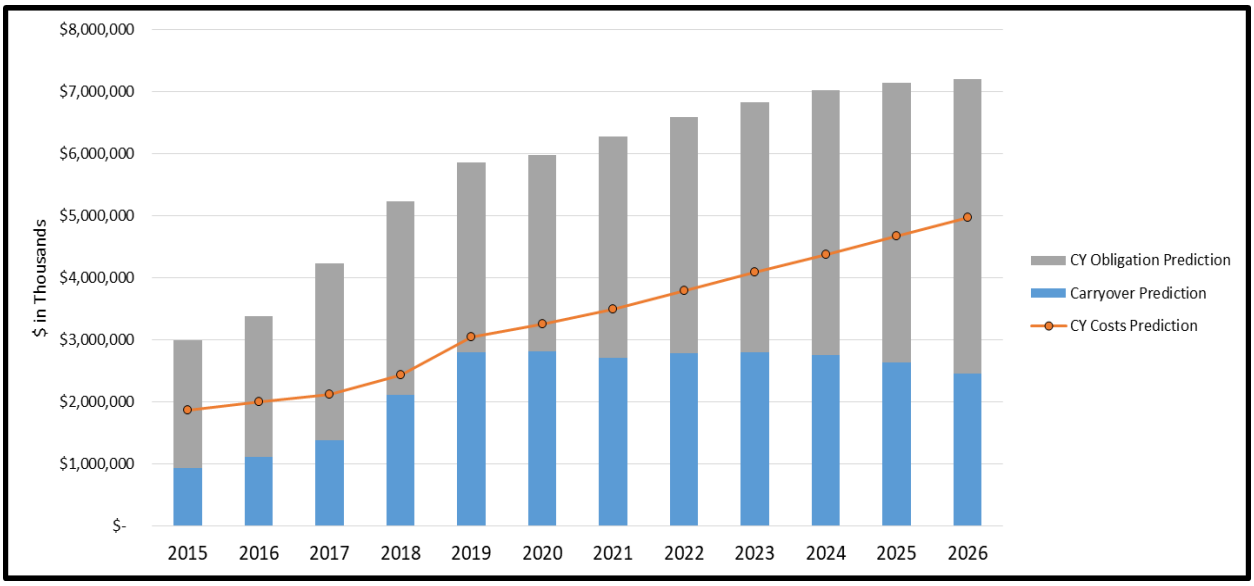

Figure 6–Historic and Projected Funds, Program Office 6

Figure 7 displays carryover against spending efficiency. This graph most clearly displays the carryover funding attribute that PA&E recommends programs focus on decreasing to increase their spending efficiency over time. Since

$$Spending\ Efficiency\ = \frac{\text{Costed Funds}}{\text{TAC}} \qquad \textbf{Equation 2}$$

and

$$TAC = \text{Carryover} + \text{Sum of CY Obligations} \qquad \textbf{Equation 3}$$

decreasing future carryover (as shown in the projections) will increase spending efficiency over time.

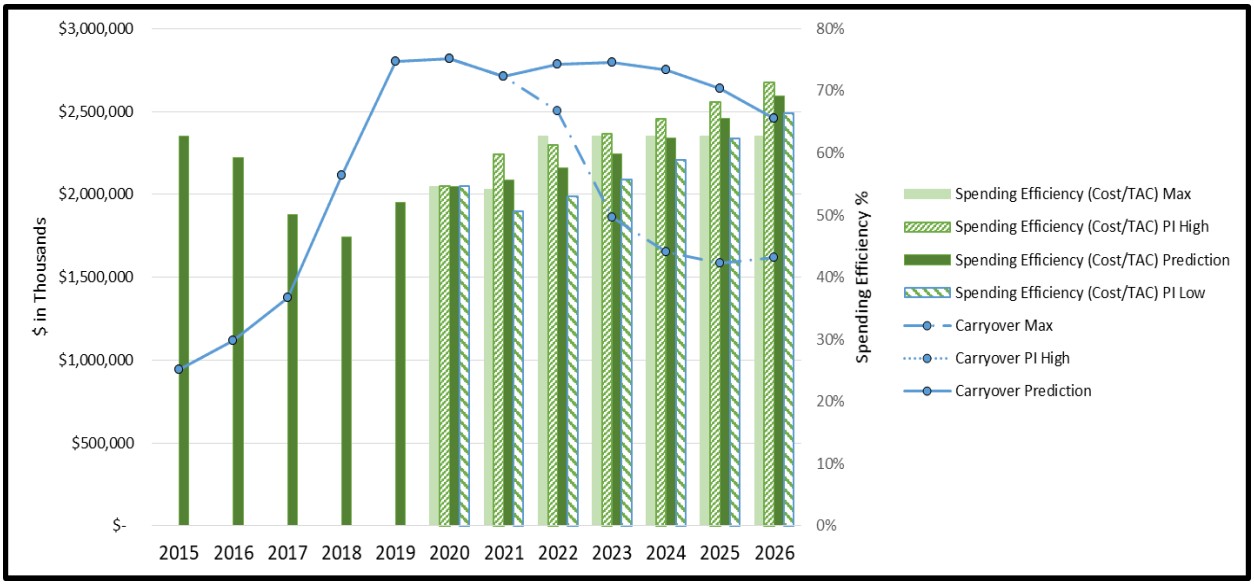

Figure 7–Carryover and Spending Efficiency, Program Office 6

Figure 8 is a more detailed version of **Figure 6**. **Figure 8** includes the historic estimate, projected linear estimate, projected linear prediction interval estimates, and maximum annual change projected estimate of obligations, carryover, and costed funds. Here historic costs are often very close to, but still below, historic obligations. This means that carryover continued to increase over time.

However, it is possible for future projected costs to exceed future projected obligations, as the prediction intervals for future projected obligations and costs overlap. Below, the projected linear obligations and high-projected linear costs overlap. This indicates that spending efficiency will likely increase in future years.

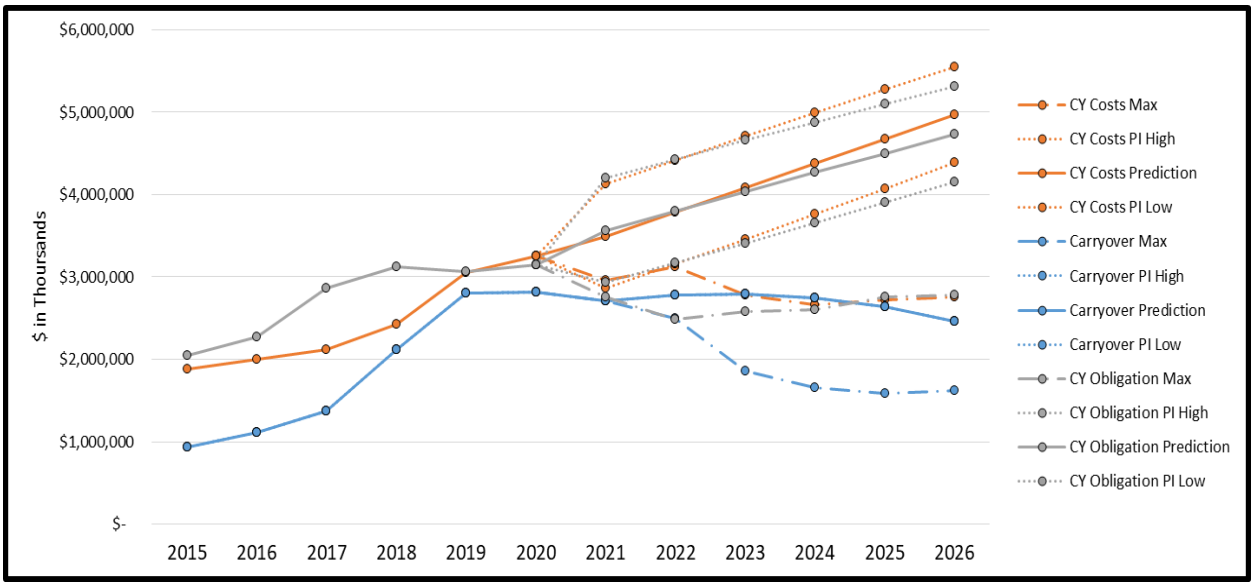

Figure 8–Detailed Historic and Projected Funds, Program Office 6

Figure 9 pulls out the same spending efficiency rates as displayed in **Figure 7**. This provides a snapshot of historic and future projected spending efficiency rates to programs. The colored areas mark the probability of the program's ability to achieve that spending efficiency rate.

- Green indicates "very likely" to achieve. This is between the linear statistical prediction interval (high and low) spending efficiency rates. The linear statistical projection spending efficiency rate is at the center of this area.
- Yellow indicates "likely" to achieve. This is between the high linear statistical projection and the maximum historic year-over-year change. In **Figure 9**, the green "very likely" area overlaps with the yellow "likely" area, since the linear statistical prediction interval spending efficiency rates overlap with the maximum historic year-over-year change spending efficiency rates.
- Red indicates "unlikely" to achieve. This is above the maximum historic year-over-year change.
- White indicates "possible" to achieve. This area is below the low linear statistical projection spending efficiency rate.

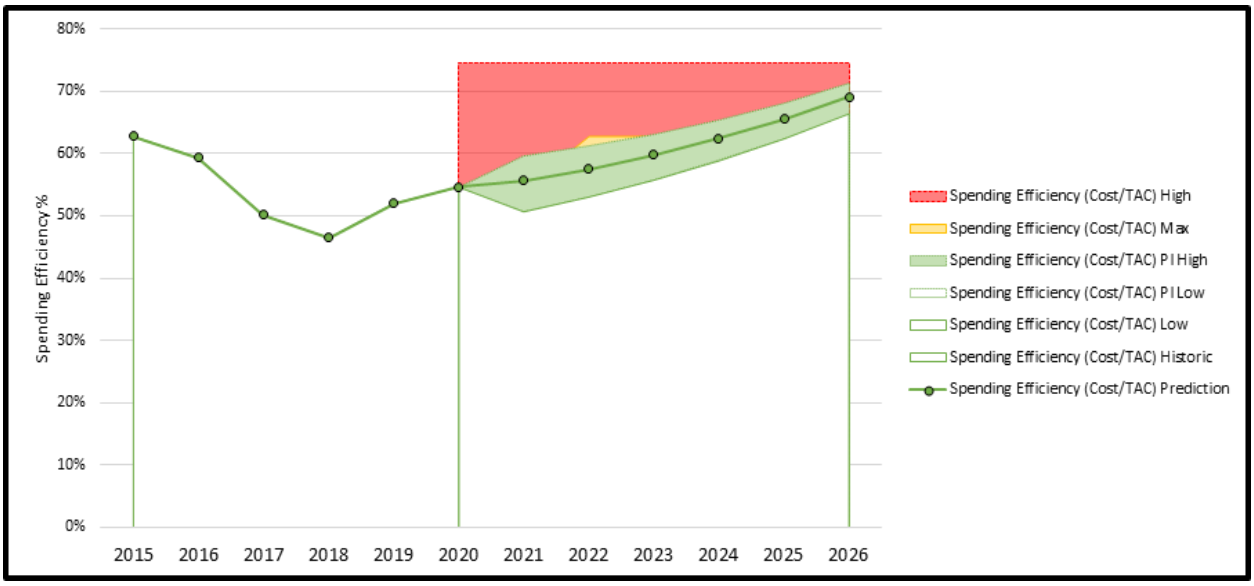

Figure 9–Spending Efficiency, Program Office 6

Figure 10 and **Figure 11** are similar to each other. **Figure 10** shows costed funds as bars underneath the total available funds to cost. (*Note:* Historic costs are almost always below total available funds to cost, which creates consistently large amounts of historic carryover as shown in the above graphs [**Figure 6**, **Figure 7**, **Figure 8**]). Future costed funds are also nearly always greater than future total available funds to cost. This is not a bad scenario, as costed funds do not need to be greater than total available funds to cost to improve spending efficiency.

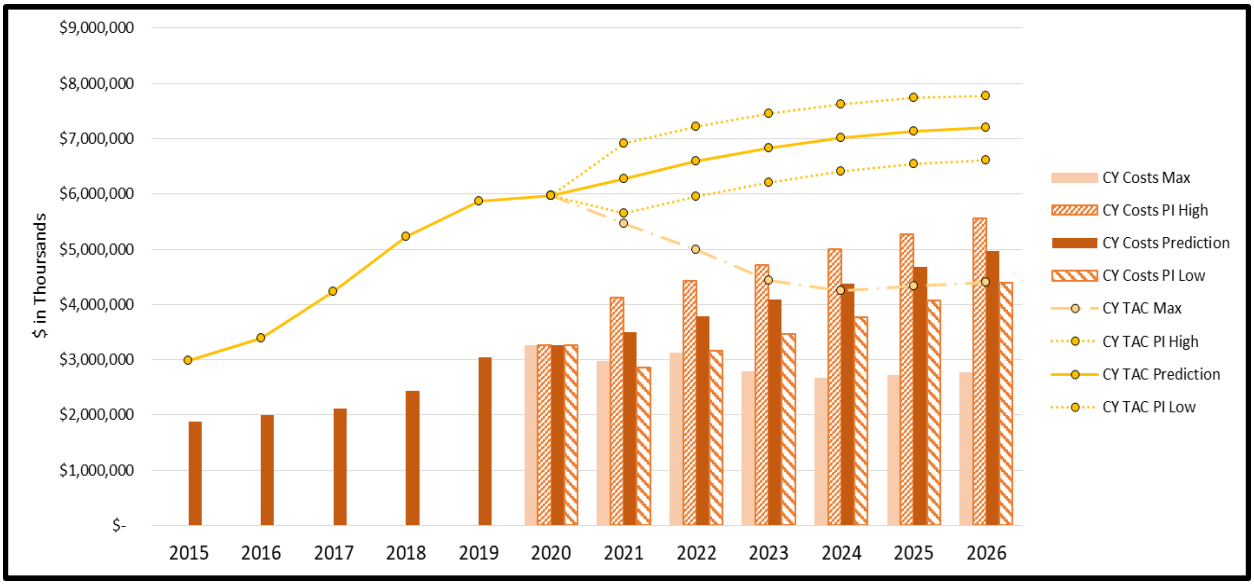

Figure 10–Current Year Costs and Total Funds Available to Cost, Program Office 6

Like **Figure 10**, **Figure 11** shows costed funds as bars against total available funds to cost. However, **Figure 11** splits total available funds to cost into obligations and carryover. When costed funds are greater than obligations, carryover decreases.

$$Carryover = Obligated\ Funds - Costed\ Funds$$ **Equation 4**

This in turn increases spending efficiency (as shown in **Figure 7** and **Figure 9**).

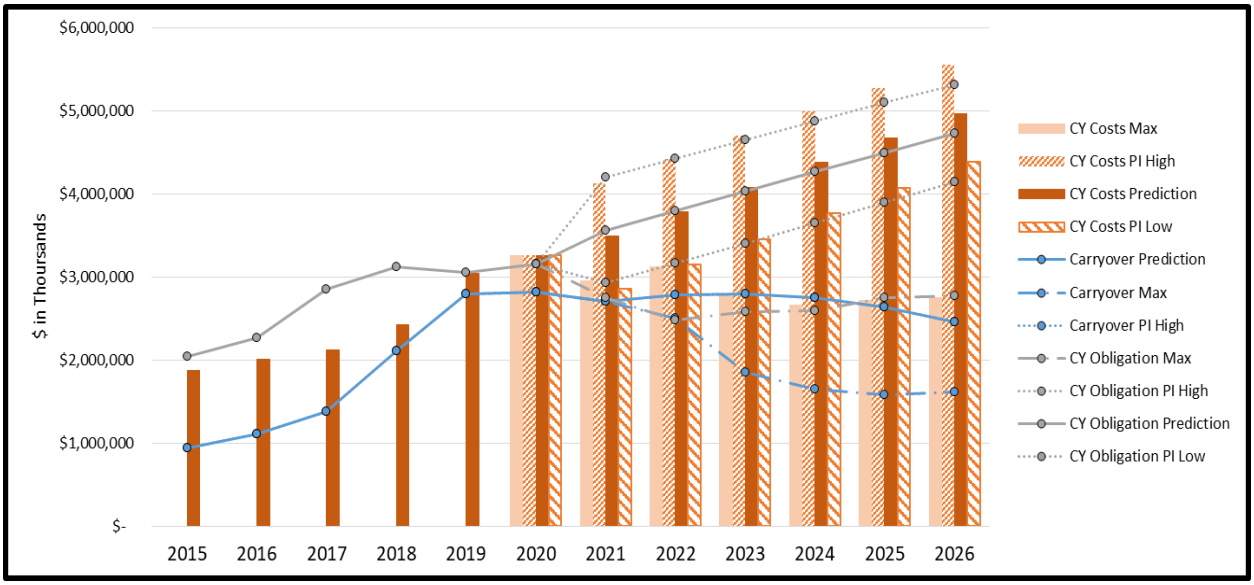

Figure 11–CY Costs and Obligations and Carryover, Program Office 6

Conclusion

While this study does not contain every answer to improving program execution, it does provide data-driven methodologies, tools, and insights to increase understanding of and improve budget execution planning for PA&E and NNSA. In practice, this study will enhance informed decision-making for PA&E as the office maintains budget processes across NNSA. Understanding the relationship between carryover and spending efficiency within the framework of the executability model will aid PA&E's ability to effectively identify and evaluate potential solutions for achieving program management goals within the NNSA. This model will provide an additional resource to understand the effects of program-level actions on budget execution and further develop the communication between PA&E and program managers in the budget formulation process. In addition, the scenario generator will serve as a unique planning tool to aid budget managers in achieving future execution and carryover reduction goals.

Each year, budget requests continue to increase for the NNSA as a whole. Since no-year funding is absent of FY limitations on obligations, the impact of execution is extremely important in reducing excess carryover balances. The analysis team intends to apply the results of this study to support PA&E's efforts to increase executability in NNSA programs.

References

1. National Nuclear Security Administration, "About NNSA," United States Department of Energy, 2021. [Online]. Available: https://www.energy.gov/nnsa/about-nnsa. [Accessed 23 March 2021].
2. Department of Defense, "DOD Directive Number 7045.14 - The Planning, Programming, Budgeting, and Execution (PPBE) Process," Department of Defense, Washington, D.C, Amended 2017.
3. Department of Energy, "Chapter 2 - Administrative Control of Funds," in *Agency Financial Handbook*, Washington, DC, Department of Energy, 2020, pp. 2-4.
4. United States Government Accountability Office, "RCED-95-91R DOE's No-Year Funding," Government Accountability Office (GAO), Washington, DC, 1995.
5. Department of Energy, "FY 2021 Congressional Budget Request for National Nuclear Security Administration," 2020.
6. Booz, Allen & Hamilton, "Earned Value Management Tutorial Model 2: Work Breakdown Structure," Office of Science, Tools & Resources for Project Management, Washington, D.C., 2011.
7. United States Congress, "William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021," Washington, DC, 2020.
8. Department of Energy, "Chapter 5 - Accounting for Obligations (Section 6)," in *Agency Financial Handbook*, Washington, D.C, 2020, pp. 1-13.
9. IDW, Oracle Business Intelligence, "Metadata Dictionary: STARS Status of Obs Summary, Program Attributes - AFF Seg 7 "B&R Sub-project Task Code"," Oracle, 2020. [Online]. [Accessed 2020].
10. Department of Energy, "Chapter 24 - Minor Construction," in *Agency Financial Handbook*, Washington, D.C., 2020.
11. National Nuclear Security Administration, "Maintaining the Stockpile," United States Department of Energy, 2021. [Online]. Available: https://www.energy.gov/nnsa/missions/maintaining-stockpile. [Accessed 24 March 2021].

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