

STRATEGIC ASSET MANAGEMENT PLAN 2022

This Strategic Asset Management Plan documents Transmission's current state and maturity in asset management organization, people, processes and systems. The SAMP recommends asset management improvement actions to be implemented across the full asset lifecycle to better create and deliver value for BPA's ratepayers and stakeholders, while also ensuring long term grid safety and reliability.

*For Transmission
Category*

Table of Contents

1.0	EXECUTIVE SUMMARY	4
2.0	ACKNOWLEDGEMENTS	6
2.1	Senior ownership.....	6
2.2	Strategy Development Approach.....	7
2.2.1	Key Contributors.....	7
2.2.2	Key Activities.....	7
3.0	STRATEGIC BUSINESS CONTEXT	7
3.1	Alignment of SAMP with Agency Strategic Plan	7
3.2	Scope.....	8
3.3	Asset Description and Delivered Services.....	9
	<i>Table 3.3-1, List of Major Assets.....</i>	<i>9</i>
3.4	Demand Forecast for Services.....	11
3.5	Strategy Duration	13
4.0	STAKEHOLDERS.....	13
4.1	Asset Owner and Operators	13
4.2	Stakeholders and Expectations	13
	<i>Table 4.2-1, Stakeholders.....</i>	<i>14</i>
	<i>Table 4.2-2, Customer Breakdown.....</i>	<i>15</i>
5.0	EXTERNAL AND INTERNAL INFLUENCES	15
	<i>Table 5.0-1, External Influences (Opportunities & Threats).....</i>	<i>16</i>
	<i>Table 5.0-2, Internal Influences (Strengths & Weaknesses).....</i>	<i>17</i>
5.1	SWOT Analysis	19
	<i>Table 5.1-1: SWOT</i>	<i>20</i>
6.0	ASSET MANAGEMENT CAPABILITIES AND SYSTEM.....	21
6.1	Current Maturity level.....	22
6.2	Long Term Objectives.....	27
6.3	Current Strategies and Initiatives	29
6.4	Resource Requirements.....	30
7.0	ASSET CRITICALITY.....	30
7.1	Criteria.....	30
7.2	Usage of Criticality Model	33
8.0	CURRENT STATE.....	35

8.1	Historical Costs.....	35
8.2	Asset Condition and Trends.....	37
8.3	Asset Performance.....	40
8.4	Performance and Practices Benchmarking.....	42
9.0	RISK ASSESSMENT.....	42
10.0	STRATEGY AND FUTURE STATE.....	51
10.1	Future State Asset Performance.....	52
10.2	Strategy.....	52
10.2.1	Sustainment Strategy.....	53
10.2.2	Growth (Expand) Strategy.....	60
10.2.3	Strategy for Managing Technological Change and Resiliency.....	62
10.3	Planned Future Investments/Spend Levels.....	62
	<i>Figure 10.3-1, Capital and Expense Future Spend.....</i>	64
	<i>Figure 10.3-2b, Capital Future Spend – Low Range.....</i>	Error! Bookmark not defined.
	<i>Figure 10.3-3, Asset Management Expense Future Spend.....</i>	65
10.4	Implementation Risks.....	65
	<i>Table 10.4-1, Implementation Risks.....</i>	65
10.5	Asset Conditions and Trends.....	67
10.6	Performance and Risk Impact.....	68
11.0	Addressing Barriers to Achieving Optimal Performance.....	70
12.0	DEFINITIONS.....	72

1.0 EXECUTIVE SUMMARY

Transmission's objective is to remain the transmission service provider of choice, by assuring we maintain financial strength, safety, reliability and competitiveness, while continuing to meet our multiple statutory responsibilities and delivering the public benefits that are so valuable to the region. Transmission's Strategic Asset Management Plan (SAMP) documents the current state and describes planned asset management improvements, maturity and competencies needed to effectively and efficiently manage the entire lifecycle of BPA assets that deliver electric transmission services. The SAMP was developed through coordination with numerous internal stakeholders and is aligned with the Agency strategy, Transmission Business Model, stakeholder requirements, organizational objectives and resulting asset management objectives.

Transmission Services manages nearly \$5 billion in depreciated assets for substations, transmission lines and communication infrastructure that is critical to the Northwest economy. The system comprises about three-fourths of the Northwest region's high voltage transmission assets. BPA's Transmission system spans approximately 300,000 square miles and includes more than 15,000 circuit miles of transmission lines, 3,500 miles of fiber, over 260 substations and 732 telecommunication facilities. These assets deliver electric power, directly or indirectly, to a population of more than 12 million through four main product categories:

- Transmission service to regional utilities and merchant entities
- Generation and line & load interconnections
- Interregional transfers of capacity and energy
- Ancillary services, such as regulation and load following services

For the 2022 refresh, Transmission Services surveyed a broad cross section of internal stakeholders to assess asset management maturity. The maturity scores ranged, on average, from 1.2 to 1.5 (out of a possible 4). In comparison, the 2020 scores averaged 1.5 to 1.9. The new maturity scores can be attributed to: more levels of the organization represented; stakeholders more familiar with Institute of Asset Management (IAM); and a more accurate internal capabilities rating due to increased knowledge of AM by staff. Though scores decreased slightly, continual cultural focus at all levels of the organization has allowed for growth and continued maturation, with numerous plans for future development over the next several years which is critical for the continued advancement of the AM Program.

Transmission was impacted by the COVID-19 pandemic, and execution rates decreased in 2020 due to pandemic impacts. The supply of materials was challenging as well as the ability for labor to perform onsite work. Precautionary work stand-downs also impacted project delivery in some locations during wildfire season.

Transmission continues to stay focused on strategic efforts to get more work done, get the right work done, and to do the work at the right time. Recent accomplishments and future plans include:

SCM – Secondary Capacity Model - *Get more work done*

The Secondary Capacity Model, a scalable delivery model using external, contracted resources as an Owner's Consultant and a Progressive Design Builder is now fully developed and operational. In FY22/FY23, we are anticipating a ramp up in the amount of capital work that will get done using this new delivery model.

CHR – Criticality, Health and Risk - *Do the right work*

Transmission continues to develop and mature our Criticality, Health and Risk methodologies and capabilities. CHR has advanced in its analytics, with comprehensive health scoring and the ability to apply the Reliability and Safety criticality dimensions at an asset level, for substation and line assets. Data is integrated into Cascade and this capability represents an advancement in AM maturity in 2021. We are utilizing CHR data to inform our decisions, discovering more, and continuing to add assets and aspects as appropriate for decision-making.

TPOT – Transmission Portfolio Optimization Tool - *Do the work at the right time*

As we look towards the future, we are developing a plan to optimize our portfolio of work. We are currently benchmarking with other utilities to understand benefits and potential cost savings from this type of tool; and we are preparing our business process documentation in order to get ready for determining what features are required in an application. Though timing is uncertain based on budget and resource availability, Transmission currently plans to begin the IT capital process in FY24 and to begin implementation of the tool.

Thereafter, Transmission's capital program will ramp up at a progressive pace over the next few years to meet system replacement (capital-sustain) program needs and to meet Project Funded in Advance (PFIA) (customer) program needs (driven in part by Renewable Portfolio Standards (RPS)). Transmission system expansion will be dominated by compliance and customer-driven interconnection requests to serve continuing growth in renewable generation and large loads, specifically data centers. Energy storage projects are on the horizon and may require system reinforcement when built. BPA and the region are increasingly looking to commercial and technical alternatives to meet dynamic system demands and therefore large infrastructure builds will continue to be augmented with a scalable flexible approach until they are ultimately required.

Transmission is continuing to mature its asset management program and capabilities and to monitor and mitigate challenges (both internal and external) in order to respond to and adapt to an evolving industry and changing environment.

2.0 ACKNOWLEDGEMENTS

2.1 Senior ownership

Transmission is proud to deliver on its important mission of reliably and safely operating the grid to serve as an engine of economic development. From 2020 through 2022, Transmission adapted to pandemic factors, wildfire risks, resource limitations, and other regional/industry changes while continuing to evolve and mature its asset management program and mitigate risks facing Transmission and the agency as a whole.

Transmission leadership will continue to support and advance SCM through FY22/23. The delivery of SCM is key in supporting the success of Asset Management. In addition, the Criticality, Health and Risk capability is continuing to develop, adapt and mature to support asset management decision making. Transmission is also actively engaged in business readiness work to support requirements for a Portfolio Optimization Tool. Transmission is proud to respond to and deliver on customer interconnection requests to support economic development, meeting Renewable Portfolio Standards in the region, and continue development of comprehensive study and regional planning activities to maintain or enhance the reliability and safety of the system.

As senior vice president, I am committed to Transmission periodic updates of the SAMP, development of Asset Plans, implementation of a risk assessment and evaluation methodology, and employing maintenance analytics and reliability engineering to make integrated maintenance/replacement decisions. These initial asset management competencies will enable Transmission to prioritize the highest value actions across the entire asset lifecycle to maintain reliability even during a period of intense interconnection activity.



Richard Shaheen
Senior Vice President, Transmission

2.2 Strategy Development Approach

2.2.1 Key Contributors

A review performed in Fall 2021 revealed that the primary strategic drivers articulated in the 2020 SAMP remain relevant in our 2022 refresh. It was also clear that some changes were needed as a result of pandemic impacts, resource availability, and other factors. Primary strategic feedback for the 2022 refresh have been provided by the Transmission Asset Manager as well as by leaders in Transmission Engineering, Transmission Planning, Transmission Field, Supply Chain, and Transmission Technology.

Transmission aspires to broaden the exposure of Asset Management within our workforce. Accordingly, over 40 individuals completed the Maturity Level Assessment across all areas of Transmission, and at various levels within the organization.

While key contributors and specified owners are identified for key initiatives, programs and projects for the delivery of Transmission’s strategy, every team member within Transmission plays a role, has responsibility and can add value to implement the prescribed activities and methodologies to balance asset performance, identify and manage risks and maximize Total Economic Value.

2.2.2 Key Activities

As mentioned in 2.2.1, the primary activities to prepare for the SAMP refresh were repeated strategy/dialogue conversations with leaders, as well as the Maturity Level Assessment. Leaders and staff also provided written feedback, and cross organizational collaboration between Transmission, Finance, and Risk also furthered the maturity of the SAMP. The following topics helped facilitate the collaborative dialogue:

- BPA Strategic Plan
- Transmission Business Model (TBM)
- Transmission Asset Plan
- Internal and External Influences
- SWOT analysis
- Transmission Plan

3.0 STRATEGIC BUSINESS CONTEXT

3.1 Alignment of SAMP with Agency Strategic Plan

BPA’s vision is to be an engine of the Pacific Northwest’s economic prosperity and environmental sustainability through delivering a safe grid, high reliability, low rates, responsible environmental stewardship and regional accountability. BPA issued its 2018-2023 Strategic Plan in January 2018 and completed a reassessment and reconfirmation of its plan in 2020. In July 2020, BPA adopted a fifth strategic goal: value people and deliver results. The five strategic goals are:

1. Strengthen financial health
2. Modernize assets and system operations
3. Provide competitive power products and services
4. Meet transmission customer needs efficiently and responsively
5. Value people and deliver results

As a major BPA business line, Transmission Services (Transmission) is instrumental in accomplishing BPA’s strategic priorities, and the SAMP reflects alignment with these priorities. Transmission is focused on several business capability initiatives in direct alignment with BPA strategic goals. A subset of these initiatives are detailed below.

BPA Strategic Goal	Transmission Asset Management Business Capability Initiative
#1 Strengthen Financial Health	6A - Criticality, Health, and Risk (CHR) – Continue to develop asset strategies and plans that are informed by asset condition, criticality and risk to ensure the right investments are made.
#2 Modernize Assets & System Operations	7A - Mission Critical IT - An ecosystem of applications and technology that align with the core businesses of generation and transmission operations at BPA to unify and streamline Critical Business System Ops (JC) and Transmission Technology Services (TT) systems and processes for architecture, infrastructure and service management. 7B - Metering Review & Updates - New generation metering at multiple sites to meet current target for BPA’s EIM (Energy Imbalance Market) participation.
#4 Meet Transmission Customer Needs Efficiently and Responsively	3A – Demand & Capacity Planning – Continue to develop tools and processes to identify constrained resources enabling BPA to manage demand based upon business priorities and make smart well-informed decisions. Implement a centralized, comprehensive, and consistent demand planning and resource management system will increase Capital work throughput. 3G - Interconnection Queue Responsiveness - Targets established; monitoring completion time for customer studies, design, and construction; looking into new contracting models to deliver customer projects faster.

Transmission will initiate a refresh to the Transmission Business Model in fiscal year 2022. The SAMP development will be coordinated with pending updates to both the Transmission Business Model and BPA’s strategic plan. Maturing Transmission’s asset management competencies in all areas will enable the modernization of assets to help BPA maintain competitive advantage in the marketplace, enable BPA to predict and respond to industry changes and deliver on public responsibilities; as well as strengthen financial health through the management of lifecycle costs and asset value.

3.2 Scope

Transmission’s SAMP covers Transmission Assets as detailed in Section 3.3. It covers Transmission Asset Management decision-making, project execution, and asset maintenance with focus from all Transmission organizations including Planning, Engineering, Technology, Field Services, Marketing and Sales, and Operations. Transmission’s SAMP does not include a discussion of the Facilities, Security, Environment, or Fleet programs. It does include a discussion of any Transmission specific impacts as a result of work in those other programs. For example, Transmission equipment related to Vancouver Control Center is included, whereas the building (and other Facilities components) is not.

The Boardman to Hemingway project (B2H) is not included in the SAMP. BPA will engage in public processes to discuss B2H with customers in 2022. BPA continues to evaluate the Grand Coulee Switchyard asset transfer, and specific impacts are not yet included in this version of the SAMP. Further impacts may be identified through the BP-24 IPR process.

3.3 Asset Description and Delivered Services

Transmission manages more than 15,000 circuit miles of high voltage transmission lines, over 260 substations, 732 telecommunications sites, approximately 3,500 miles of Fiber, approximately 195,600 acres of right of way and two control centers. See Table 3.3-1 for a summary of assets.

Table 3.3-1, List of Major Assets

Asset	Description
Alternating Current Substations (AC Subs)	Over 260 substations with more than 32,000 major equipment items including high value, critical items such as transformers, reactors and circuit breakers.
High Voltage DC/ Flexible AC Transmission Systems (HVDC/FACTS)	Specialized conversion and control equipment located at Celilo Converter Station, Maple Valley, Keeler and Rogue Static VAR Compensation sites, and numerous series capacitor installations on the high voltage alternating current intertie transmission lines.
Control Centers	Two redundant and geographically distributed control centers monitoring and controlling the grid and data systems. Over 85 automation systems.
Power System Control (PSC) and System Telecomm	732 sites and ~ 11,000 pieces of equipment, 3,500 miles of fiber optic cable, all vital to BPA’s ability to control and monitor the grid.
System Protection and Control (SPC)	956 locations, approximately 28,000 major units of 33 equipment types, all critically important to protect the grid for reliability and safety.
Access Roads	11,860 miles of access roads with bridges, culverts and gates
Land Rights	Approximately 80,000 tracts of easement plus fee-owned properties
Wood Lines	Approximately 4,800 miles total in 336 separate transmission lines with 73,500 wood poles.
Steel Lines	10,300 circuit miles with 43,500 lattice steel and engineered steel pole transmission lines and all associated towers, hardware and components.

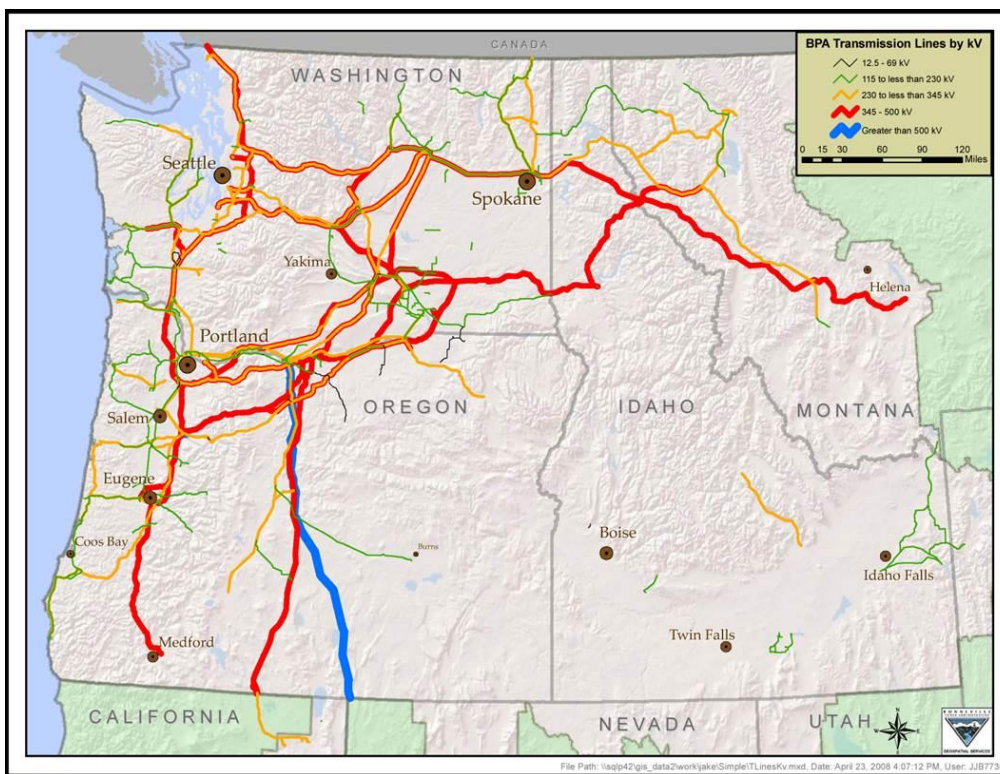


Figure 3.3-2, Asset Locations

Transmission manages over 200,000 major unit assets, 732 telecommunication sites, and two control centers. Depreciated (book) value is approximately \$5 billion dollars. Maintenance activities are prioritized based on compliance drivers and time. Corrective work is prioritized based on impact to system reliability and safety. All emergency and compliance work are given highest priority.

Transmission assets deliver the following products and services:

- **Ancillary Services and Control Area Services (ACS):**
This product supports the reliable transmission of energy from resource to load, by providing capacity flexibility within BPA’s Balancing Authority Area to support customers’ generation interconnection, load-service, and marketing, and by responding to Contingencies and generation/load deviations from schedules. Under the pro forma tariff, the transmission provider is required to provide, and transmission customers are required to purchase, certain Ancillary Services. The transmission provider is also required to offer other Ancillary Services that the transmission customer must either purchase or self-supply through a customer’s own resources or purchases from a third-party.
- **Generator Interconnection/Integration (GI):**
GI projects are customer requests to interconnect/integrate to the BPA system, resulting in potential network additions and/or interconnection facilities. A key objective of the Transmission Services product management strategy is to interconnect customer projects as efficiently as possible, ultimately meeting customer timelines. In doing so, BPA continues to fulfill its commitment to the region to provide an adequate, efficient, economical and reliable power supply.

- **Network Transmission (NT):**

The NT Service product is intended for, and available only to, load serving entities requesting use of BPA's transmission system for delivery of generation to serve their loads. NT customers provide 10-year load and resource forecasts so that BPA can fulfill its obligation to plan its system to serve NT customer load.

- **Point-to-Point (PTP):**

Point to Point transmission is a transmission service that allows a customer to schedule energy from point A to point B. PTP is highly valuable because of its unique flexibility. It can be used to market power to third parties as well as to serve load. It can be resold, redirected to other firm or non-firm products, including different paths. It can also be used for dynamic transfers both on the network and on interties.

Refer to the Open Access Transmission Tariff (OATT) for additional information pertaining to Transmission products and services. Transmission also offers products and services not required by the OATT, such as BPA's dark fiber lease program.

3.4 Demand Forecast for Services

Currently, over 90% of total transmission sales comes from rate segments that include Network, Intertie, and Ancillary Services. Long-term (5 year and 10 year) forecasts project this same demand based on either Network loads or Point-to-Point reserved transmission demands.

The Transmission Plan is a document developed by the Transmission Planning (TPP) organization, in which recommended alternatives for transmission reinforcements are studied and documented. The plan is the output of an annual planning process with a ten-year outlook. The recommended alternatives include transmission needs identified from the annual reliability system assessment, transmission service requests, new generation and line & load interconnection requests. Acknowledging the many uncertainties that exist in the evolving energy industry, the Transmission Plan is a robust, yet flexible forecast of Transmission needs.

Transmission system expansion will be dominated by compliance and customer-driven interconnection requests to serve continuing growth in renewable generation and large loads, specifically data centers. Energy storage projects are on the horizon and may require system reinforcement when built. BPA and the region are increasingly looking to commercial and technical alternatives to meet dynamic system demands and therefore very large infrastructure builds will become less likely in the next decade.

Within Section 12 of the [Transmission Plan](#) a narrative description is provided of the transmission needs identified through the transmission planning process. This includes the preferred alternative, an estimated cost, and estimated schedule for completion of the preferred alternative. Reinforcement projects for the transmission system are identified and described, along with proposed projects identified to meet the forecast requirements of BPA and other customers over the ten-year planning horizon. This section provides the proposed new facilities organized by type of project. The types of projects include the following:

- Projects required to provide load service and meet Planning Reliability Standards
- Projects to improve operational or maintenance flexibility
- Projects required to meet requests for transmission service
- Projects required to meet requests for Generator Interconnection/integration service
- Projects required to meet requests for Line and Load Interconnection service

Refer to the Transmission Plan for detailed information regarding required products and services, as well as, market factors that may affect delivery of service.

The current long range sales forecast is based on sales and revenues from the BP-22 Transmission Rate Case, with the out-years adjusted for identified factors, particularly Network load and Network contract demand. Network transmission service includes products used to either serve load to customers, or move transmission from a Point-of-Receipt to Point-of-Delivery for load service and marketing usage. Network Integration (NT) sales serve load to customers and are based on metered customer loads at the peak hour of the Transmission load in the month. The load forecast is based on forecast developed by Agency Load Forecast, with an annual load growth applied to out-years. Point-to-Point service (PTP) moves energy over transmission paths in the Network based on reserved demand (firm and non-firm). Long-term service includes service for one year or more with the demand amount specified to move transmission from Point-Of-Receipt (POR) to Point of Delivery (POD) over specified time duration. Short-term service includes service less than one year and is market driven by hydro and pricing conditions.

Intertie sales (IS) likewise are based on demand and capacity. Long-term sales for IS include sales durations of one year or longer and are based on confirmed reserved capacities and deferrals. The long-term capacity on the Southern Intertie is almost fully subscribed from north-to-south with high rates of renewals (95%), so added sales are limited. Short-term IS sales include demand for near-term service with regional price spreads as the primary inputs for customer behavior.

Another sales category includes required Ancillary Services. As described in Section 3 of the OATT, customers that purchase Network and Intertie transmission are required to acquire Scheduling, Control, and Dispatch service (SCD). Other Ancillary Services include products that apply to certain customers only.

Additionally, BPA has recognized an increasingly dynamic, uncertain and changing environment. We've seen changes in traditional operational, marketing and planning practices including oversupply of energy, negative market prices, a movement towards smart-grids, and an evolving regulatory environment responding to retail customer self-supply and distributed energy. Across the Northwest, states are committing to carbon-free power. Washington, Oregon, Idaho and California have pledged and adopted legislation to move to clean energy. To meet landmark clean energy goals, coal plants will need to be retired and our Transmission system will need to adapt in order to supply clean, reliable, and controllable resources that can meet energy demands across all hours. Energy storage projects could be on the horizon and may require system reinforcement when built. BPA and the region are increasingly looking to non-wire (commercial and technical alternatives) to meet dynamic system demands and therefore very large infrastructure builds might become less likely in the next decade, while system adaptations may be required in new ways not yet determined. Due to declining costs of renewable energy, Transmission needs to prepare to respond to potential variable energy resources. Our Transmission assets may also need the ability to realize the value of sub-hourly dispatch with flexible and low carbon hydro resources. Transmission is also seeing changes in use and system operations. With the emergence and growth of the energy imbalance markets, the region needs a well-designed electricity market built on a foundation of resource adequacy, intra-hour energy balancing, and the ability to compensate explicitly for capacity resources that provide system reliability and flexibility. Our Transmission assets and systems will need to be modernized to accommodate these shifts in the industry and in demand.

3.5 Strategy Duration

Transmission's SAMP duration is 10 years, with a refresh every 2 years. It provides a long-term view that takes into consideration organizational needs, external expectations, current state of existing assets, and the agency's asset management capabilities. It is reviewed annually as part of Asset Plan development work.

4.0 STAKEHOLDERS

4.1 Asset Owner and Operators

Transmission provides services for generation and load interconnection to the Federal Columbia River Transmission System. BPA interconnection procedures adhere to the requirements of its Open Access Transmission Tariff (OATT).

BPA also manages and responds to long-term firm transmission service requests (TSR) on the BPA network through the Transmission Service Request (TSR) Study and Expansion Process (TSEP). Transmission also operates and manages network assets owned by other entities. Management of those assets is handled through a rate case process with segmentation and inter-business line budgeting. Customer service agreements with the asset owner(s)/operator(s) are other tools used when work/coordination is required on assets that BPA does not own.

Transmission supports real-time dispatch of the system as well as coordinates with internal groups, western utilities and groups needed for reliability (including the Reliability Coordinator), and complex outages. In addition, Transmission develops systems for the control centers such as automatic generation control, load shedding, reactive switching and remedial action schemes, standards and agreements to support interconnected operations, and manage data generated in real-time.

Transmission coordinates system operation and planning issues with groups such as the Western Electricity Coordinating Council (WECC), Institute of Electrical and Electronics Engineers, Inc. (IEEE), North American Electric Reliability Council (NERC), Electric Power Research Institute (EPRI) and NorthernGrid (NG).

Transmission also works closely with the other BPA asset categories: Facilities, Environment, Security, Fleet, and IT. For example, the Facilities Asset Management program manages certain elements of the control house (the building, HVAC systems, etc), whereas Transmission manages equipment replacement within the control house. The Environment and Security capital programs manage improvements to Transmission assets, such as addressing oil containment concerns or enhancing security fencing. The Fleet program procures vehicles used throughout the Transmission system.

4.2 Stakeholders and Expectations

BPA's ratepayers and stakeholders expect reliable service at the lowest transmission rates consistent with a sustainable business model. Internal to BPA, Finance and Risk expect prioritization of Transmission investments based on a net economic benefit ratio (NEBR) while Transmission manages programmatic and execution risks. To deliver on these requirements, Transmission must have effective methodologies for investment evaluation and decisions. Total Economic Cost (TEC) modeling tools are used to inform investment levels by asset type. Transmission is investigating reliability engineering and portfolio optimization methods and tools to improve decision making over the full asset lifecycle. Transmission is also continuing to mature its Criticality, Health and Risk (CHR) capability. To meet internal and external stakeholder expectations, Transmission must continue to implement improvements and achieve efficiencies.

Table 4.2-1, Stakeholders

Stakeholders	Expectations	Current Data Sources	Measures
Customers (see 4.2-2)	Control Costs	Long Term Rates Forecasts, Integrated Program Review (IPR)	Rate Forecast from Long Term Planning / Marketing
	Reliability	Reliability database, SCADA, OARS	System Average Interruption Duration Index (SAIDI), System Average Interruption Frequency Index (SAIFI)
	Transmission Service and Interconnection Availability	Transmission Service Request queue, Interconnection queue	Transmission Service Requests granted vs. denied, queue waiting time. Request to Energization duration for new interconnections.
Government Agencies (USFS, USACE, FAA, Reclamation, USFWS)	Communication	Public Comment Records, Forums including telephone meetings	Customer Satisfaction Surveys
	Compliance with Regulations	Public Comment Records, Agreements, Documented Policies	NEPA Permitting duration
	Joint Funding for Shared Investments	Agreements	Request to Signed Agreement duration for new interconnections.
FERC	Open Access to BPA's Transmission System	BPA's Open Access Transmission Tariff	Transmission Service Request Mgmt. Interconnection Request Mgmt.
	Proper Asset Accounting	Plant Accounting Policy and Procedures	Timely Unitization
Environmental Interests Parties	Compliance with Regulations	Industry regulations and standards (NEPA)	NEPA Permitting
	Minimized Impacts	Environmental Assessment Documents	Net Carbon Footprint, Visual Rendering
Fish and Wildlife Advocates	Transmission operations help support fish passage	Outage and Remedial Action Scheme records	Generating Unit forced outage rate, RAS availability
Commercial Energy Market Entrants	Enable distributed generation and energy storage	Interconnection queue	Request to Energization duration for new interconnections and/or metering and telemetering.
NERC/WECC	Compliance with Regulations	Resolver	Internal/External Auditing, RSIPP Decision Documentation, Self-Reports
Staff	Job Security and Satisfaction	Administrative database	Federal Employee survey results, turnover figures
	Safety database	Incident statistics	Health and Safety

Stakeholders	Expectations	Current Data Sources	Measures
	Training	Administrative database	Agreed professional development
	Safety	Industry regulations and standards	Safety Metrics (Lost Time Accident Rates, Days Away Restricted or Transferred, Total Case Incident Rate)
Public	Safety	Public safety management system	Non-conformance records
Public	Communication	Public Comment Records, Forums including telephone meetings	Tribal Satisfaction Surveys
Cultural Interests	Compliance with Regulations	Public Comment Records, Agreements, Documented Policies	Number of cultural resource disturbances Number of realty actions on Tribal land

Table 4.2-2, Customer Breakdown

Customer Breakdown ¹	Top Priorities
Preference Customers	Load service responsibilities
	Responsiveness to utilities’ end-use customers, their utility boards and political pressure
	Keep the lights on – provide reliable service to their customers
Independent Power Producers	Identify economical interconnections for their generation projects, including wind, solar and battery storage
	Develop generation projects in a timeframe that meet their customer’s needs and power purchase agreements
	Transmit generation output to their customers
Investor Owned Utilities	Reliably serve customer loads at rates acceptable to Regulators
	Effectively and efficiently utilize existing BPA transmission rights to access regional low cost generation resources to deliver to IOU load
	Optimize IOU marketing transactions to increase IOU revenue to offset operational costs that impact IOU ratepayers and stockholders
BPA Power Services	Utilize the BPA grid to market the output of the 31 federal hydro generation plants, the Columbia Generation Station nuclear plant, and other resources to power purchasers throughout the west.
	Keep transmission rates low to help Power Services remain competitive in the energy marketplace.

5.0 EXTERNAL AND INTERNAL INFLUENCES

Transmission operates within complex external and internal environments. Table 5.0-1 details the primary External Influences (Opportunities and Threats) as well as the affects to Transmission and actions we are taking. Table 5.0-2 details the primary Internal Influences (Strengths and Weaknesses) and also lists affects and actions. The SWOT (Strengths, Weaknesses, Opportunities, Threats) Table 5.1-1 concisely presents these factors organized by internal Strengths and Weaknesses and external Opportunities and Threats in a simple matrix. Some topics are considered both opportunities and threats, and that has been depicted as well.

Table 5.0-1, External Influences (Opportunities & Threats)

External Influences	Affects and Actions
Opportunities	
<p>Changing generation mix and distributed energy resources.</p>	<p>Affects: Generation production in the Pacific Northwest (and across WECC) are changing from traditional and dependable coal and hydro methods to also include more renewable sources such as wind and solar which can be somewhat less predictable. The ongoing market advancement of distributed energy resources (DERs) is challenging BPA’s ability to interconnect new systems in a timely, cost effective manner; however, these DERs also offer BPA an opportunity to leverage voluntary non-BPA investments to help address bulk grid problems.</p> <p>Actions: The new mix of generation sources may require future investments in transmission reinforcements for reliable load service. Transmission continues to perform long term planning assessments to remain well connected to regional developments.</p>
<p>Timely response to customer Interconnections for new generation and major load additions</p>	<p>Affects: Exemplified by new photovoltaic solar generation and data center loads, BPA’s stakeholders demand ever-faster and cheaper interconnections to the grid. New Power Contracts will be shaped, in part, by customer perceptions of the value of BPA’s products and services, the availability of competitive market substitutions, and challenges associated with long-term planning amidst the considerable and ongoing transformation of the electric power industry landscape.</p> <p>Actions: Transmission has implemented improvements to study, plan and execute these interconnections in a much shorter timeframe, and will continue to do so on an on-going basis. This work must be coordinated with Power Contract developments and connected to customer needs.</p>
<p>Rapid technology changes and new potential guiding legislation</p>	<p>Affects: Technological change is more substantial than previous decades and is occurring at an accelerated pace. We have the opportunity to modernize our grid. New guiding legislation for BPA is probable in this period of transformation.</p> <p>Actions: Technological obsolescence will require Transmission to replace equipment and systems in shorter cycles, likely increasing the cost of its communication and control systems. Transmission is anticipating these changes and is planning sustain program needs around technological obsolescence as one factor.</p>
<p>Power/Energy Industry Analytical Tools</p>	<p>Affects: Increase of organizations focusing on Asset Management and lifecycle costing.</p> <p>Actions: BPA has more opportunities to learn about (benchmark) or acquire tools to help with identifying and implementing innovative, lower lifecycle cost alternatives to provide better business value to the region. Transmission meets with other utilities regularly for ongoing benchmarking and improvements.</p>

External Influences	Affects and Actions
Threats	
Regularly reoccurring natural catastrophe events, such as fires, earthquakes and grid attacks	<p>Affects: Load pattern changes due to temperature changes in SW and NW. Timing of precipitation (earlier freshet/ perhaps bimodal freshets) and therefore generation patterns for Federal Columbia River Power System (FCRPS) in the Northwest will affect transmission bulk power flow.</p> <p>Increased wildfire risk may affect transmission lines and other assets in the field, and could influence public perception of BPA.</p> <p>Actions: Transmission is currently maturing processes, tools, methodologies, and plans to help prepare for weather-related events, including wildfire risk.</p>
Pandemic supply chain interruption and cost escalation	<p>Affects: Due to global supply chain factors, material pricing has been higher with elongated schedules for delivery. Market conditions for human resources are also constrained.</p> <p>Actions: Continue to mature risk-based decision-making to ensure we are choosing the best options for maintaining our assets.</p>
Long-term (regional) resource adequacy	<p>Affects: Renewables and battery storage (along with some new transmission) are expected to serve as substitutions for retiring fossil-fueled thermal generation serving the Northwest and American West, exacerbating concerns over long-term (regional) resource adequacy and transmission availability and reliability.</p> <p>Actions: Continue to maintain close connection with resource adequacy efforts in the region.</p>
Evolving cyber security threats	<p>Affects: An emerging external influence is the threat of cyber-attacks from outside our organization including hackers, cybercriminals, and other malicious persons who are trying to do harm. Energy organizations are a prime target of growing and evolving cybersecurity threats given the criticality of their infrastructure to our nation. Current and future state architecture must evolve to account for these increased risks.</p> <p>Actions: Continued Cyber Security diligence is required in order to protect networks, devices, and data from unauthorized access or criminal use and ensure confidentiality (limiting data access), integrity (ensuring your data is accurate), and availability (making sure it is accessible to those who need it).</p>

Table 5.0-2, Internal Influences (Strengths & Weaknesses)

Internal Influences	Affects and Actions
Strengths	
Reliable Transmission Grid	<p>Affects: Transmission demonstrates a long history of safe and reliable grid operations, which satisfies customers in the region.</p> <p>Actions: Continue to dedicate resources to maintaining system reliability and compliance with NERC and WECC mandatory reliability standards.</p>

Internal Influences	Affects and Actions
Resiliency	<p>Affects: Cultural response to unplanned outages has a time proven commitment to rapid restoration for an event.</p> <p>Actions: Continue to respond to unplanned outages for service restoration.</p>
Low Cost Sources of Capital	<p>Affects: BPA, as a public sector utility, is a nonprofit provider of transmission services and has access to lower costs of capital than IOUs or other transmission providers.</p> <p>Actions: Utilize public sector status to employ the lowest cost of funding method available to us. Continue to earn high credit scores.</p>
Safety	<p>Affects: Agency-wide commitment to safety-centric culture; where public service is a daily driver for decision-making.</p> <p>Actions: Carry-on safety-centric culture.</p>
Weaknesses	
Attraction/retention of workforce, and high number of experienced workers eligible for retirement.	<p>Affects: High retirement rates and other attrition are contributing to Transmission workforce being a top enterprise risk. Transmission’s workforce is highly specialized, limiting opportunities to address workload peaks and adding cost to scoping and preliminary engineering activities.</p> <p>Actions: BPA must provide greater opportunities and competitive pay to keep and attract a qualified workforce. Greater innovation and use of best industry practices will not only help with retention but will also reduce project cost and duration. Transmission will need to create sustainable organizational structures and develop greater personnel competencies.</p>
Lack of integrated asset data repositories and systems	<p>Affects: With approximately 40 systems containing asset information, Transmission is awash in data and the inability to integrate information systems automatically has challenged employees to examine ways to integrate the information and document/develop proposals for improvements.</p> <p>Actions: Transmission is working on a holistic architecture for systems and data, such as an Enterprise Architecture across BPA, which clearly defines asset information and data strategy, governance, and systems.</p>
Department alignment on objectives and prioritization factors throughout execution	<p>Affects: With numerous organizations working to support Transmission Asset Management, alignment can be challenging and can result in a slower pace of improvements, due to several priorities moving forward simultaneously.</p> <p>Actions: Transmission has established cross-functional teams and communication frameworks to continue to improve alignment for optimum use of constrained resources. Efforts underway to improve processes and data will also support departmental alignment.</p>

Internal Influences	Affects and Actions
Aging infrastructure	<p>Affects: Transmission’s physical assets are aging, leading to high capital needs for replacements. Telecom systems are End of Life/End of Service.</p> <p>Actions: Continue to mature asset management capabilities to focus limited resources on most critical replacements. Evaluate opportunities to change practices to maximize limited resources.</p>
IAM cultural awareness	<p>Affects: Silos in organizations can create sub cultures where different organizations work towards different, even opposing end states, which could lead to poor cross-departmental interactions and sub-optimal performance.</p> <p>Actions: Everyone has an impact to asset management and needs to be aware of their role. Develop Asset Management discipline and increase knowledge base for all Transmission organizations involved in the acquisition, operation and care of physical assets for the benefit of Transmission, BPA, our customers and the general public.</p>

5.1 SWOT Analysis

Transmission has been impacted by many global factors in the recent past, ranging from the COVID-19 pandemic, supply chain impacts, wildfire events and increased fire risks, to challenges with hiring/retention, as well as high numbers of experienced workers eligible for retirement. Transmission’s SWOT analysis, below, summarizes specific Strengths, Weaknesses, Opportunities, and Threats. The specific affects/actions are explained in the preceding section (5.0-1 and 5.0-2).

Transmission is responding to and mitigating impacts of global factors, such as by ordering more equipment to have in stock (to mitigate material delays). Transmission is also hiring additional employees in constrained areas (such as in the field and in cyber security related areas).

Transmission’s continued work to mature Asset Management, such as by improving asset management data and alignment (through Enterprise Architecture partnership, asset hierarchy maturation, and Criticality, Health and Risk maturation, will continue to benefit Transmission as it works to manage these complexities.

Table 5.1-1: SWOT

<i>Favorable</i>	<i>Unfavorable</i>
<i>Strengths</i>	<i>Weaknesses</i>
<ul style="list-style-type: none"> • Reliable Transmission Grid: Long-term history of a reliable system of uptime performance. • Resiliency: Cultural response to unplanned outages has a time proven commitment to rapid restoration for an event. • Low Cost Sources of Capital: BPA has access to lower costs of capital than IOUs or other transmission providers • Safety: Agency-wide commitment to safety-centric culture; where public service is a daily driver for decision-making. 	<ul style="list-style-type: none"> • Attraction/Retention of high quality talent, high numbers of experienced employees eligible for retirement- BPA is impacted by the tight labor market, reinforcing the need to continue to enhance work place culture and respond to employee suggestions for improvement. • Lack of integrated asset data repositories and systems- impacts decision support and employee experience • Department alignment on objectives and prioritization factors throughout execution- Continuous improvement especially important due to resource constraints. • Aging Infrastructure: Transmission’s physical assets and telecom systems are aging and replacement needs will be high over the coming decade • IAM Cultural Awareness: Everyone has an impact to asset management and needs to be aware of their role
<i>Opportunities</i>	<i>Threats</i>
<ul style="list-style-type: none"> • Changing generation mix and distributed energy resources: could lead to opportunities to reinforce the system • Timely customer interconnections: opportunity to meet customer needs quickly and responsively • Rapid technology changes and new potential guiding legislation: opportunity to modernize Transmission system and partner in the region • Power/Energy Industry Analytical Tools: BPA may have more opportunities to learn about or acquire tools to advance asset management 	<ul style="list-style-type: none"> • Regularly reoccurring natural catastrophe events; potential fires, earthquakes and grid attacks: High impact challenges ranging from grid operations to wildfire season planning and response • Pandemic supply chain interruptions and cost escalation: Impact BPAs ability to deliver work within planned funding levels to achieve results. • Long-term (regional) resource adequacy: Potentially affected by weather patterns and other system changes and needs. • Evolving cybersecurity threats: An emerging external influence is the threat of cyber-attacks from outside our organization

6.0 ASSET MANAGEMENT CAPABILITIES AND SYSTEM

On the five-point Institute of Asset Management maturity scale, Transmission’s current asset management practices range from 1.2 to 1.5, on a scale of 0 to 4. The visuals provided below are shown on a 3 scale to make variations of scoring more visible. The organization has identified its asset management needs and has demonstrated progress by committing to ongoing efforts that will continue to mature asset management capabilities.

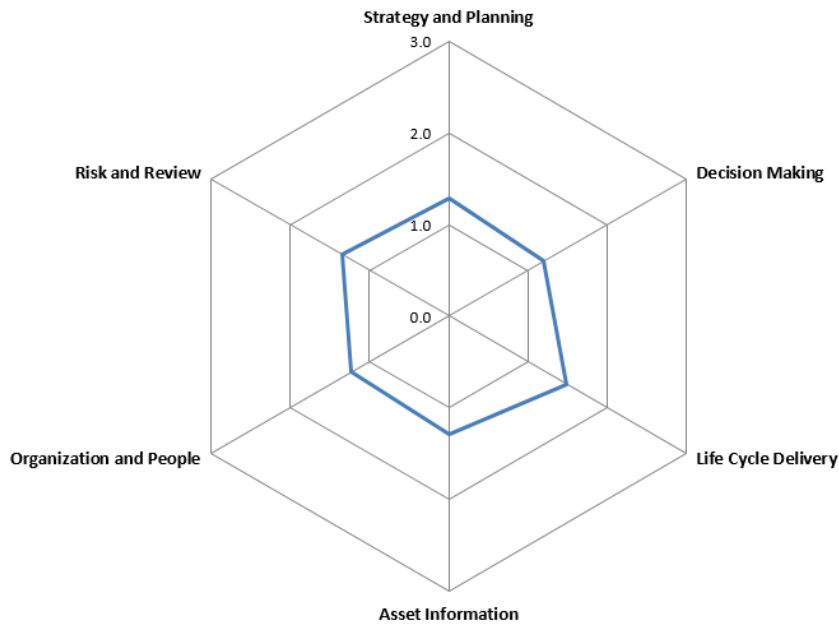


Figure 6.0-1, Asset Management Maturity Radar Chart

While asset management responsibility resides throughout Transmission Services, accountability is placed with the BPA’s Chief Engineer, the Vice President of Transmission Planning & Asset Management. Asset management delegation of authority flows through TP’s Internal Operations Manager to the Strategy, Asset & Program Management (TPO) Manager, who also serves as Transmission’s Asset Manager.

Transmission’s Asset Management Executive Council (TAMEC) is a strong supporter of asset management. The TAMEC reviews and approves Transmission capital funding recommendations prior to submittal to the Agency Capital Project Review Team (ACPRT) and the Finance Committee (FC). Through a charter, the TAMEC has authorized the Portfolio Management Team (PfMT) to make the daily portfolio management decisions. In recognition of the importance and value of full lifecycle asset management, the Asset Management Governance Team (AMGT) represents organizations from the entire asset management lifecycle. Efforts and maturity initiatives are developed cross functionally to continue to mature in Asset Management initiatives.

Transmission recognizes there is great opportunity in effectiveness and cost savings through integrated replacement and maintenance decisions. Asset information is not fully integrated into Transmission’s capital process, and improving this will improve visibility and alignment with other processes.

6.1 Current Maturity level

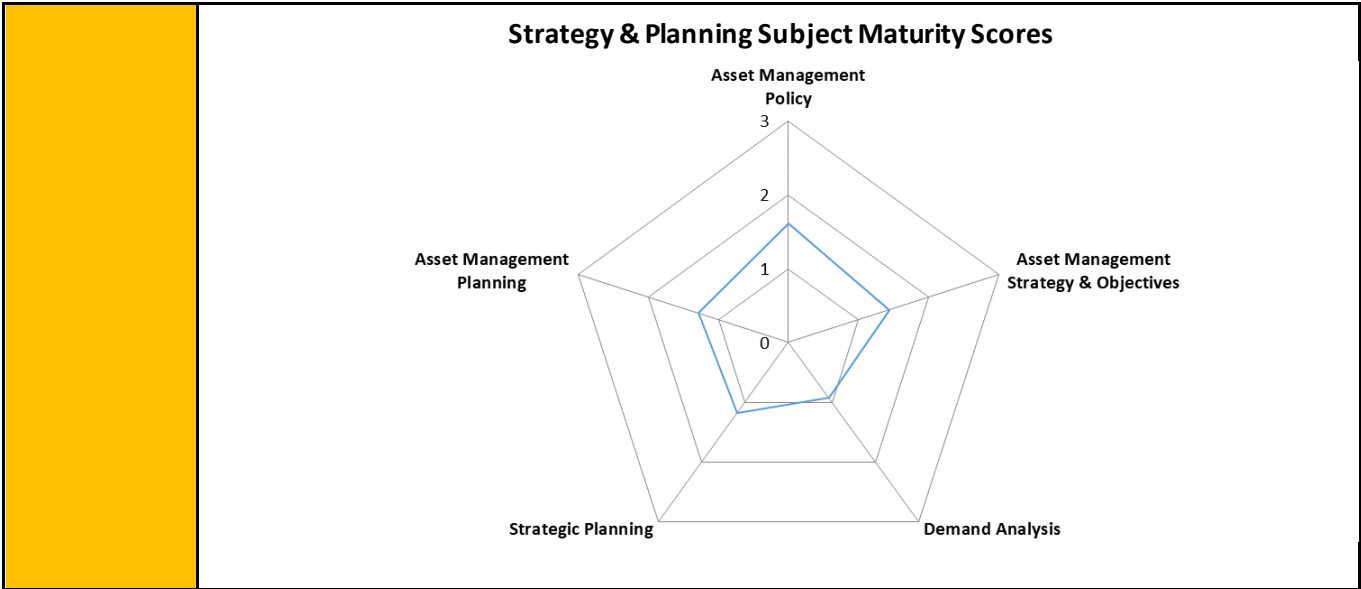
The Asset Management Maturity Assessment was refreshed in October 2021. Forty+ people participated in giving their feedback of the maturity level for all 39 Institute of Asset Management (IAM) Subjects and identified strengths and weaknesses for the requirements they were knowledgeable of.

The results of the most recent Asset Management Maturity Assessment clearly indicate Transmission is well on our way with our Asset Management journey. Transmission is aware of and acknowledges critical short-comings that need to be addressed in each of the IAM Groups. Top priorities and dependencies have been identified and sequencing is occurring to ensure coordinated plans for making improvements to the most important and foundational work.

Many of the initial Asset Management improvements are operational and teams are now working to ensure proper documentation and incorporation between organizations. In the coming years, Transmission will continue the long-term focus and continue the incremental improvements along our Asset Management journey to start realizing benefits and then optimizing to obtain the greatest value from our assets.

Table 6.1-1 Maturity Level

Subject Area	Maturity Level
<p>Strategy & Planning</p>	<p>Strategy & Planning Strengths</p> <p>The AM Policy, the Strategic Asset Management Plan, and the Transmission Asset Plan have been coordinated with multiple organizations and authorized by leadership.</p> <p>Strategy & Planning Weaknesses</p> <p>Strategic alignment between plan and communications of plan could still use improvement. Quantitative demand analysis tools and techniques are not effectively utilized for forecasting demand and demand analysis is not incorporated when developing alternative planning scenarios.</p> <p>Strategy & Planning Actions</p> <p>Asset Management Initiatives are launching and underway to address alignment of plans and to develop demand analysis capabilities.</p>



Decision Making

Decision Making Strengths

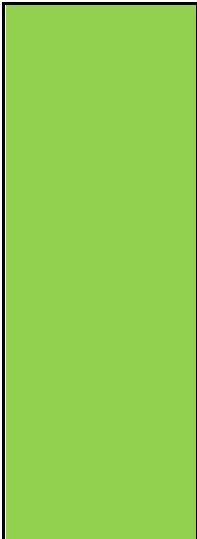
Capital Investment Acquisition (CIA) processes for capital investment decision-making are operational. Decision records are maintained. Shutdown and outage strategy are in line with the organization’s criteria for asset management decision-making.

Decision Making Weaknesses

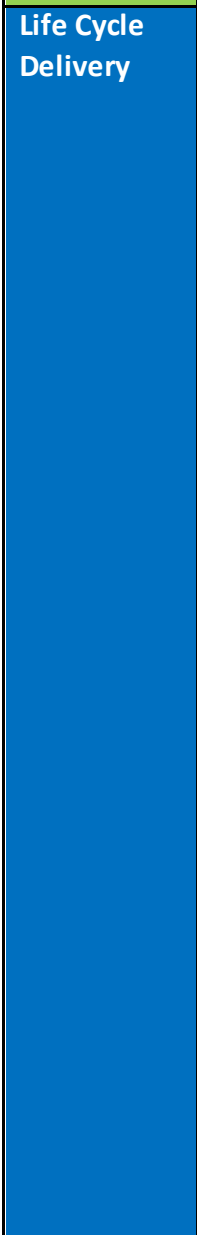
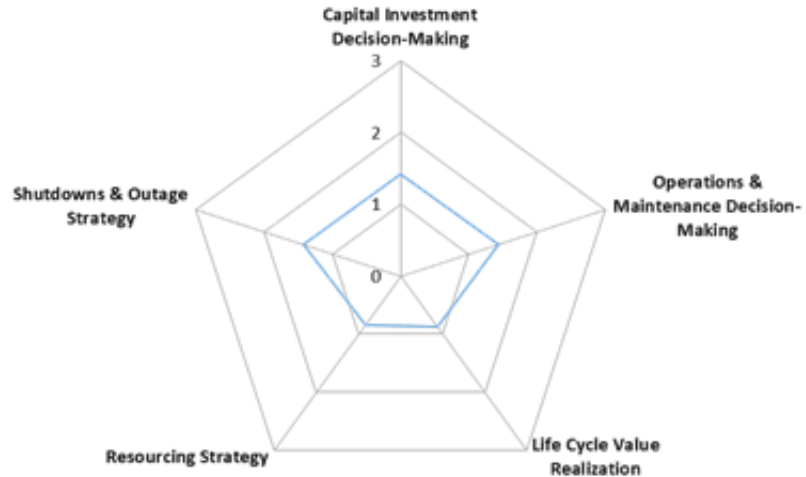
The methods, processes, and criteria (including risk) for life cycle value realization are not consistently available, aligned, documented or utilized. Records are not always available to demonstrate conformance. Resources and a resourcing strategy to source the required resources are not optimal.

Decision Making Actions

Groups working on improving Asset Management Decision Making are included in requirements-gathering for Asset Information Initiatives and efforts (such as Asset Hierarchy), to facilitate data-driven decisions. An effort is underway to create a cross organizational resource strategy and proposed plan to improve visibility and the management of resources.



Decision Making Subject Maturity Scores



Life Cycle Delivery Strengths

Capital Investment Acquisition (CIA) processes for asset create/acquisition is operational. Documentation and systematic processes and/or plans are in place for managing unplanned events.

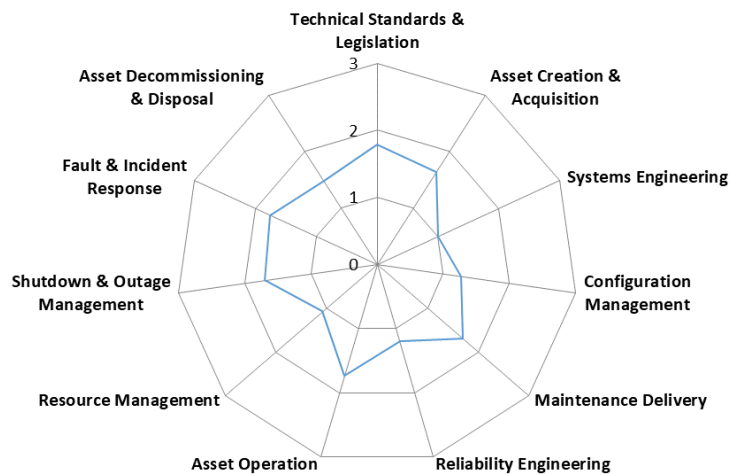
Life Cycle Delivery Weaknesses

Life cycle costing in the acquisition and creation of assets is not available. Project management controls to ensure the timely and cost efficient delivery of the asset management plan(s) are not optimal.

Life Cycle Delivery Actions

Development of the life cycle costing capability will greatly benefit from the creation of the Asset Hierarchy and structuring financial, non-financial, and technical information in a usable structure and system. Improvements to MS Project will allow for better controls. The cross organizational resource strategy will enable better resource management.

Life Cycle Delivery Subject Maturity Scores



Asset Information

Asset Information Strengths

The organization has consistently identified the need for data, information and systems improvements across many organizations.

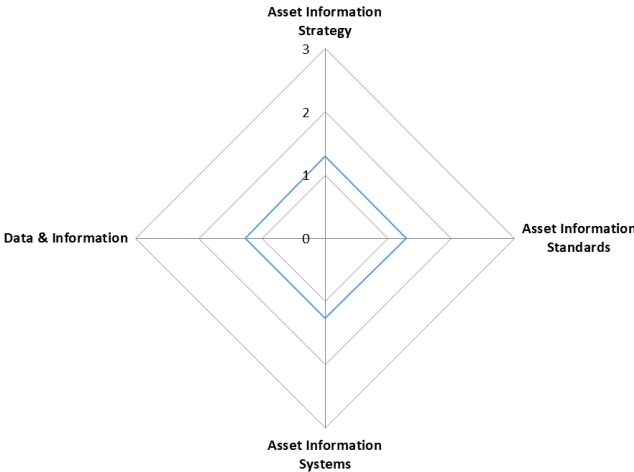
Asset Information Weaknesses

Transmission has not fully integrated BPA’s Asset Information Policies into its processes and tools. Some programs lack a defined Asset Hierarchy. Due to the number of systems, the complexity of data, and the manual entry required, we are unable to consistently bring together financial, non-financial, and technical asset information.

Asset Information Actions

Cross-organizational Initiatives are planned to address Enterprise Architecture, Asset Information Strategy, Asset Information Systems, and data, including an Asset Hierarchy.

Asset Information Subject Maturity Scores



Organization & People

Organization & People Strengths

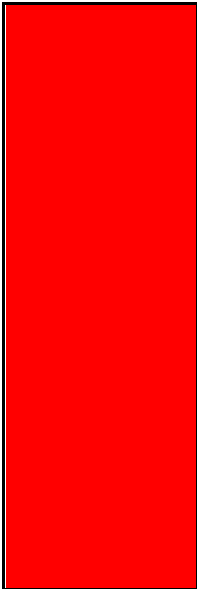
The organization identifies Asset Management activities that are appropriate for outsourcing and those which should remain in-house. Top management promotes cross-functional working and supports leadership in Asset Management.

Organization & People Weaknesses

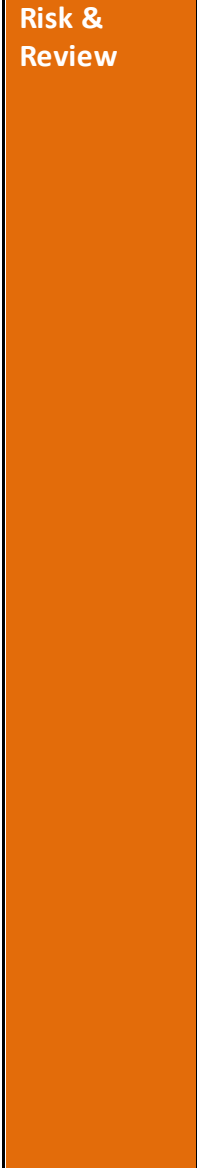
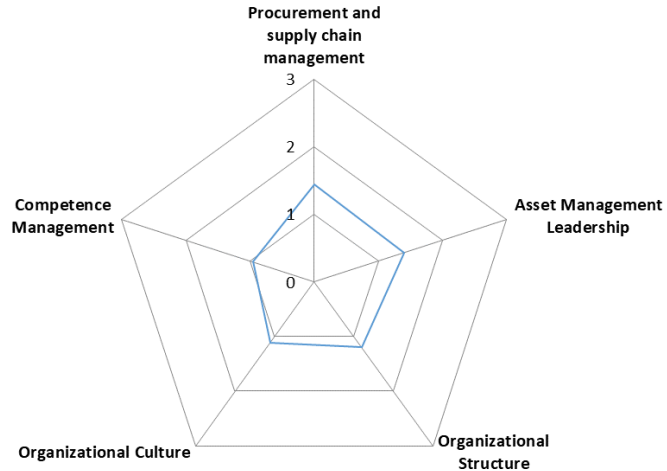
Resource demand is unknown and unavailable to support all aspects of our Asset Management System as it continues to mature. Roles and responsibilities aren't sufficiently understood in all cases. Our organizational structure isn't resourced consistent with roles, responsibilities, and workload to enable effective delivery.

Organization & People Actions

Continue IAM training. Increase communications and awareness. Develop Asset Management System framework and incorporate Enterprise Architecture and define roles. Continue hiring staff as identified for successful Asset Management implementation.



Organization & People Subject Maturity Scores



Risk & Review

Risk & Review Strengths

Transmission has identified what is to be monitored and measured for asset performance and health monitoring. Transmission has identified the people and organizations that can have an impact on or experience the consequences of the asset management program.

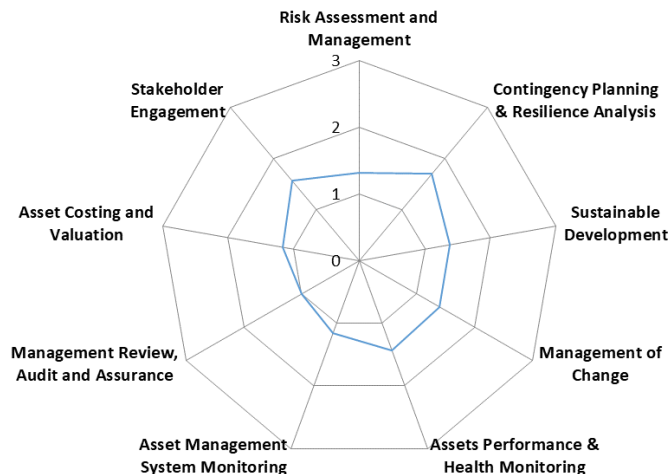
Risk & Review Weaknesses

The organization hasn't fully determined methods or criteria for asset performance and health monitoring. Risk tolerance in regards to asset performance is not well defined, therefore, risk mitigation plans and internal controls are not yet developed. Asset cost assessments are locally managed and not a cross-functional activity.

Risk & Review Actions

The Criticality, Health, and Risk Initiative remains top priority and will begin to incorporate more organizations, systems, documentation, and communication. Asset Performance Metrics are in various stages of operations and development.

Risk & Review Subject Maturity Scores



6.2 Long Term Objectives

In the 2020 SAMP, Transmission identified two primary long-term objectives. These continue to be primary objectives, and together, they relate to all six IAM subject groups.

1. Risk based Planning & Prioritization (Group 1- Strategy and Planning, Group 2- Asset Management Decision Making, Group 4- Asset Information, Group 6- Risk & Review)
2. Financial Effectiveness (Group 2- Asset Management Decision Making, Group 3- Life Cycle Delivery, Group 4- Asset Information, Group 5- Organization & People, Group 6- Risk & Review)

Objective 1: Risk based Planning & Prioritization

Transmission continues to support the agency strategic plan, number 2a (Administer an industry leading asset management program). Understanding and applying asset Criticality, Health & Risk (CHR) is the widely accepted best practice for capital planning and prioritizing investments including maintenance. Transmission has continued to mature this capability and a roadmap is presented in Figure 6.2-1). At its current maturity level, CHR is primarily applied in decision making around a subset of sustain assets. The subset is based on assets currently in Cascade with the most mature data. Ultimately, CHR will be an additional support tool to be used in prioritization decisions across expand and sustain. This includes robust implementation of each of the three components: Criticality, Health, and Risk for each program area (with any exceptions documented).

- Specific: Transmission will quantify asset criticality, health & risk.
- Measurable: Transmission will complete remaining logic sheets across identified impact dimensions, and will complete scoring specific assets in Cascade based on these logic sheets.
- Achievable: Transmission has dedicated resources assigned to this priority.
- Relevant: Institute of Asset Management recognizes that understanding cost, performance and risk are the fundamentals for effective business model and decision making. CHR is the adoption the IAM model and ISO-31000 framework.
- Time bound: Transmission will complete the scoring by FY24.

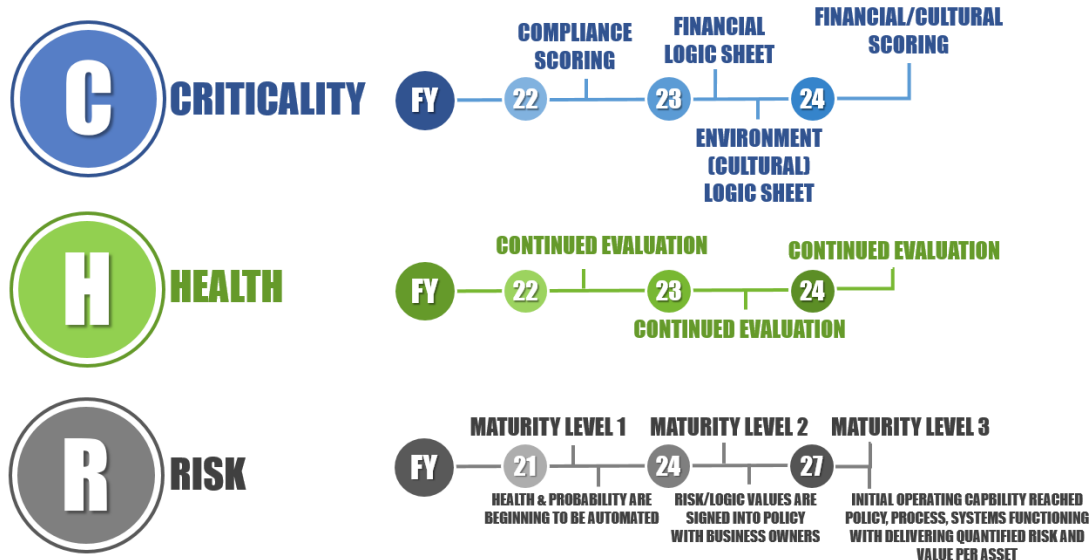


Figure 6.2-1 CHR Roadmap

Objective 2: Financial Effectiveness

Managing the lifecycle costs of federal assets is in direct alignment with the Agency strategic goals 1 & 2 (strengthening financial health and modernizing assets and system operations). This is central to maintaining the long-term value and reliability of the power and transmission systems. Transmission is continuing to expand its execution capability through the Secondary Capacity Model (SCM) in order to support replacement of aging assets. Transmission is also embarking on efforts to align asset information throughout the information lifecycle, so that decisions are based on current and complete asset information data. This alignment would also allow Transmission to perform lifecycle costing. Figure 6.2-2 provides additional detail.

- **Specific:** Transmission is documenting/defining an asset hierarchy for all managed assets. The existing processes/systems will be mapped, resulting in improvement recommendations toward asset information alignment and lifecycle costing. Transmission will partner with Enterprise Architecture for these maturity efforts.
- **Measurable:** The asset hierarchy will be documented, and at least one identified gap toward lifecycle costing will be addressed by the end of FY23. The remaining gaps will also be prioritized and scheduled and incorporated into a maturity roadmap.
- **Achievable:** Transmission’s cross-functional Asset Management Governance Team (AMGT) is actively prioritizing and resourcing these initiatives.
- **Relevant:** The IAM anatomy emphasizes the importance of asset data management in building an organization’s asset management capability.
- **Time bound:** This will be complete by the end of FY23.

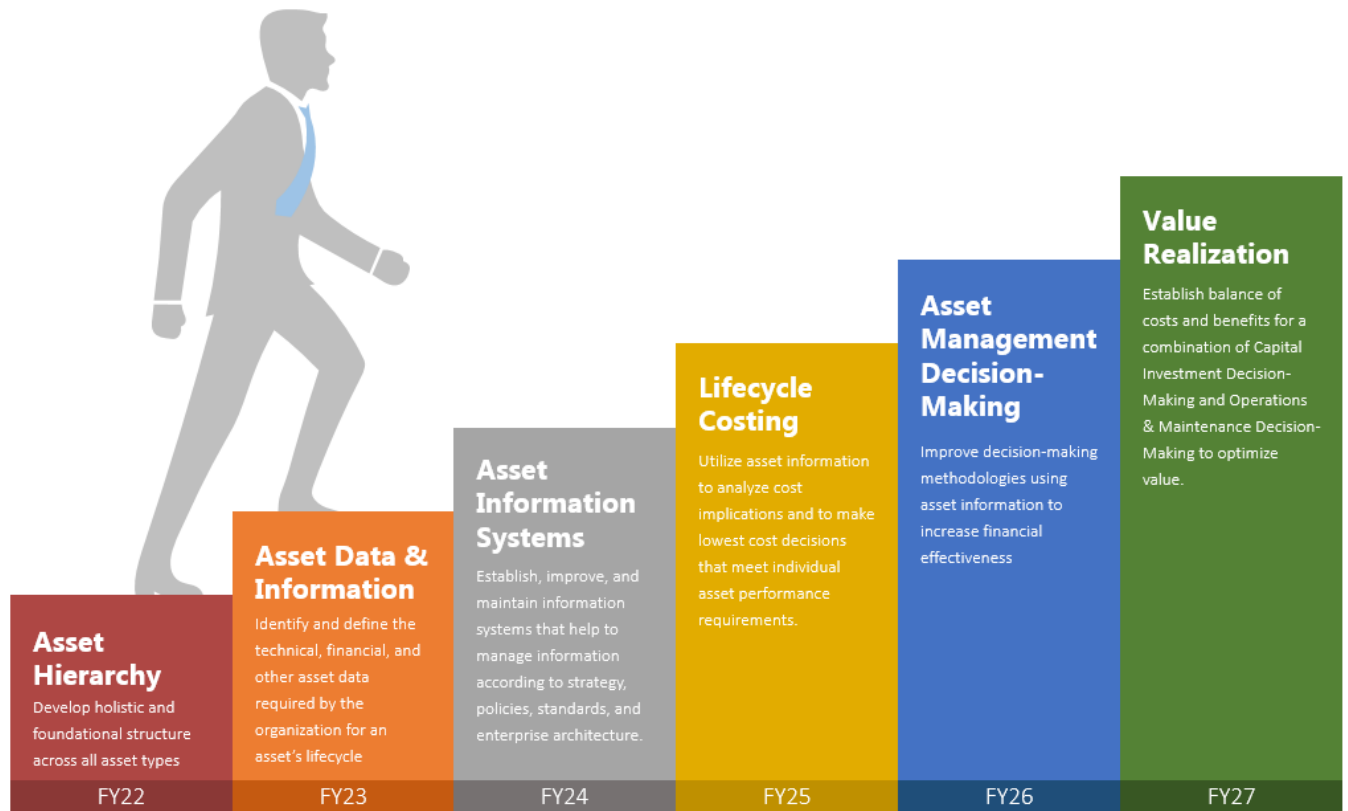


Figure 6.2-2 Asset Information Roadmap

6.3 Current Strategies and Initiatives

Transmission is currently implementing several current initiatives, across all IAM subject areas. The three featured below are of primary importance and align with all of the IAM subject areas.

1. Criticality Health & Risk (Objective 1: Risk based Planning & Prioritization)
2. Secondary Capacity Model (Objective 2: Financial Effectiveness)
3. Asset Hierarchy (Objective 2: Financial Effectiveness)

Initiative 1: Criticality, Health & Risk (CHR)

BPA continues to develop capabilities to understand asset criticality, health and risks. Defensible and proven methodologies and analytical methods will be developed, tested and adopted to inform prioritization of capital investments. CHR can be applied to specific maintenance decisions as needed, but is not applied comprehensively at this time. Maintenance prioritization is primarily based on compliance, safety, and customer service factors, as well as manufacturer recommendations and time. CHR analytics can be included as a factor in the decision making, but specific timelines will be evaluated as part of coordination work in developing the roadmap details. Transparent, objective CHR information and risk quantification will enable Transmission decision makers to optimize the utilization of financial and human resources to deliver best value for BPA and the region. Transmission's objective is for each asset program to have robust implementation of Criticality, Health, and Risk at the asset level. Transmission recognizes the complexity of this and maturation will continue over many years.

1. Continue towards completing all criticality dimension logic sheets and scoring
2. Continue asset information collection
3. Continue to develop the Asset Management metrics for consistent reporting to customers

Initiative 2: Secondary Capacity Model (Portfolio Delivery)

Transmission's backlog of assets needing replacement is increasing. Specific amounts of backlog varies by program, but for example, in the Subs AC program, it increased by over 3000 units in 2019, compared to a total asset population of around 32,000. Clear visibility of asset information will support this capability development. Increasing execution throughput requires a systematic approach that addresses multiple constraint dimensions impacting the asset lifecycle. Currently Transmission is striving to an ultimate goal of creating available and flexible resource capacity to meet the demand delivered from asset management lifecycle planning, system expansion planning, and customer system needs.

1. Continue to operationalize the Secondary Capacity Model to augment the Primary Capacity Model (current model) that offers flexibility as demand fluctuates and as other capacity models expand and contract.
2. Continue to mature the Demand Planning and Work Scheduling capability to enable centralized resource assignments and task tracking across the Transmission portfolio of projects. The aggregation of the information from the Work Scheduling service will produce information for strategic resource planning.

The combination of these efforts are expected to drive efficiencies in current processes and practices in the Portfolio Delivery Model while simultaneously seeking out additional resourcing options in order to deliver on the demands provided by Portfolio Planning.

Initiative 3: Asset Hierarchy

Transmission is working to define an asset hierarchy for all managed programs. Certain Transmission programs have an asset hierarchy defined but not documented, whereas other programs do not have a hierarchy defined at all. The Asset Hierarchy effort will identify/document asset hierarchies specific to each program. Unique identifiers will also be identified when possible. The asset hierarchy effort is currently being scoped but significant progress is expected in FY22. Certain questions still being considered include whether to stage the effort, and to focus on certain assets before other assets, or whether to structure the hierarchy to fit existing systems, or to be more general at this point in development. The Asset Hierarchy is a foundational effort that will support future asset management systems and process development. Ultimately, specific steps will include (as detailed in Figure 6.2-2):

1. Asset Hierarchy across all asset types
2. Asset Data and information; identify and define the technical, financial and other asset data required by the organization for lifecycle costing
3. Asset information systems
4. Lifecycle costing
5. Asset Management decision making and value realization through implementation of the Transmission Portfolio Optimization Tool (as described in more detail in section 10).

6.4 Resource Requirements

Transmission has leveraged additional contract options and resources to support the Portfolio Delivery Model, as part of SCM (Secondary Capacity Model). Transmission has also recently stood up a standalone organization and hired additional new resources to support Criticality, Health & Risk. Additional staff will continue to be required as part of continued asset management maturity, for example, as part of standing up the Transmission Portfolio Optimization Tool. Financial resource requirements are discussed in more detail in Sections 8 and 10.

7.0 ASSET CRITICALITY

7.1 Criteria

Transmission has adopted the ISO-31000 approach to managing risk. This incorporates the quantified health of an asset and quantified impact to the business across five risk dimensions: Compliance, Environmental, Financial, Reliability, & Safety. These five risk dimensions currently have equal weighting to one another. Transmission recognizes that part of criticality is to be able to differentiate and prioritize investments based on an understanding of what is more critical or less critical. Transmission will continue to mature the application of Criticality along with the maturation of other aspects of CHR.

This is visualized by a 5x7 illustration of the aforementioned risk dimensions and the corresponding consequence impacts on a scale of 1-7; where 1 = negligible and 7 = catastrophic. The scale applied to each consequence impact is the criticality. The following figure provides the criteria for determining criticality based on these dimensions.

	SAFETY	RELIABILITY	FINANCIAL	ENVIRONMENTAL	COMPLIANCE
Impact Level	The potential impact of a risk even on a public or worker safety	The potential impact of a risk even on service or grid reliability	The potential risk event resulting in a financial costs to customers/rate payers measured in incremental dollar impact	The potential impact on natural resources such as air, soil, water, plant or animal life	The potential impact of noncompliance with federal, state, local, industrial, or operational standards or requirements
Catastrophic	Many Fatalities, Mass Serious Injury or Illness: Many fatalities of employees, public members or contractors; Mass serious injuries or illness resulting in hospitalization, disability or loss of work; Widespread illness caused typically caused by sustained exposure to agents.	Customer Hours Impact: Outage resulting in greater than 20 million total customer hours of interruption.	Impact > \$3 billion in costs; consider costs to customers, shareholders and third parties.	Irreversible and immediate damage to surrounding environment (e.g. extinction of species).	NonCompliance Impact: Actions resulting in potential closure, split or sale of Company.
Severe	Few Fatalities, Serious Injuries or Illness; Permanent Disability: Few fatalities of employee, public member or contractor; Many serious injuries or illnesses resulting in hospitalization, disability or loss of work; Localized illness typically caused by acute or temporary exposure to agents.	Outage resulting in at least 2 million total customer hours of interruption.	Impact between \$300 million and \$3 billion in costs; consider costs to customers, shareholders, and third parties.	Resulting in acute longterm damage greater than 10 years; Severe damage to surrounding environment.	NonCompliance Impact: Regulator issued cease and desist orders; Regulators force the shut down of critical assets, and demand changes to operations/administration
Extensive	Serious Injuries or Illness; Permanent Disability: Serious injuries or illness to many employees, public members or contractors resulting in hospitalization, disability or loss of work.	Outage resulting in at least 200,000 total customer hours of interruption.	Impact between \$30 million and \$300 million in costs; consider costs to customers, shareholders, and third parties.	Resulting in significant mediumterm damage greater than 2 years;	NonCompliance Impact: Regulatory investigations and enforcement actions, lasting longer than a year; Violations that result in multiple large nonfinancial sanctions; Regulators force the removal and replacement of management positions.
Major	Serious Injuries or Illness; Permanent Disability: Serious injuries or illness to few employees, public members or contractors resulting in hospitalization, disability or loss of work; Several employees, member of the public or contractors sent requiring treatment beyond first aid.	Outage resulting in at least 20,000 total customer hours of interruption.	Impact between \$3 million and \$30 million in costs; consider costs to customers, shareholders, and third parties.	Resulting in moderate mediumterm damage greater than few months; Reversible damage to surrounding environment.	NonCompliance Impact: Significant new and updated regulations are enacted as a result of an event; Violations that result in adopting modest changes to operations/administration; Increased oversight from regulators.
Moderate	Minor Injuries or Illness: Minor injuries or illness to several employees, public members or contractors; Few employees, member of the public or contractors requiring treatment beyond first aid.	Outage resulting in at least 2,000 total customer hours of interruption.	Impact between \$300k and \$3 million in costs; consider costs from customers, shareholders, and third parties.	Resulting in moderate shortterm damage of few months; Reversible damage to surrounding environment with no secondary consequences.	NonCompliance Impact: Violations that result in minor changes to operations/administration; No additional oversight from regulators.
Minor	Minor Injuries or Illness: Minor injuries or illness to few employees, public members or contractors requiring first aid.	Outage resulting in at least 200 total customer hours of interruption.	Impact between \$30k and \$300k in costs; consider costs to customers, shareholders, and third parties.	Immediately correctable damage to surrounding environment.	NonCompliance Impact: Selfreported or regulator identified violations.
Negligible	No injury or illness.	Outage resulting in less than 200 total customer hours of interruption.	Impact of less than \$30k in costs; consider costs to customers, shareholders, and third parties.	Resulting in negligible to no damage; Very small damage scale, if not negligible.	NonCompliance Impact: No compliance impact up to an administrative impact.

Figure 7.1-1 Impact/Consequence Scale

The Impact/Consequence scale has been applied to specific dimensions of risk, to create logic sheets. These logic sheets offer more detail on what would cause an asset/site to move between impact dimensions.

The following logic sheets have been completed, through partnership with the SME organizations responsible for each risk dimensions:

- Compliance
- Environmental (Natural Resources/Pollution and Abatement)
- Reliability
- Safety

The following logic sheets remain to be completed:

- Environmental (Cultural)
- Financial

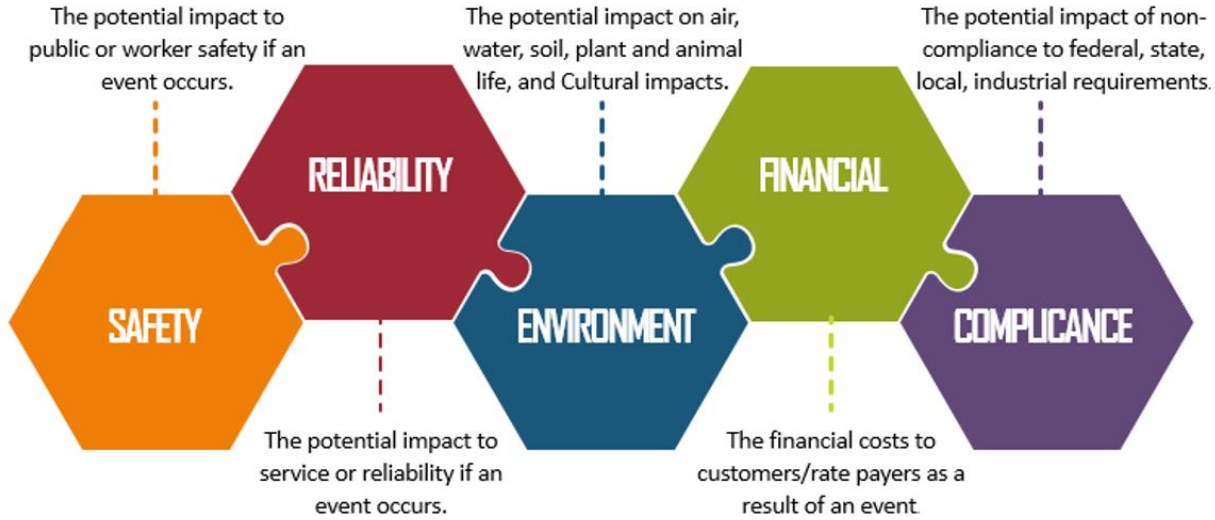


Figure 7.1-2 Asset Risk Dimensions

When logic sheets are completed, the assets are then scored based on the criteria depicted in the logic sheets. While the compliance logic sheet has been completed, assets have not yet been scored for that dimension. Heat maps in section 9 are derived from the impact dimensions that have been scored.

In addition to the impact dimensions above, Criticality also is determined as it applies to specific program areas. For example, individual asset managers may rank assets by criticality as it relates to objectives specified in their strategies. This is documented extensively in Transmission’s 2017 strategy documentation, but some examples are included below. Though these definitions can’t be easily aggregated and compared between programs, they do provide a very extensive understanding of criticality and prioritization factors within program areas.

For System Protection Control (SPC), an example is below:

Less Important		More Important	
Load-shedding relays	DFR	RAS	Transformer relays
Indicating meter transducers	Control equipment	Reactive relays	Bus relays
Relay communications		Revenue metering	Line relays
		SER	Breaker relays

Figure 7.1-3 SPC Criticality

Another example, for control center assets, follows.

Criticality

<i>Low</i>	<i>Moderate</i>	<i>High</i>
n/a	After-the-fact analysis systems	Systems that offer real-time grid visibility and control
	Systems that exchange data with other entities	Systems that enable cross-CC and/or utility communications and data exchange
	Lightning monitoring and Fault location systems	Data Center infrastructure, like networks, environment management and monitoring.
	Training systems	

Figure 7.1-4 Control Center Criticality

7.2 Usage of Criticality Model

In general, the Criticality score is incorporated into risk formula for final risk score:

$$RS = TEF * C_p * 10^{CI}$$

RS = Risk Score of a risk statement

TEF = Triggered Event Frequency – Number of times a risk event occurs per year

C_p = Conditional Probability that an outcome occurs given the risk event has occurred

CI = Consequence/Impact – Expected severity of impact for risk statement

Transmission continues to mature in applying criticality data in asset decision making. A dashboard was created in order to support use of this data, and a screen shot is represented in figure 7.2-1. As it exists today, this is one input in prioritization decisions for the assets included in Cascade. However, the capability will continue to mature so that more risk dimensions are included, data is available for more assets, and data/report updates are more automated as part of the implementation of the Transmission Portfolio Management Tool.

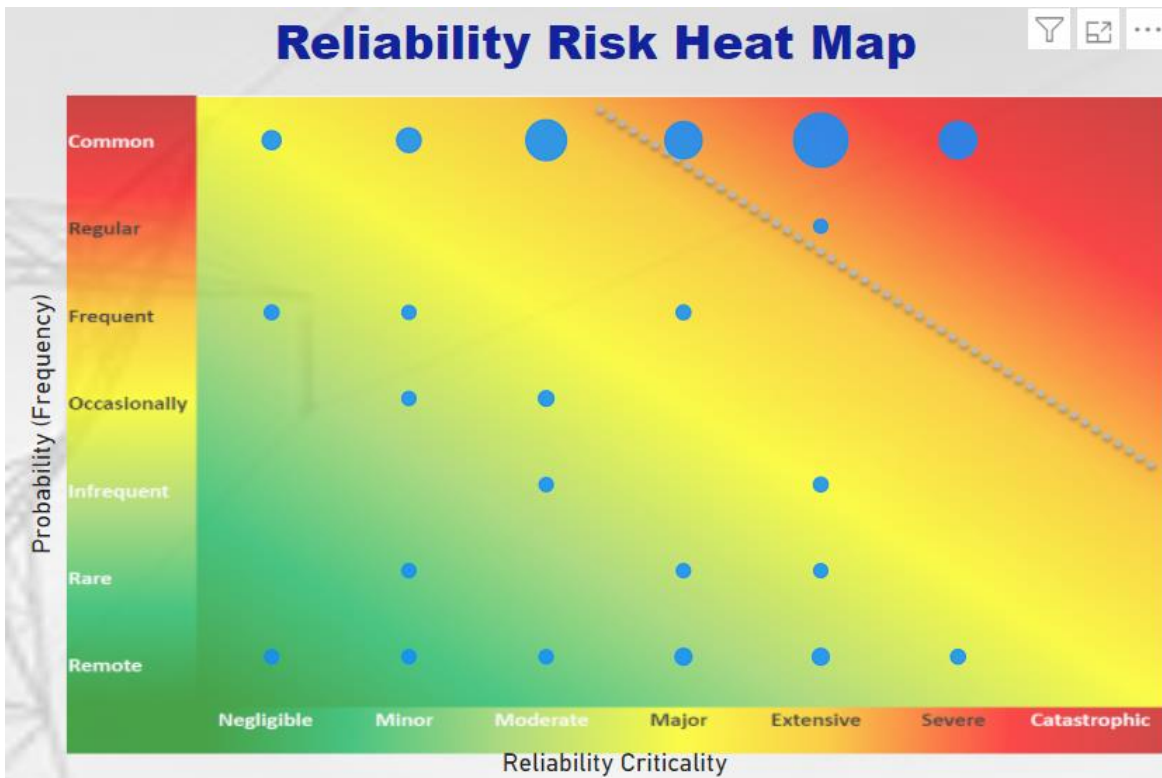


Figure 7.2-1 Reliability Risk Heat Map

Figure 7.2-1 demonstrates the reliability criticality on the X axis and the Probability of failure (based on health scores) on the Y axis. The circles on the graph represent planned bundles, with more bundles/more assets being represented by larger bubbles. Smaller bubbles represent fewer numbers of assets and/or fewer planned bundles.

Transmission is currently working on a comprehensive roadmap for the CHR capability, including criticality. At a high level, this will include evaluating specific applicability by program, and documenting exceptions. CHR analytics support asset replacement decision making by Transmission Asset Managers. While the capability is available today, it continues to mature and be refined over time. Some of this refinement will relate to specific criticality scoring, such as to identify primary impact dimensions that relate to the calculation of a risk score for a certain type of asset. CHR is not applied to process development but those opportunities could be evaluated and incorporated in the future.

8.0 CURRENT STATE

8.1 Historical Costs

Transmission’s historical costs along with the current approved rate case costs are depicted in the table below.

Table 8.1-1 Historical Spend

Capital & Expense Sub-Categories	Historical Actual Spend					SOY	Rate Case
	FY17	FY18	FY19	FY20	FY21	FY22	FY23
Sustain	\$ 200,521	\$ 159,682	\$ 139,552	\$ 145,053	\$ 158,605	\$ 180,200	\$ 212,000
Expand	\$ 70,149	\$ 71,595	\$ 84,617	\$ 61,684	\$ 100,116	\$ 81,900	\$ 115,000
PFIA	\$ 5,197	\$ 32,907	\$ 57,201	\$ 15,626	\$ 10,916	\$ 15,000	\$ 50,000
Total Capital	\$ 275,867	\$ 264,184	\$ 281,370	\$ 222,363	\$ 269,638	\$ 277,100	\$ 377,000
Maintenance	\$ 133,121	\$ 132,140	\$ 136,732	\$ 131,733	\$ 138,263	\$ 142,073	\$ 144,084
Other	\$ 88,425	\$ 84,705	\$ 85,927	\$ 94,389	\$ 105,300	\$ 107,167	\$ 108,248
Total Expense	\$ 221,547	\$ 216,845	\$ 222,659	\$ 226,121	\$ 243,563	\$ 249,239	\$ 252,333
Total Transmission	\$ 497,414	\$ 481,029	\$ 504,029	\$ 448,485	\$ 513,202	\$ 526,339	\$ 629,333

The below figures provide historical spend variations by program, between the years of 2019 and 2021. They also include FY22 SOY and FY23 rate case projections. The primary variation in execution rates between expand, sustain, and PFIA programs was that the volume of PFIA projects varied by year. Capital expenditures were lower in FY20, primarily due to pandemic impacts, and increased again in FY21. Rate case projections for FY23 are included here for perspective of the anticipated future ramp up over the next year.

The Other Expense asset sub-category covers support provided to facilitate the output of capital and maintenance programs under the Transmission asset management asset category. This includes aircraft services, logistics services, NERC/WECC compliance, environmental planning, enterprise services and other non-capitalizable business support functions. The Transmission Other Expense asset sub-category does not include Non-Transmission asset categories that are in other SAMPs such as Fleet, and Security.

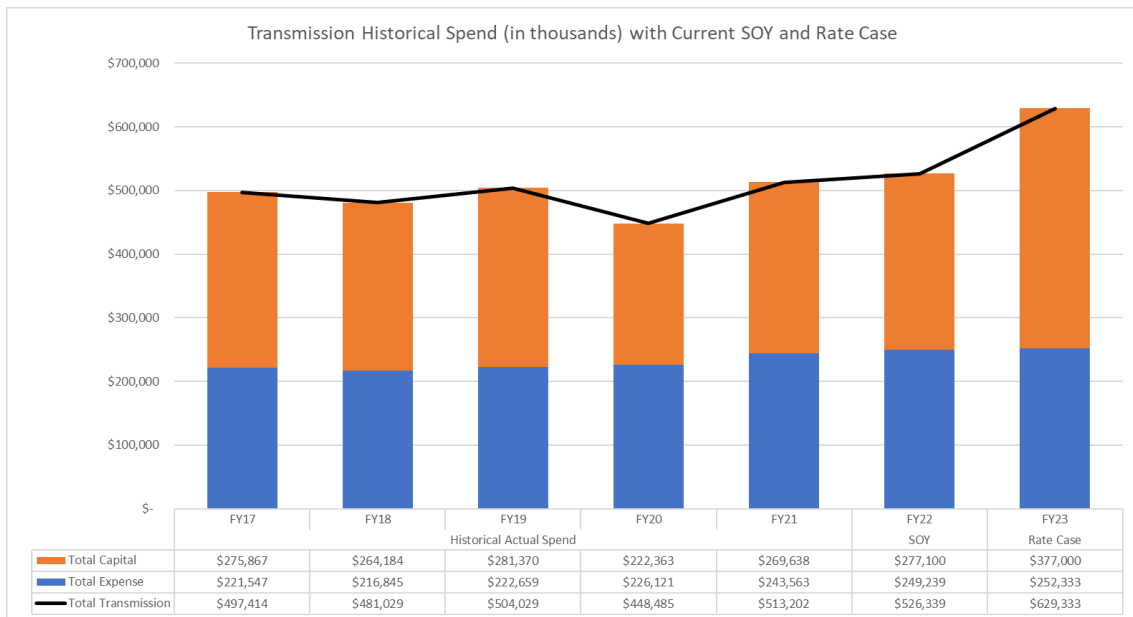


Figure 8.1-2 Historical Expenditures: Capital and Expense

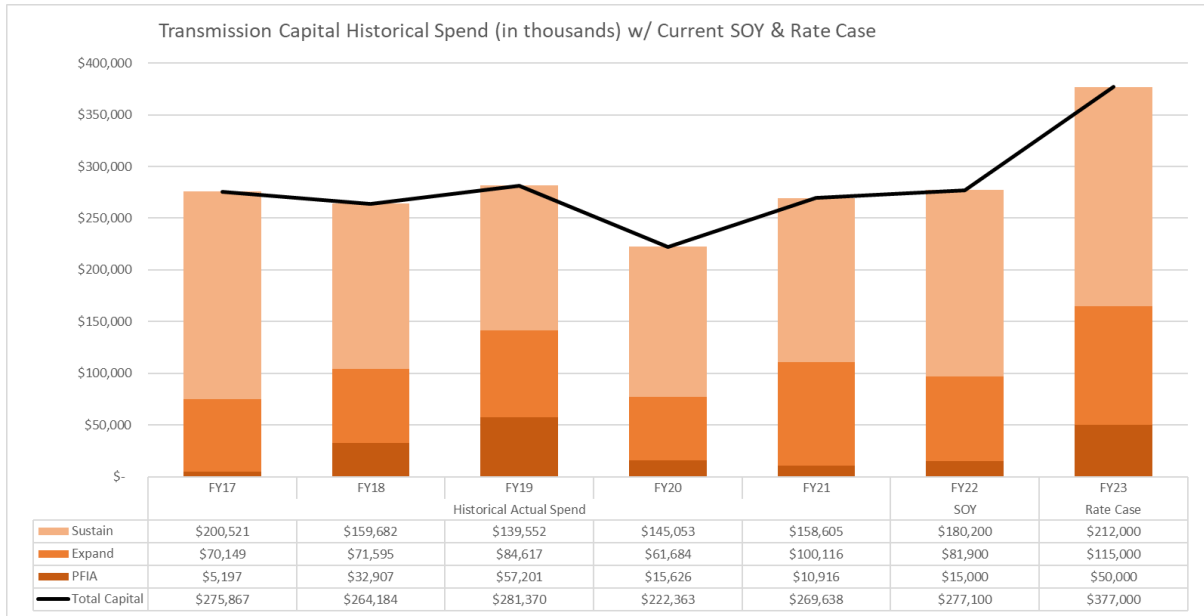


Figure 8.1-3 Historical Expenditures: Capital

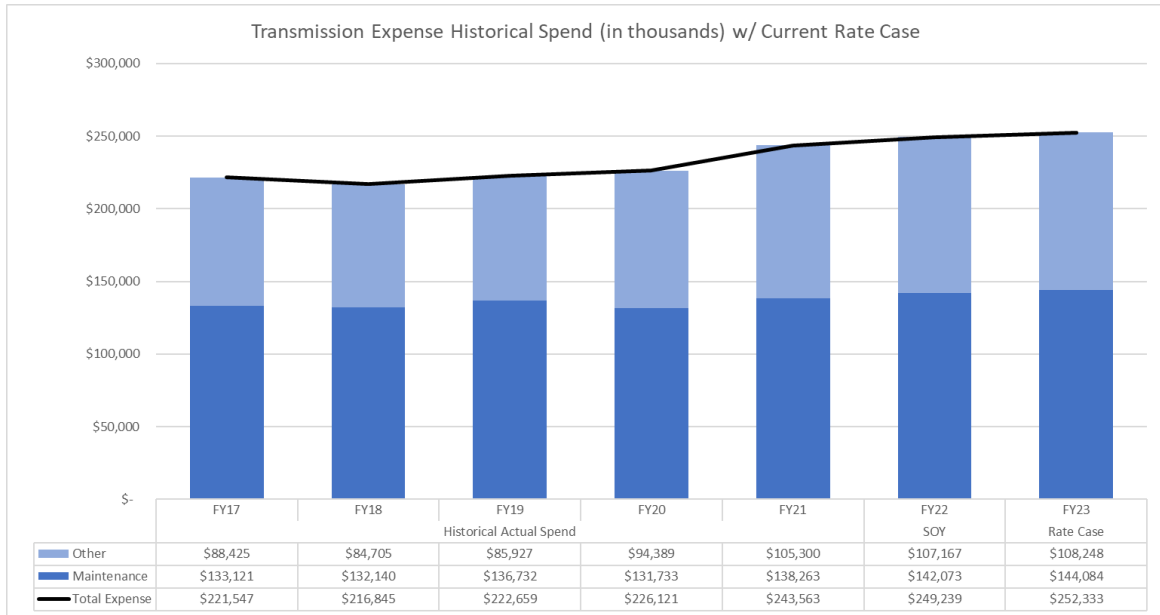


Figure 8.1-4 Historical Expenditures, Asset Management Expense

Asset Management program spending has been relatively consistent over the past five years, including the proportion spent on maintenance.

8.2 Asset Condition and Trends

During the first quarter of FY19, Transmission published its first Health Policy that sets out a common methodology for assessing the health of BPA's Transmission assets by quantifying the overall process for assessing condition-based health. It specifies the parameters, values and conditions to be used. This information enables long-term planning in replacement and maintenance activities to obtain asset management maturity in alignment with the Institute of Asset Management (IAM) framework, allowing optimized life-cycle decisions and risk to be quantified.

The Current Health Score for an individual asset is stored in Cascade and is most mature for substation assets. It is derived from information relating to:

- The age of the asset;
- The Normal Expected Life for an asset of its type;
- Factors relating to aspects of the environment in which the asset is installed that may impact its Expected Life (Location Factors);
- Factors relating to the usage of the asset at its specific location that may impact its Expected Life (Duty Factors);
- Factors relating to the observed condition of the asset (Observed Condition Inputs);
- Factors relating to the condition/health of the asset determined by measurements, tests or functional checks (Measured Condition Inputs); and
- A factor relating to generic reliability issues associated with the individual make and type of an asset (Reliability Modifier).

The calculation of Current Health Score is performed in two main steps:

- Calculation of an initial age-based Health Score (the Initial Health Score) using an age-based degradation model; then
- Modification of the Initial Health Score using known condition information for the asset and a Reliability Modifier, if appropriate.

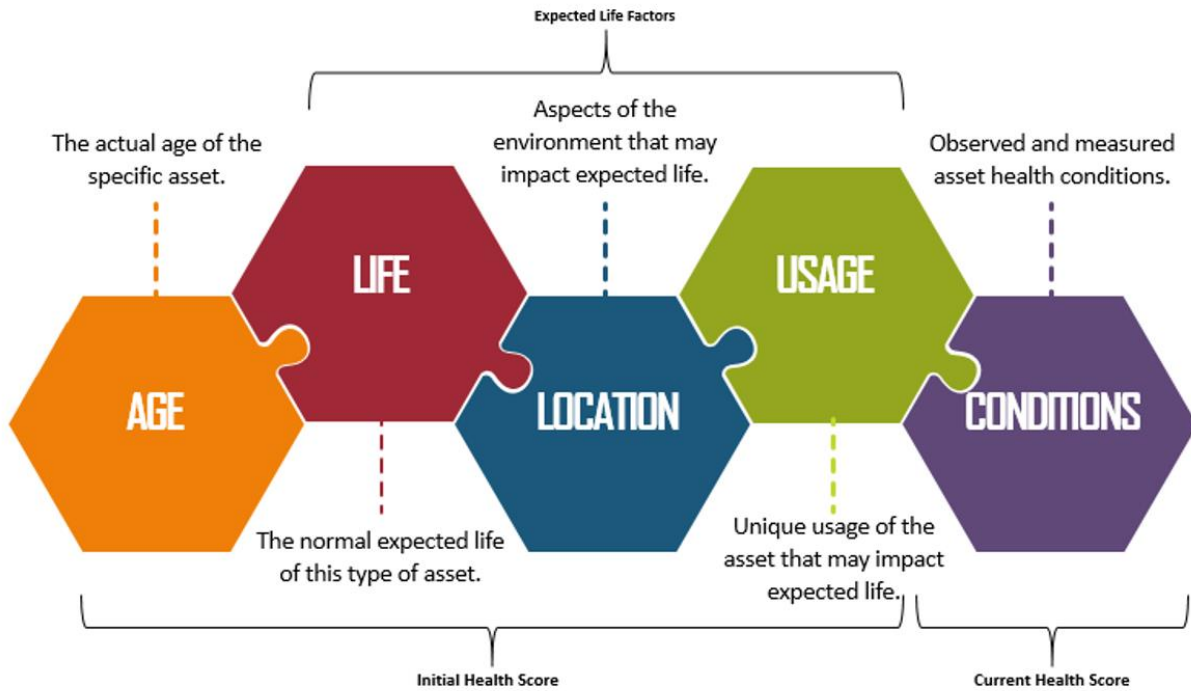


Figure 8.2-1, Asset Health

Figure 8.2-2 below is a snap shot of Transmission’s health scores for assets within the substation and steel structures & wood poles for line assets. The decision was made to display asset health at the program level because this provides an overview of Transmission assets and gives the reader a more holistic perspective regarding the number of assets being managed, and the distribution of health scores. The health scores range between one and ten. Assets with a health score closer to one indicates the assets are in good condition, whereas, assets nearing a score of ten may have a higher likelihood of failing.

As mentioned above, the health score calculation includes age as a factor, but age is not the only factor. Figure 8.2-2 displays assets at the program level and provides an overview of the distribution of asset health by program. In the past, age has been used as a proxy for health, but now age is considered as a factor within the methodology. This methodology is still new for BPA and only applies to certain assets. Some assets such as *strain-bus and pedestals* do not reside in structured asset information systems, this creates challenges in assessing asset condition due to the lack of structured data.

As mentioned previously, this data is most mature for substation assets. The algorithms still require refinement for SPC, PSC, and line assets and health scores may change as the capability continues to mature.

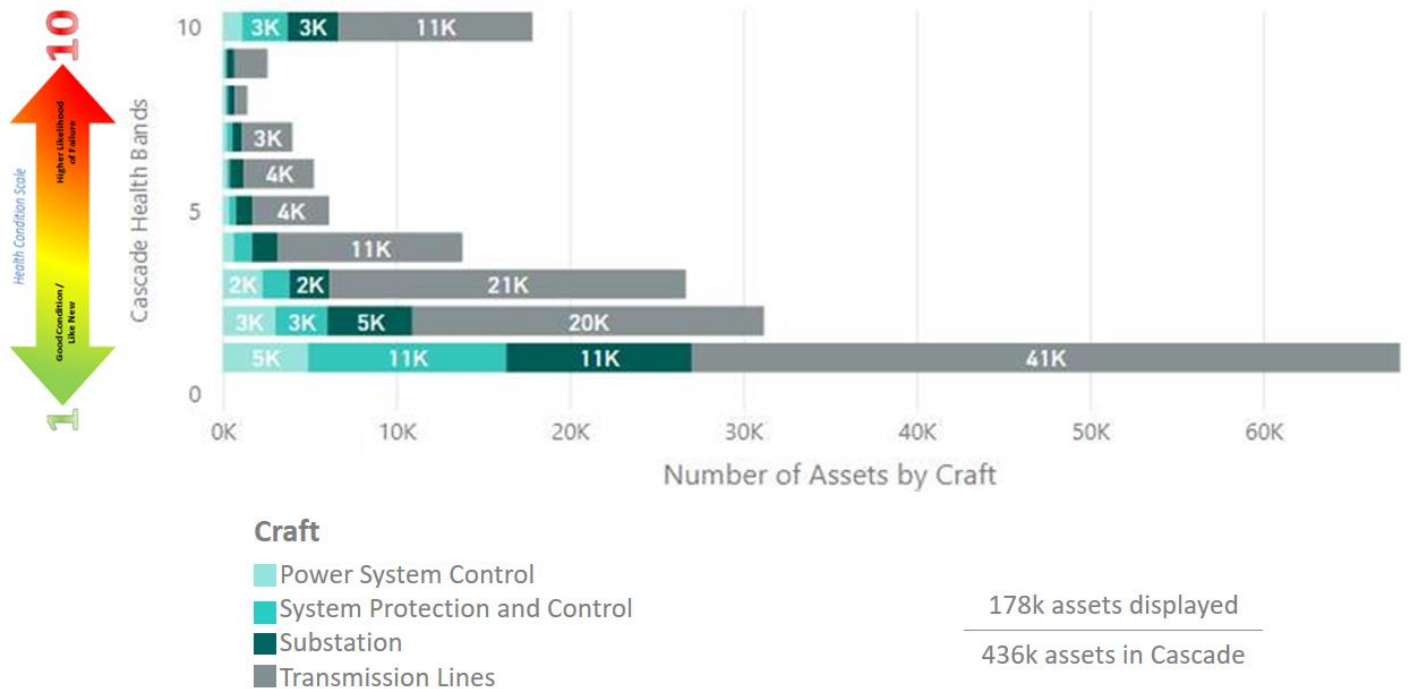


Figure 8.2-2, Asset Condition by Health

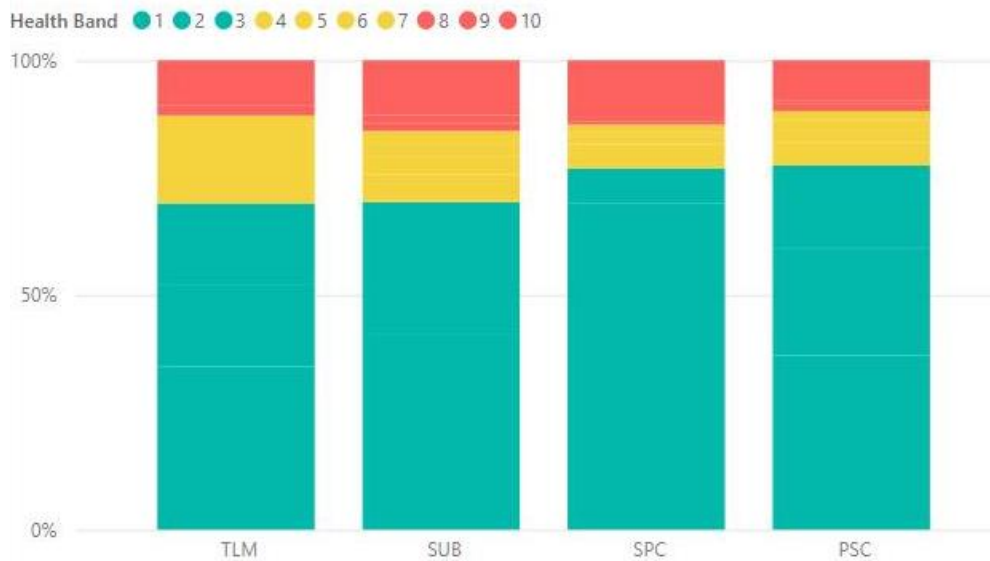


Figure 8.2-2, Percent of Health by Program

Health is also discussed in Transmission’s 2017 strategy documentation and individual program understandings of health is leveraged in program planning for all asset types. For example, in SPC, health is based on maintainability and operability, and varies by asset type.

Overall Component Health Demographics												
Major SPC Component	Maintainability						Obsolescence			Asset Health		
	Good	Fair	Poor	Good	Fair	Poor	Good	Fair	Poor			
Digital Relays												
500kV	Good	Fair					Good	Fair		Fine		
230-345kV	Good	Fair					Good	Fair		Fine		
69-169kV	Good	Fair					Good	Fair		Fine		
<69kV	Good	Fair					Good	Fair		Fine		
Transformer & Reactive	Good	Fair					Good	Fair		Fine		
Special Protection & Control Schemes (RAS)	Good	Fair					Good	Fair		Good		
SERs												
BETA 512				Poor	Poor				Poor	Poor		
BETA 4100			Fair	Poor				Fair	Poor	Impaired		
D20	Good	Good					Good	Good		Good		
DFRs												
Rochester				Poor	Poor				Poor	Poor		
BEN	Good	Good					Good	Good		Good		
Revenue Meters												
Electronic		Fair	Fair					Fair	Poor	Fair		
Digital	Good	Good					Good	Fair		Good		
Remote Metering System			Fair	Poor					Poor	Impaired		

Figure 8.2-3, SPC Health Demographics (subset of assets represented)

Though these type of demographics vary by program (and therefore can't easily be aggregated to compare across programs), they are highly useful in individual program decision making. Most programs use CHR data in combination with other data specific to their program. For example, in the lines program, the initial CHR health score could be very good, because today, the score is based primarily on the health of the pole. However, the asset manager, based on their expertise and other program data, also takes into account the health of the conductor and hardware, in order to understand the health of the asset more comprehensively. Because Transmission's system is so complex, typically one substation or line contains assets of varying health scores. The asset managers include these factors in their decision making and use the best analytics available to support their decisions.

8.3 Asset Performance

Asset health performance does exist for some assets but the granularity varies by asset type. The alternating current Substation (Subs AC) program has the most granular level of performance data. However, for other assets (including Subs AC), data exists in approximately 40 systems. Depending on the source system Transmission has limited usable information. While standing up CHR as a cross-functional output for decision making, the agency is working towards best practices for the management of asset information. By improving asset information governance, stewardship, and system architecture, along with the initial operating capability for CHR, the corresponding outputs will be used in asset analytics.

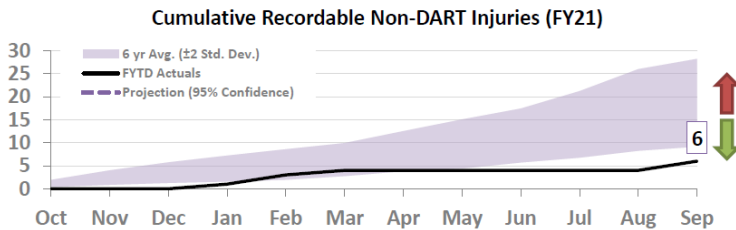
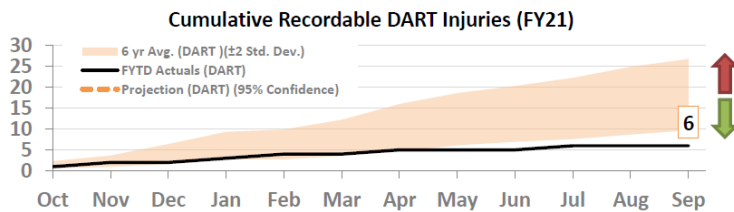
Currently, Transmission is developing several AM metrics and they are listed in section 10.1, Future Asset Performance as well as below, in Table 8.3-1.

Table 8.3-1, Asset Management Metrics

Objective	Description
Portfolio risk score (Reliability Score)	The Risk Score, based on the reliability impact dimension and calculated using the formula in section 9. The Risk Score will be calculated by bundle and summed at the portfolio level.
High risk assets replaced (completed/planned)	A metric demonstrating the number of high risk assets replaced. The risk threshold would be defined as to what constitutes 'high risk' and the metric would be available based on defined impact dimensions.
Portfolio risk spend efficiency (completed/planned)	A calculation based on a bundle's risk score and actual (or planned) execution cost, used to demonstrate how much it is costing to reduce risk on the system.
Portfolio risk reduction (completed/planned)	A calculation based on the entire portfolio of work, and how much risk is being reduced as a result of executing projects (based on the comparison of risk scores before the bundles are complete).
Program risk reduction (completed/planned)	Similar to the 'portfolio risk reduction' except calculated on a program by program level.
Health score from 1 to 10, focus on assets above an 8 lowered (completed/planned)	Health scoring, as presented in figure 8.2-2

Transmission Services establishes and updates performance standards on an annual basis and reports trends through informal dashboards distributed to all personnel and formal reports prepared for executive leadership. Transmission currently tracks safety and outage metrics which can be found in the Transmission Quarterly Report. The following is a summary of the measures tracked:

- Safety: Transmission tracks Recordable Injuries and reports on cause, Incident Frequency Rate (IFR) and Days Away, Restrictions, and Transfers (DART)



- Financials: Rate Case revenues and expenses are compared to start of year, FY-to-date and end-of-year forecast
- Reliability: Counts of unplanned outages by week and cumulative to date are trended against previous performance and pre-defined warning limits

System Automatic Interruption Duration Index (SAIDI) / System Automatic Interruption Frequency Index (SAIFI) Asset Investments: Transmission System Infrastructure key performance indicator (KPI) tracks and projects capital spending on a single fiscal year basis

- Asset Replacements: Both the Transmission System Infrastructure Key Performance Indicator and the programmatic Sustain business case tracks asset replacements in each sustain program.
- Compliance:
 - Regulatory (FERC, NERC, WECC)
 - Legal/financial
 - Partnerships and New Technology
 - Technology Innovation projects
 - Commercial and other generation dispatch and load management arrangements

8.4 Performance and Practices Benchmarking

Transmission participates with a variety of peer utilities and organizations, in order to share knowledge, data, and process development information. In the Asset Management space, benchmarking is informal and flexible based on the specific issue. For example, Transmission might meet with a group of partner utilities to ask them about what their processes or tools look like, in order to support addressing specific gaps or investment decisions.

Transmission is a member of several organizations that support information sharing, including:

- Electric Power Research Institute (EPRI)
- Centre for Energy Advancement through Technological Innovation (CEATI)
- North American Transmission Forum (NATF)
- International Wildfire Risk Mitigation Consortium (IWRMC)

Transmission has participated in member surveys on topics ranging from estimating to asset management systems, to questions more specific to particular equipment. Results are confidential with controlled distribution, and not available to be included in the SAMP.

9.0 RISK ASSESSMENT

BPA's Transmission system includes many aging assets, and a key focus for BPA is to manage the associated asset risks. With regard to asset condition and risk, Transmission evaluates the risk of asset failure and the associated reliability impacts along with the replacement cost.

Transmission is also pursuing strategies to:

- Expand the use of condition based risk management across key asset categories
- Continue to develop and implement processes for capturing, registering, assessing and tracking asset related risks
- Make risk informed investment and prioritization decisions across the asset lifecycle.

Transmission is working to mature the risk methodology and is developing a roadmap for the capability. The goal of the methodology is to identify and reduce the likelihood or impact of failures to minimize disruption to customers and maintain reliability. This roadmap will include developing all of the necessary terms and calculations, as well as any system, process or tool enhancements that are needed. Transmission's capability is based on Southern Cal Edison's work, and Transmission will be operationalizing the following equation:

$$RS = TEF * C_p * 10^{CI}$$

RS = Risk Score of a risk statement

TEF = Triggered Event Frequency – Number of times a risk event occurs per year

C_p = Conditional Probability that an outcome occurs given the risk event has occurred

CI = Consequence/Impact – Expected severity of impact for risk statement

Impact dimensions are applied to specific assets in Cascade for a subset of equipment types. Impact dimensions are currently available in the system for:

Safety

Reliability

Environment (Natural Resources)

Environment (Pollution and Abatement)

In a mature future state, Transmission will represent heat mapping based on data, at the program level, so that Transmission's asset risk profile is presented at a high level by each impact dimension. In the current state, Transmission leverages the Total Economic Cost (TEC) models to allocate funds between programs based on total economic cost. Transmission will incorporate the TEC analytics into future AM systems and plans to ultimately retire the TEC models as the Portfolio Optimization Tool is implemented. This transition is described in more detail in section 10.1.

Total economic cost is depicted in the figure below, and demonstrates what type of information is included in the measure. Risk is primarily based on the Reliability and Financial perspectives in this framework, though other factors are included in varying degrees as components of the cost data. For example, environmental impacts may be included in 'emergency replacement cost' impacts. Total economic cost modeling data does not support heat mapping, but it does present various scenarios of funding levels by program and at the overall Transmission level. These scenarios are evaluated and additional factors (for example, execution pace, other major projects/risks, etc) are incorporated into final program distributions set as part of budget setting processes.

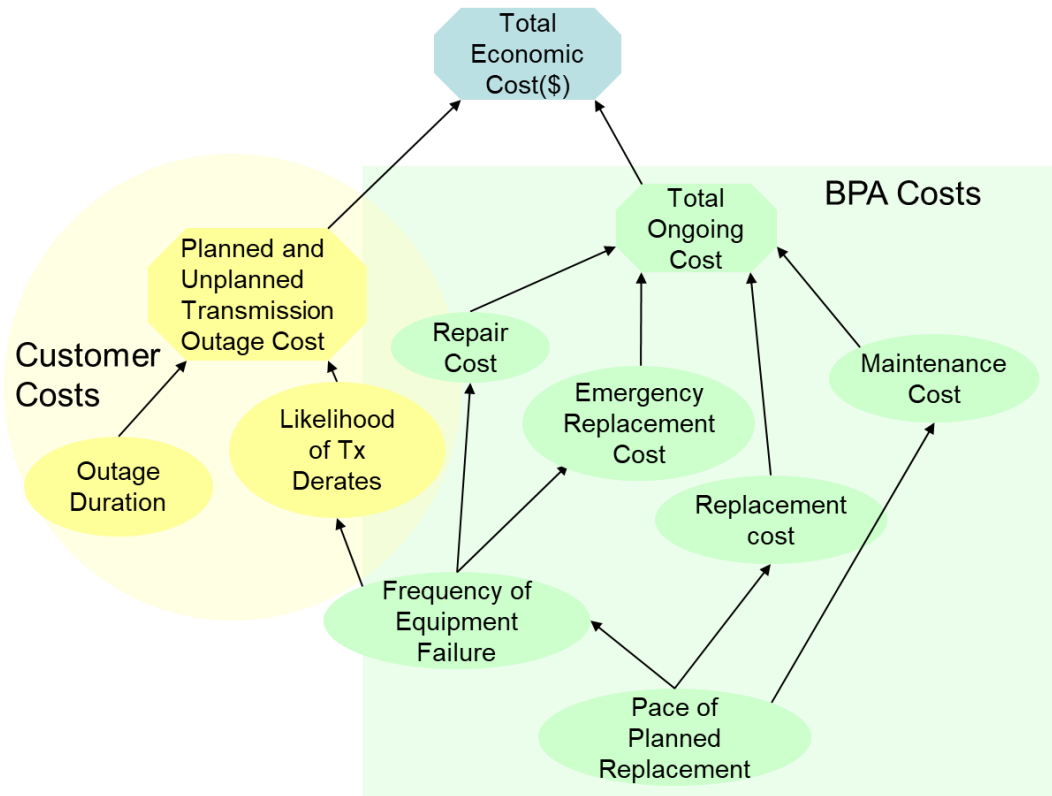


Figure 9.1-1, Total Economic Cost Framework

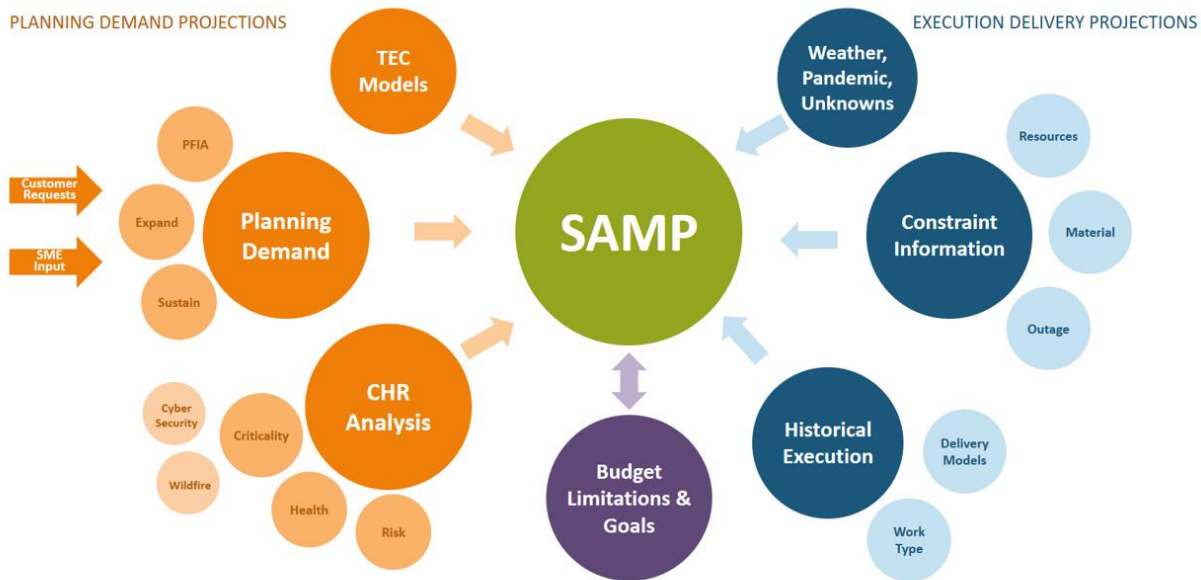


Figure 9.1-2, SAMP Risk Assessment Considerations

Transmission is developing the capability to assess risk across five impact dimensions: Reliability, Safety, Environment, Compliance, and Reliability.

Reliability:

The Reliability dimension is understood in relation to outages resulting in customer interruption, load loss, and curtailment of firm service. The substation assets are plotted in this dimension in Figure 9.1-3, and replacement decisions are guided by reliability risk.

		Criticality						
		1	2	3	4	5	6	7
Health	10	581	595	735	572	213	234	0
	9	86	100	86	81	51	26	0
	8	75	111	95	77	23	26	0
	7	157	181	93	98	47	26	0
	6	159	207	151	169	112	31	0
	4-5	405	493	436	488	395	180	0
	1-3	2514	3012	3329	3774	2582	2646	0
		Negligible	Minor	Moderate	Major	Extensive	Severe	Catastrophic

Figure 9.1-3, Substation Assets, Reliability Impact Dimension

Figure 9.1-3 plots substation assets and their health scores (Y axis) and Reliability impact dimension score (X axis). Program decisions are made based on this data, and projects have been planned to address the 234 assets with health scores of 10 (worst condition) and Severe Impact.

The Reliability impact dimension is most mature in the sense that a prototype heat map was created in the summer of 2021 that would apply to all programs. This heat map was first presented in section 7 and is also provided in Figure 9.1-4 below. This heat map was a manual solution and was used to guide decision making in the summer of 2021. The line in the upper right hand corner was the ‘risk tolerance’ and any projects that fell above that line (based on the risk scoring methodology) would be prioritized for scoping. The dashboard is currently being revisited in order to build a firm foundation for continued growth over the coming two years.

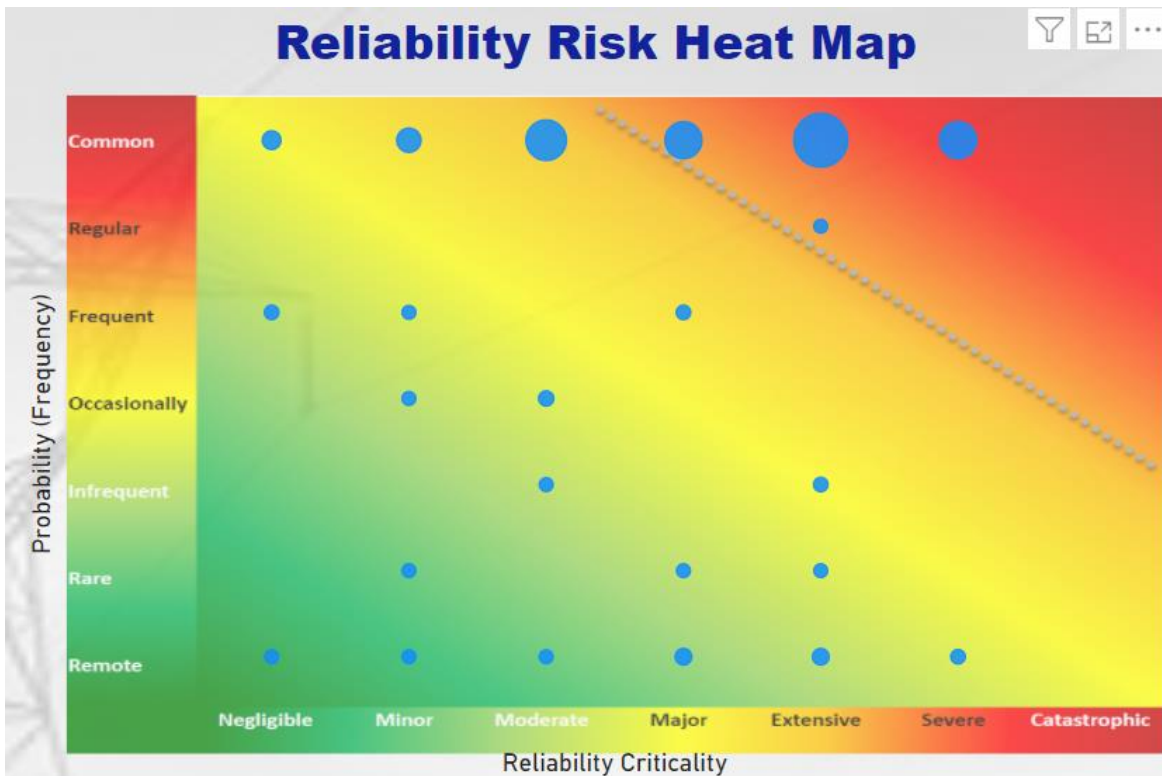


Figure 9.1-4, Reliability Risk Heat Map

Figure 9.1-4 demonstrates the reliability criticality on the X axis and the Probability of failure (based on health scores) on the Y axis. The circles on the graph represent planned bundles, with more bundles/more assets being represented by larger bubbles. Smaller bubbles represent fewer numbers of assets and/or fewer planned bundles.

Transmission programs have undergone significant risk assessment activities over the past 10 years. For example, Figure 9.1-5 below demonstrates the current state (in 2013) as well as the Future State with/without Program (2023). Risk in this figure is not specific to Reliability, but Reliability plays a large part in understanding risk (in particular, outages resulting from asset failures).

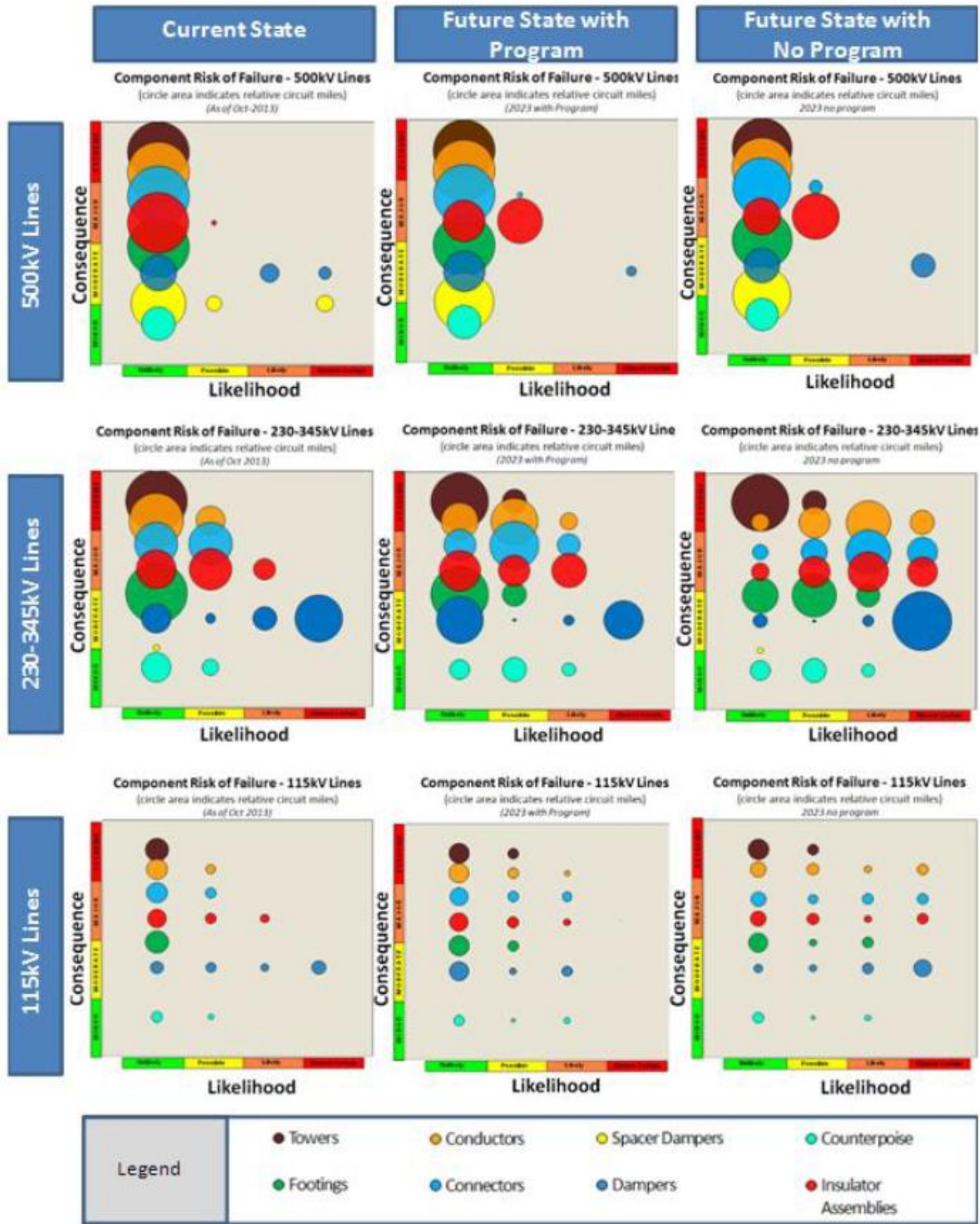


Figure 9.1-5, Steel Program Risk Mapping (2013)

Figure 9.1-5 represents the assets/components shown in the legend, and what the effect of the program execution would be on these populations of assets. Larger bubbles represent more assets, and the visuals

show the expected risk mitigation as a result of executing the steel line program, seen at the granular asset/component level.

Safety:

Transmission understands Safety based on several factors: for example, asset proximity to navigable rivers and/or highways, recreational facilities, and other location-based factors. Other considerations include failure modes, such as asset explosions or fire risk. Safety impacts from outages are also considered - for example, outages in wintery conditions. There is some inter-relatedness between the Reliability impact dimension and the Safety impact dimension.

In the Steel program (represented in Figure 9.1-5 above), an example of a safety consideration would be evaluating the risk of a component failure that leads to dropping the line. Safety is a primary consideration in the Wildfire Mitigation Plan, which is described in depth in a separate external document. Transmission commonly addresses Safety concerns as emergency projects, especially when the concern is discovered as part of inspection/maintenance work.

Substation assets are represented in Figure 9.1-6 based on Cascade Health Data as well as Safety impact dimension scoring.

		Criticality						
		1	2	3	4	5	6	7
Health	10	667	1	82	1,714	213	360	0
	9	87	7	21	252	37	42	0
	8	99	(Blank)	20	203	29	59	0
	7	95	1	11	362	59	76	0
	6	198	10	67	347	79	144	0
	4-5	1020	33	116	784	243	268	0
	1-3	7449	634	1191	3505	2254	3025	0
		Negligible	Minor	Moderate	Major	Extensive	Severe	Catastrophic

Figure 9.1-6, Substation Assets, Safety Impact Dimension

Figure 9.1-6 represents substation assets, plotted against health score (Y axis) and Safety Impact Dimension score. There are no assets with a Catastrophic Safety Risk, and the assets with ‘Severe’ impact are made visible and incorporated into substation program planning.

Many assets across Transmission have clear links to Safety. For example, as part of the PSC/Telecommunications Program, telephone systems are replaced. Telephone System replacements (Figure 9.1-7) are related to safety because they are critical to daily operation and maintenance activities, and to the ability to communicate across the system even when cell phone service is not available.

Asset	Description
Telephone Systems	BPA maintains an extensive internal Dial Automatic Telephone System (DATS) for daily operation and maintenance activities. This equipment includes DATS switches and supporting systems, key system and telephone equipment, and teleprotection systems.

Figure 9.1-7, Telephone Systems

Environment:

Environmental factors are represented for substation assets in the below figures (9.1-8 and 9.1-9, specific to the natural resources dimension and to the pollution and abatement dimension. Examples of factors considered in the natural resources dimension include proximity to wetlands, the impact size of the site, impacts to fish, wildlife, and plants, and wildfire risk. For pollution and abatement, considerations include oil spills, proximity to water, lead cables, toxic waste, and PCBs. Examples of projects driven by this dimension would be replacing breakers with PCBs, or adding oil containment around certain substation equipment.

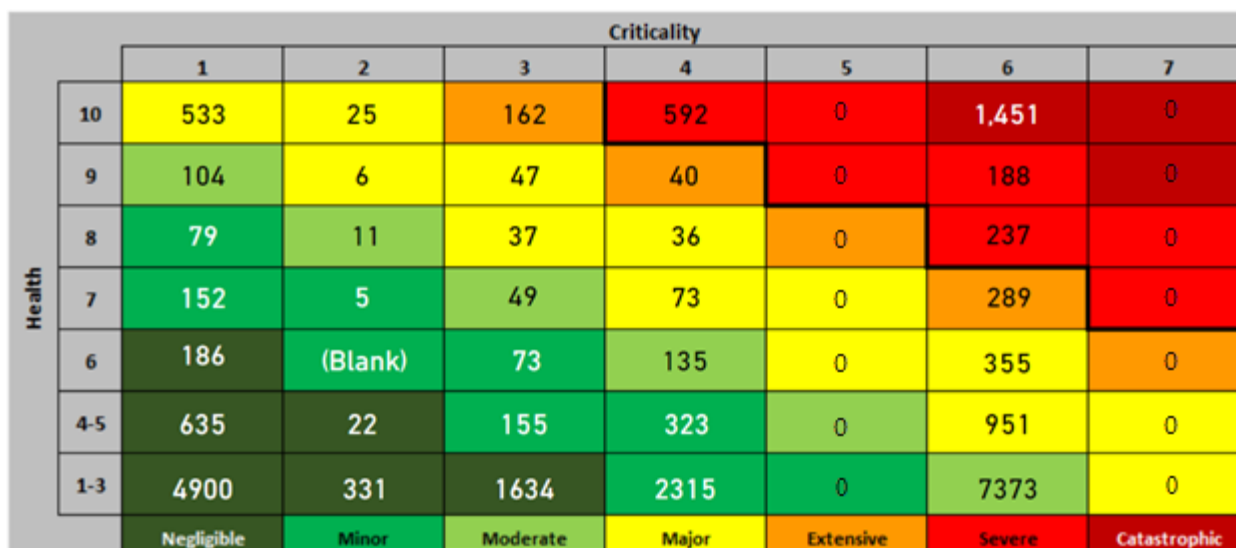


Figure 9.1-8, Substation Assets, Natural Resources Dimension

Figure 9.1-8 represents substation assets, plotted against health score (Y axis) and Natural Resources Impact Dimension score. There are no assets with a Catastrophic Natural Resources Risk, and the assets with 'Severe' impact are made visible and incorporated into substation program planning.

		Criticality						
		1	2	3	4	5	6	7
Health	10	1,460	519	763	0	61	103	0
	9	235	98	88	0	1	3	0
	8	226	97	63	0	1	21	0
	7	316	131	118	0	6	15	0
	6	470	148	161	0	9	27	0
	4-5	1234	459	538	0	12	65	0
	1-3	8586	3837	3286	0	78	441	0
		Negligible	Minor	Moderate	Major	Extensive	Severe	Catastrophic

Figure 9.1-9, Substation Assets, Pollution and Abatement Dimension

Figure 9.1-9 represents substation assets, plotted against health score (Y axis) and Pollution and Abatement Impact Dimension score. There are no assets with a Catastrophic Pollution and Abatement Risk, and the assets with ‘Severe’ impact are made visible and incorporated into program planning.

Compliance:

A logic sheet has been developed for Compliance, but impact dimensions have not yet been applied to individual equipment in Cascade.

In the Compliance impact dimension, Transmission considers the following primary NERC/WECC compliance standards and qualitatively evaluates projects by standard, listed below:

- Remedial Action Directive- risk that asset failure would result in a Remedial Asset Directive, or would be associated with a previously issued Remedial Action Directive
- FAC-501-WECC-1- Asset failure is on a WECC path
- PRC-005- Asset failure from PRC-005 asset type list
- FAC-003- Asset failure would result in impairment to FAC-003 Clearance Requirements
- CIP-06/14- Asset failure was a result from failure to properly meet physical security physical security requirements
- TPL-001- Establish Transmission system planning performance requirements within the planning horizon to develop a Bulk Electric System (BES) that will operate reliably over a broad spectrum of System conditions and following a wide range of probable Contingencies. Asset failure is a result of equipment not properly applied within its capabilities or ratings.
- EOP-008- Asset failure is a result of lack of redundancy from system controllers
- FAC-008- Asset failure is a result of improper rating methodology inducing over capacity failure mode. This may result in a curtailment and/or de-rate.

Financial:

The financial impact logic sheet has not yet been completed.

Because the Financial logic sheet has not yet been developed, the qualitative discussion of the Financial impact dimension will evolve over time. However, in the current state, Transmission considers the following when evaluating a proposed project from the Financial Impact Dimension:

- *Whether the investment is likely to result in additional revenues
- *Whether the investment has an effect on maintenance or future replacement costs
- *Whether the investment minimizes the risk of an outage that would impact service to customers or cause a system de-rate

Transmission also incorporates the Financial impact into portfolio planning, such as by ramping up the sustain program over time to mitigate future rate impacts due to high rates of asset failures or other impacts.

10.0 STRATEGY AND FUTURE STATE

Transmission Asset Management continues to mature and is currently working to define detailed roadmaps for this next phase of maturity. At a high level, the strategic direction entails continuing to mature the CHR capability, improving data integration throughout the asset lifecycle, and being able to use this data to optimize the portfolio of work. Transmission also continues to work toward replacing the highest risk assets on the system, as measured with CHR, Total Economic Cost (TEC), and other methodologies specific to a given asset program. Figure 10.0-1 demonstrates this over time. The Transmission Portfolio Optimization tool (TPOT) is planned to begin in 2024 and be implemented in 2027, though that timeline is heavily dependent on available IT resources and budget. The tool will incorporate Transmission’s existing analytical capabilities, allow Transmission to create and evaluate various portfolio alternatives, streamline several asset inform systems, and optimized base on different constraints, risks, and benefits. Transmission’s CHR and TEC capabilities will continue to be matured and leveraged as part of decision making in the meantime, and will both be integrated as needed into requirements for TPOT.

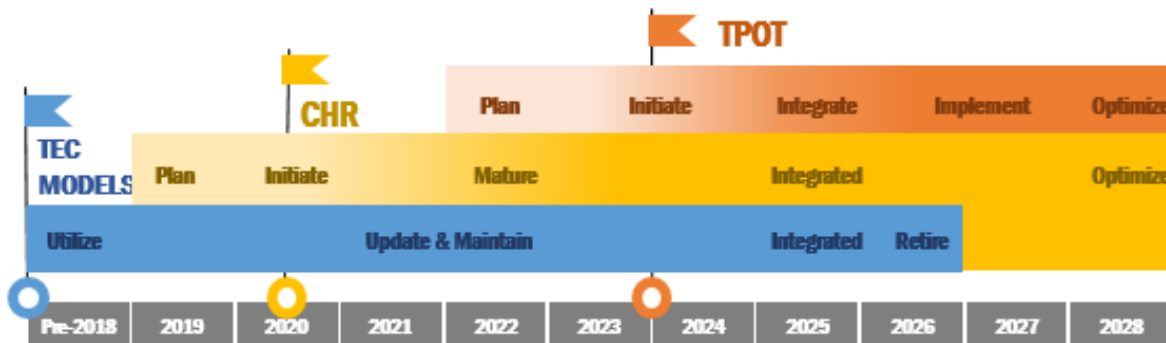


Figure 10.0-1: Asset Management Investment Decision Making Criteria and Tools

10.1 Future State Asset Performance

In the 2020 SAMP, Transmission proposed the concept of Asset Management metrics related to Reliability Strength. In the years since, Transmission has continued to develop potential metrics and is working toward reporting and tracking six scores over the coming years. At this time, the AM metrics are in development and, as a result, Transmission has not applied this to the portfolio. The metrics in development are included in Table 10.1-1 and leverage Transmission’s CHR capability. The metrics will mature along with CHR over the coming years and become automated for more consistent and reliability reporting for future customer meetings.

Table 10.1-1, Future Asset Management Metrics

Objective	Description
Portfolio risk score (Reliability Score)	The Risk Score, based on the reliability impact dimension and calculated using the formula in section 9. The Risk Score will be calculated by bundle and summed at the portfolio level.
High risk assets replaced (completed/planned)	A metric demonstrating the number of high risk assets replaced. The risk threshold would be defined as to what constitutes ‘high risk’ and the metric would be available based on defined impact dimensions.
Portfolio risk spend efficiency (completed/planned)	A calculation based on a bundle’s risk score and actual (or planned) execution cost, used to demonstrate how much it is costing to reduce risk on the system.
Portfolio risk reduction (completed/planned)	A calculation based on the entire portfolio of work, and how much risk is being reduced as a result of executing projects (based on the comparison of risk scores before the bundles are complete).
Program risk reduction (completed/planned)	Similar to the ‘portfolio risk reduction’ except calculated on a program by program level.
Health score from 1 to 10, focus on assets above an 8 lowered (completed/planned)	Health scoring, as presented in figure 8.2-2

Transmission continues to report on asset performance as it relates to SAIDI/SAIFI while also managing a comprehensive preventative maintenance program. Asset performance decisions will be based upon Health Scoring and SME feedback for individual projects, as well as other related data and reporting information. As Transmission matures, asset management metrics will be set reflecting that maturity.

10.2 Strategy

The Transmission Asset Strategy Integration (TASI) initiative completed in FY2016 after six years of development resulted in a cohesive asset strategy that is risk informed and focuses on reducing total economic cost across the BPA Transmission sustain asset program areas.

These strategies comprise the foundation of the sustain asset management program and focus on optimizing replacement plans, but also include, high value efficiency improvements to fully realize and create value for Transmission and its customers over the long-term.

The sustain strategies further support the replacement plan modelling capabilities (ie. The TEC models) as well as Criticality, Health and Risk analytics.

10.2.1 Sustainment Strategy

Over the past few years, Transmission Services has been maturing its asset management program with a goal of sustaining its existing assets to meet reliability and availability targets at optimal lifecycle costs. Long-term asset strategies and asset plans have been developed for:

- Alternating and direct current substations
- Control centers
- Power system control/telecommunications
- System protection and control
- Rights-of-way
- Wood lines
- Steel lines

Sustainment planning is asset driven and considers the condition of the assets and the demands placed upon them. Each of the program strategies contains a representation of asset health and risk of failure to the system along with a strategy for mitigating any associated risks. The strategies provide the direction for addressing the most critical assets first while a corresponding plan has been developed to implement risks mitigation, slow down or eliminate capital replacement backlogs, and reach optimal lifecycle management.

AC Substations

The AC Substations program has developed a risk-informed asset management strategic approach where substation assets are planned for replacement based on reducing total economic cost. This strategy includes a quantification of not only risks to BPA, but to BPA's customers as well. Currently, the 'steady state' replacement pace has not yet been reached, hence the ramp up in capital dollars depicted in table 10.3.

Key risks to be addressed

- Risks to system reliability
- Increasing equipment failure rates due to aged equipment
- Functional obsolescence - Equipment impacted by system expansion and load growth
- Technology obsolescence – Equipment no longer available, spare parts, long lead time and/or cost, vendor product support

Strategy Elements

Modeling and analyzing equipment replacement on a total economic cost basis revealed there is a large backlog of equipment beyond its economic lifecycle. By strategically addressing the backlog, it will require the implementation of the following:

- Replacement plans that address backlog based on economic lifecycle and effective age
- Using readily available data to assist in repair/replace decisions
- Process improvements aimed to better coordinate replacements between programs to gain efficiencies and reduce outages
- Develop and implement predictive analysis to identify trouble equipment using readily available information.
- Improve work related processes and coordination
- Strategic placement of on-site spares for transformers and reactors

HVDC and FACTS

Replace and upgrade components and systems as required for High Voltage Current (HVDC). Flexible Alternating Current Transmission (FACTS) assets at the highest risk of failure or obsolescence.

Key risk to be addressed

- Risks to system reliability
- Cyber Security Compliance
- Inadequate vendor support
- Spare parts availability, long lead times and/or cost
- Obsolete systems
- Work force availability

Strategy Elements

- Continue to replace and upgrade unserviceable and obsolete systems and components within BPA's fleet of Series Capacitors, Static VAR Compensators and the Celilo HVDC Converter Station.
- Special emphasis on adjusting Subs DC Program goals with consideration to NERC-CIP requirements and the rapidly changing environment of high speed, microprocessor-based control systems

Control centers

The strategies to improve control center asset performance are focused on addressing critical asset risks first, as well as high risk asset issues before they reach critical stage.

Key risk to be addressed

- Risks to system reliability and flexibility
- Wide range of evolving operational, regional market, industry, regulatory, and security related requirements

Strategy Elements

- Complete Asset Service Lifecycle Plans for every system and update them at least annually. Ensure integration of the Program Asset Plan priorities management and Project Portfolio Management processes.
- Server and workstation lifecycle standards support determining system upgrade planning and risk methods. Other CC equipment lifecycle standards will be developed and incorporated into systems lifecycle planning.
- Complete Windows Migrations efforts for remaining OpenVMS systems
- Develop and support a CC Data Management Program and Strategy
- Develop business architecture and strategic "line of sight" to CC assets
- Develop visibility, tools, and processes to support more complete and proactive Demand & Capacity Management in the CC
- Strategically plan for CC asset information management improvements
- Establish plans for appropriately dedicating CC technology and architecture planning functions or roles
- Develop a cyber-security and risk management strategy towards evolving the current practices for system visibility, risk assessment, decision making and compliance response

In the long run, this strategy will help:

- Ensure replacement or maintenance actions result in no assets assessed as Critical Risk Level of failure, obsolescence, or noncompliance

- Critical systems meet their respective availability targets.
- Provide redundancy and deployment of the most important systems in a geographically diverse manner to help ensure continuity of operations in the event of loss of a control center.

Power System Control/Telecommunications

The Power System Control (PSC) assets are critical control components for the transmission system. The program is highly driven by emerging technologies and regulatory compliance and must be positioned to respond to changes. Much of the equipment has a short lifecycle due to its technology type and external forces often drive the availability of spare parts and continued support from the manufacturer.

Key risks to be addressed

- Unplanned equipment replacements due to failures
- Outage risks and high economic costs due to equipment failure
- Technology interoperability issues
- Technology obsolescence and evolution
- Lack of manufacturer support
- Changing power system operations needs and evolving regulatory requirements

Strategy Elements

By using the total economic cost analytical approach, this strategy reflects the identification of a replacement plan that provides the greatest opportunity to reduce risks and therefore cost to BPA and its customers. This drives the development of a strategy that includes:

- Focus on replacing critical, at-risk equipment first
- Less critical and risky equipment is allowed to run to failure
- Accumulated backlog of replacements is planned based on economic lifecycle
- Preparation for future technology
- Work process improvements
 - More robust testing
 - Documentation clean up and management
 - Enhanced training
 - Coordination with SPC program for replacements

Rights-of-Way (Access Roads, Vegetation Management, Land Rights)

Key risks to be addressed

- Wildfire risk due to vegetation, rights of way widths, and access roads.
- Safe access for operation, maintenance, and capital work.
- Safe and adequate access for heavy equipment required for maintenance and capital build activities.
- Manage vegetation to maintain needed clearance for lines.
- Safe access for emergency work.

Strategy Elements

- Integrated vegetative management approach—a system of managing plant communities whereby managers set objectives, identify compatible and incompatible vegetation, consider action thresholds, and evaluate, select, and implement the most appropriate control methods to achieve set objectives.

- The Access Road program is working on a maintenance program to look at the road system holistically to help save money and provide a safer road system. Currently, maintaining roads (expense) is about one-third the cost compared to rebuilding roads (capital). Transitioning from capital to expense will take several years and require an initial increase in capital expenditures to bring the roads up to current standards, after which the capital budget will decrease. The maintenance program budget will need to increase over time as the program shifts from rebuilding to maintaining the roads.
- Ensure right-of-ways are safely and legally accessible to transmission paths and remote sites, and meet environmental regulations.
- Ensure BPA is compliant with all regulatory authorities.
- Ensures/supports BPA's relationship with landowners and other agencies through pro-active engagement and partnership.

System Protection and Control

Replace specific populations of equipment groups that are at highest risk of failure or technological obsolescence.

Key risks to be addressed

- Lack of Original Equipment Manufacturer (OEM) support for most SPC equipment due to advanced age
- Risks associated with poor health condition of older SPC equipment
- Decreasing skill set to maintain older equipment as SPC employees retire
- Increased corrective maintenance workload to maintain older equipment in poor health
- Increase in higher cost emergency repairs

Strategy Elements

The SPC strategy and implementation plan were developed using a risk-informed evaluation of strategic alternatives with a goal towards reducing total economic costs. This strategy includes:

- Targeting replacement of high-risk high-economic-cost protective relays
- Replace older DFRs then subsequently managing units on a 15-18 year lifecycle
- Actively coordinate with PSC program to replace all Beta SERs with SER/SCADA standard
- Replace majority of at-risk revenue and interchange meters over the next 10 years
- Control & Indication - develop a lower cost mini console replacement and begin replacing old units

Steel Lines

The strategy includes an initiative-taking plan to replace vital overhead system components nearing end-of-life. It sets standard metrics for collecting and retaining asset condition data with enough granularity to identify condition trends, target, and pace replacement efforts, manage components over time and better predict remaining service life.

Key risks to be addressed

- Condition of transmission line equipment
 - Component criticality to line performance
 - Aging related characteristics
 - Concerns for obsolescence
 - Sub-component connectivity

- Load impacted/load loss
- Wildfire mitigation

Strategy Elements

- Spacer dampers replaced 2008-2015
- Insulator replacements planned through FY26
- 2.5" re-conductor projects planned through FY31

Additions to the plan are spurred by:

- TLM reports via Cascade or Foreman determination of new or worsening problem conditions often lead to high-priority work. Primary examples are:
 - Tower damage
 - Insulator pin corrosion
 - Failing compression fittings
 - Failed marker balls
- Equipment Age and Obsolescence
 - Much of the program is driven by active-component age. We have 80-year-old equipment still in service.
 - Copper conductor is still in service and is replaced at opportune times. While it can still be serviceable, because it's obsolete, fittings aren't available and emergency restoration requires either a re-conductor or a non-standard repair.
- Standards drive additional scope - When we're working on a line, we may add scope to standardize equipment
- Compliance – Impairment mitigation is additional unplanned work that adds into the schedule and cost on most steel sustain projects. Impairment discovery has become the norm, and will be added to the plan and budget for future work.
 - Prioritization:
- SME concerns – SMEs inform the prioritization of all equipment replacement, impairment mitigation
- CHR is fed by TLM and Cascade, Age, Obsolescence, Standards and SME concerns
- WMP adds information about ignition probability and fuel load. In problem areas this will heighten the priority of work that might wait otherwise.

Wood Lines

The strategy focuses on shifting from individual components of the line, such as wood poles, to an asset life cycle strategy that combines life extension replacement of all the aged components on the structure and systematic replacement of aged, poorly performing wood pole lines.

Key risks to be addressed

- Condition of transmission line equipment
 - Component criticality to line performance
 - Aging related characteristics

- Concerns for obsolescence
- Sub-component connectivity
- Load impacted/load loss
- Wildfire mitigation
- Impairment mitigation

Strategy Elements

- Transmission Line Rebuild
- Copper conductor replacement
- Yearly Priority Pole replacement
- Impairment mitigation

The Wood Lines Sustain Program uses a combination of SME input, data driven reporting, and CHR analysis to prioritize how to address the most important maintenance and replacement work with the limited resources available to the program. Regular collaboration between engineering and transmission line maintenance subject matter experts informs initial decision making on how to focus efforts and begin prioritizing work. Working prioritization lists are developed with both groups of SMEs covering perceived performance, future concerns, and design functionality. Future prioritized work from this process includes obsolete conductor designs, identified line impairments, and maximizing wood line rebuild performance versus a yearly wood pole inspection replacement program.

Data reporting further refines prioritization work within the Wood Lines Sustain Program. Historical outage reporting helps identify the worst performing wood pole lines and the Total Economic Cost models forecast helps direct the most efficient rate of expense. The Total Economic Cost models primarily consist of information gathered from separate databases such as TLDD and Cascade. Total Economic Cost outage risk over time on equipment is based on age and specific equipment failure curves. Examples of future work prioritized with this information includes line rebuilds, re-conductors, and priority pole replacements.

Finally, CHR data and analysis is utilized with careful consideration of all other available information such as SME input and data reporting. CHR data and analysis is a powerful evaluation tool with several key data factors available for raw evaluation, but prioritization methods must consider a thorough understanding of the maturity of the calculated data. Much of the component health information for the wood lines transmission system is not yet implemented into the CHR database leading to unreliable health information for complete assemblies. Also, complete CHR analysis of value provided by unique line projects is not yet an automated process and consumes a large amount of man-hours with each request. Wildfire mitigation has developed into a primary focus for the Wood Lines Sustain Program due to the utilization of CHR information

As asset management matures using CHR and, a portfolio optimization tool, the various programs methodologies for assessing asset health and risk will all follow the same architecture. Thus, allowing for a systematic approach, using best practices, to compare the assets and programs.

Line Ratings - Impairments to Wood and Steel Lines

With the improving accuracy and density of Lidar data for transmission lines, we are finding many conductor clearance impairments across the system on both Wood and Steel lines. These impairments present a safety risk to the public and a reliability risk to the transmission system. A dedicated Line Ratings group examines each line involved in a Sustain Project to identify any impairment mitigation that should be included in the project scope. Line ratings are addressed separately from the Wood and Steel programs to maintain visibility and ensure that budget is available both for Line Ratings and for Steel and Wood lines.

Aircraft

BPA's aircraft fleet are used to transport equipment, inspect asset conditions, support vegetation management and wildfire mitigation efforts, enable/support project work, and support BES and communications system restoration. Aircraft are strategically located throughout the system with service focused on ensuring system reliability and resiliency.

The Aircraft program works BPA Aircraft Services, GSA, and DOE OAM to provide optimized fleet configuration and recaptalization, in support of the Aircraft Services mission.

Tools and Test Equipment Acquisition Process (TEAP)

TEAP Tool program is responsible to ensure BPA keeps up to date with the latest tools, instruments, and test equipment for mainly transmission and supply chain organizations. Many times test equipment is only supported by the manufacturer for certain period and causes BPA to keep updating. The majority of this equipment is used to gather readings and run test on the transmission system ensuring reliability and keeping BPA in compliance. This equipment is not managed by one organization similar to other programs, but is managed and operated by the end user. Request for replacement come in to the TEAP tool program on a as needed basis. A majority this equipment is "off the shelf" item resulting in a high degree of certainty on project completion dates.

Operations & Maintenance Strategy

Transmission continues to align its replacement and maintenance work streams by utilizing processes and analytics to converge an integrated best value strategy at all levels of the organization. Independent of resource constraints, some investment activities that would mitigate risk and realize significant value for Transmission because of pursuing the activity, could be halted, or postponed due to the required financial treatment of the activity. Sometimes this is a result of it being an unanticipated expenditure or the available budget has already been consumed and/or committed. It is important to ensure financial mechanisms such as IPR align to business strategies that incorporate cost, performance, and risk for all Transmission assets.

Current state is interval-based maintenance with correctives initiated by internal standards and guides to drive a maintenance action. The future vision is based on more efficient gathering and use of maintenance data and equipment reliability estimations to inform risk based planning processes.

10.2.2 Growth (Expand) Strategy

BPA develops long-term system expansion and reinforcement plans for the transmission system. These plans are based on a comprehensive system assessment, examination of current transmission service and interconnection requests. The plans are updated each calendar year based on the latest assessment of system needs.

For the latest System Assessment, BPA's transmission system was divided into twenty-seven load service areas. Each area is assessed under the limiting system conditions for that area. Each area is then analyzed in order to identify any potential performance deficiencies and determine possible corrective action plans or confirm existing corrective action plans and timing to meet applicable standards and criteria and ensure system reliability and cost-effectiveness. BPA also assesses the performance of the fourteen paths (Figure 10.2.2-1) and four interties (Figure 10.2.2-2) over the Planning Horizon. This includes an evaluation of the total transfer capability (TTC) of the path or intertie. The evaluation confirms that the TTC is sufficient to meet existing obligations over the Planning Horizon or identifies any potential corrective action plans necessary to meet the applicable standards and criteria to ensure system reliability.

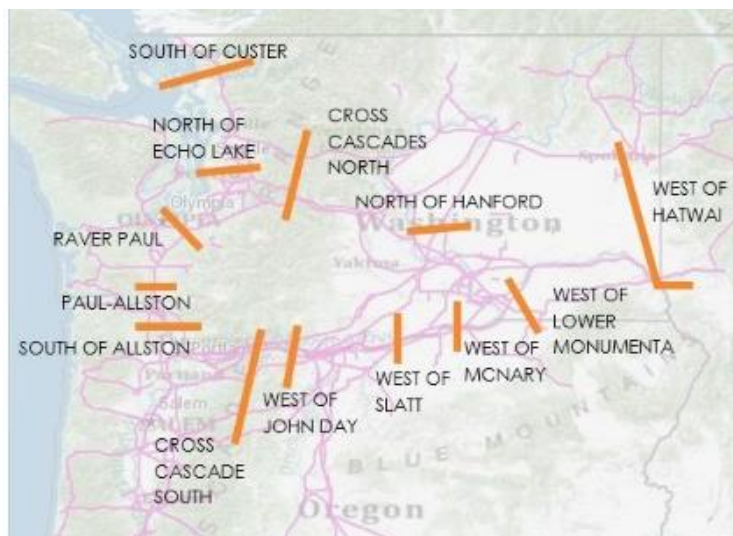


Figure 10.2.2-1, Transmission Paths

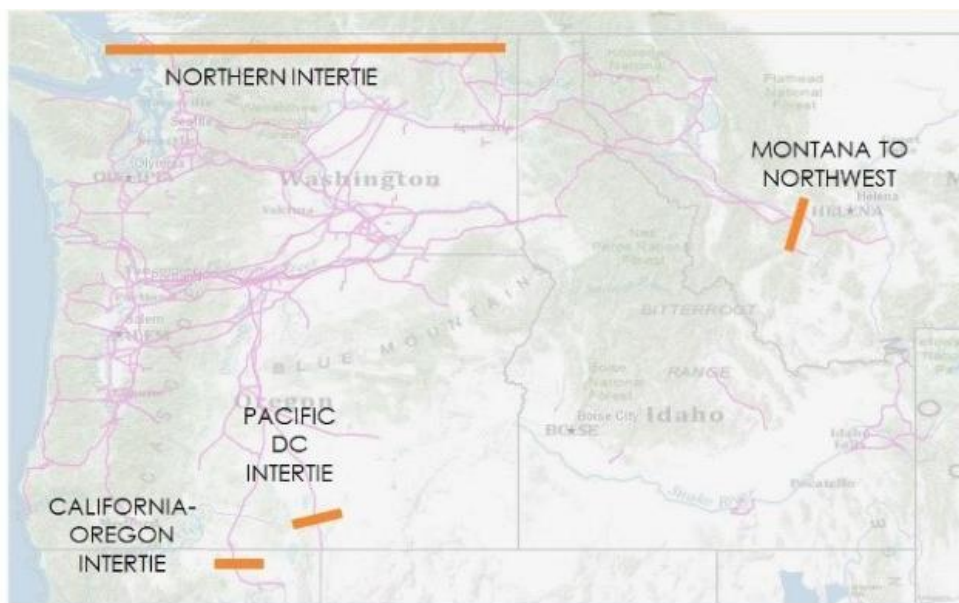


Figure 10.2.2-2, Transmission Interties

The studies conducted for each load area and path includes steady state, voltage stability, and transient stability studies. Short circuit analysis is also conducted annually as part of BPA's Switchgear Replacement Program. Transmission also includes analysis of potential non-wires alternative solutions for areas where potential projects are identified.

The BPA transmission system is planned to meet applicable NERC Transmission System Planning Performance Requirements in Standard TPL-001-4. System tests and the required performance for those tests are established in the TPL-001-4 Standard.

The planning process, methodology and results are available in the Transmission Plan, published in December 2021 and located on BPA website at [Transmission Plan](#).

Recently, Transmission has seen a significant jump in generation interconnection requests. This increase is driven largely by states' renewable portfolios which have progressively required more carbon-free, renewable generation like solar and wind. For example, the state of Washington's renewable portfolio standard (RPS) required 25% of its power generation be from renewable sources by 2020, and to be 100% carbon neutral by 2030. Similarly, Oregon's RPS for 2020 was set to 20% of all generation, increasing to 27% by 2025. The state recently passed a requirement for 100% renewable resources by 2040. These increasing renewable requirements are creating a high demand for new renewable generating resources which will need transmission service. Developers are putting more and more projects in BPA's interconnection and transmission queues in anticipation of getting a power purchase agreement from an IOU or a public utility to help meet the increase in renewable requirements. Although some projects will be able to use existing, or redirected transmission rights, others will need new transmission rights. Transmission's PFIA program is expected to increase in order to support these projects, and that increase is reflected in section 10.3.

10.2.3 Strategy for Managing Technological Change and Resiliency

Resiliency

Transmission continues to integrate resiliency into the AM strategy and program. One example of this significant work is the Wildfire Mitigation Program and Plan. Transmission is working to mature its capability through acquisition of modeling tool(s) and fire scientist resources. This resiliency work directly supports the capital projects planned as well as potential responses to and preparation for fire season.

In addition, Transmission is developing a proposal for a dedicated access road maintenance program that looks at the road system holistically to provide timely access to the system, protect the environment and provide safer conditions for everyone on the road system.

Transmission continues to prepare for a potential seismic event by integrating seismic considerations into existing design processes and capital projects.

Cyber Security

Cyber security is included in the framework for managing current and future state models for Transmission Information and Operational technology systems and related assets. This maximizes the value throughout the stages of its lifecycle and aligns with the organization's strategic direction.

Federal Information Security Management Act (FISMA) and North American Electric Reliability Corporation (NERC) Critical Infrastructure Protection (CIP) regulations provide a framework for cyber security and resiliency through adherence to policies and internal controls, and provide assignment of responsibility. This framework and supporting management structure and processes provide assurance that cybersecurity strategies align and support business objectives.

These frameworks provide standardized controls and common processes, principles, and management tools that assist in the implementation of security solutions which align with the organization's strategic direction

This implementation, with oversight and review by BPA Office of Cyber Security (OCS) and CIP compliance Reliability Standard Owners (RSO), is vital to identify, protect, detect, respond, and recover from threats and current and emerging cyber security risks such as network intrusion, ransomware attacks, malware exploits, and advanced persistent threat (APT), etc.

10.3 Planned Future Investments/Spend Levels

Transmission's future spending needs are represented in Table 10.3-1 for expand, sustain, PFIA and O&M. The level of granularity supports identifying trends in the different program areas at a strategic level. The table represents a ramp up to support the sustain program and PFIA (Projects Funded in Advance) program demands and requirements.

Transmission has identified the need to ramp up the sustain program to mitigate risks to the system posed by an aging asset population. The SAMP excludes impacts to specific programs; however, the Asset Plan will supply more detail.

Table 10.3-1 Future Expenditures (in thousands)

Capital & Expense Sub-Categories	FY24	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33
Sustain	\$ 271,000	\$ 273,000	\$ 283,000	\$ 288,000	\$ 292,875	\$ 283,000	\$ 289,000	\$ 287,750	\$ 291,000	\$ 297,000
Expand	\$ 112,000	\$ 112,000	\$ 112,000	\$ 112,000	\$ 110,875	\$ 109,750	\$ 107,500	\$ 105,250	\$ 103,000	\$ 98,230
PFIA	\$ 42,000	\$ 50,000	\$ 50,000	\$ 50,000	\$ 50,000	\$ 50,000	\$ 50,000	\$ 34,750	\$ 33,000	\$ 31,350
Total Capital	\$ 425,000	\$ 435,000	\$ 445,000	\$ 450,000	\$ 453,750	\$ 442,750	\$ 446,500	\$ 427,750	\$ 427,000	\$ 426,580
Maintenance	\$ 147,615	\$ 150,986	\$ 154,242	\$ 157,484	\$ 160,755	\$ 164,055	\$ 167,296	\$ 170,466	\$ 173,535	\$ 176,485
Other	\$ 110,900	\$ 113,432	\$ 115,878	\$ 118,313	\$ 120,770	\$ 123,248	\$ 125,683	\$ 128,064	\$ 130,369	\$ 132,585
Total Expense	\$ 258,514	\$ 264,418	\$ 270,120	\$ 275,797	\$ 281,525	\$ 287,303	\$ 292,979	\$ 298,530	\$ 303,904	\$ 309,070
Total Transmission	\$ 683,514	\$ 699,418	\$ 715,120	\$ 725,797	\$ 735,275	\$ 730,053	\$ 739,479	\$ 726,280	\$ 730,904	\$ 735,650

Table 10.3-2 Midpoint for Future Capital Expenditures used in BP-24 IPR and rate case processes (in thousands)

Capital Sub-Categories	Transmission Midpoint for IPR/BP-24									
	FY 2024	FY 2025	FY 2026	FY 2027	FY 2028	FY 2029	FY 2030	FY 2031	FY 2032	FY 2033
Sustain	243,900	245,700	254,700	259,200	263,588	254,700	260,100	258,975	261,900	267,300
Expand	100,800	100,800	100,800	100,800	99,788	98,775	96,750	94,725	92,700	88,407
PFIA	37,800	45,000	45,000	45,000	45,000	45,000	45,000	31,275	29,700	28,215
Transmission Total	382,500	391,500	400,500	405,000	408,375	398,475	401,850	384,975	384,300	383,922

This SAMP is based on Transmission’s future spending needs as shown in Table 10.3-1 above and Figure 10.3-2a below represents the current need for future Capital expenditures and our goal for execution. To accommodate for risks and uncertainties around execution, BPA used a midpoint for projected future Capital Expenditures shown in Table 10.3-2 above for BP-24 IPR and rate case processes only. Transmission faces uncertainty in critical areas of resourcing, material availability, and supply chain factors that may affect execution. Transmission is developing and has mitigations in place for several identified industry risks at this time.

Figure 10.3-1 below represents the current need for asset management capital (blue- includes sustain, expand, PFIA) and expense (orange). Figure 10.3-2a represents the current need for asset management capital. Figure 10.3-3 O&M Expense dollars match the BP-22 IPR process for FY24 to FY31. An increase for FY32 and FY33 O&M Expense was extrapolated based on the data from FY24 through FY31, (1.8% and 1.7%, respectively). The Other Expense asset sub-category covers support provided to facilitate the output of capital and maintenance programs under the Transmission asset management asset category. This includes aircraft services, logistics services, NERC/WECC compliance, environmental planning, enterprise services and other non-capitalizable business support functions. The Transmission Other Expense asset sub-category does not include Non-Transmission asset categories that are in other SAMPs such as Fleet, and Security.

Expense and capital future expenditures will be refined as part of the BP-24 process.

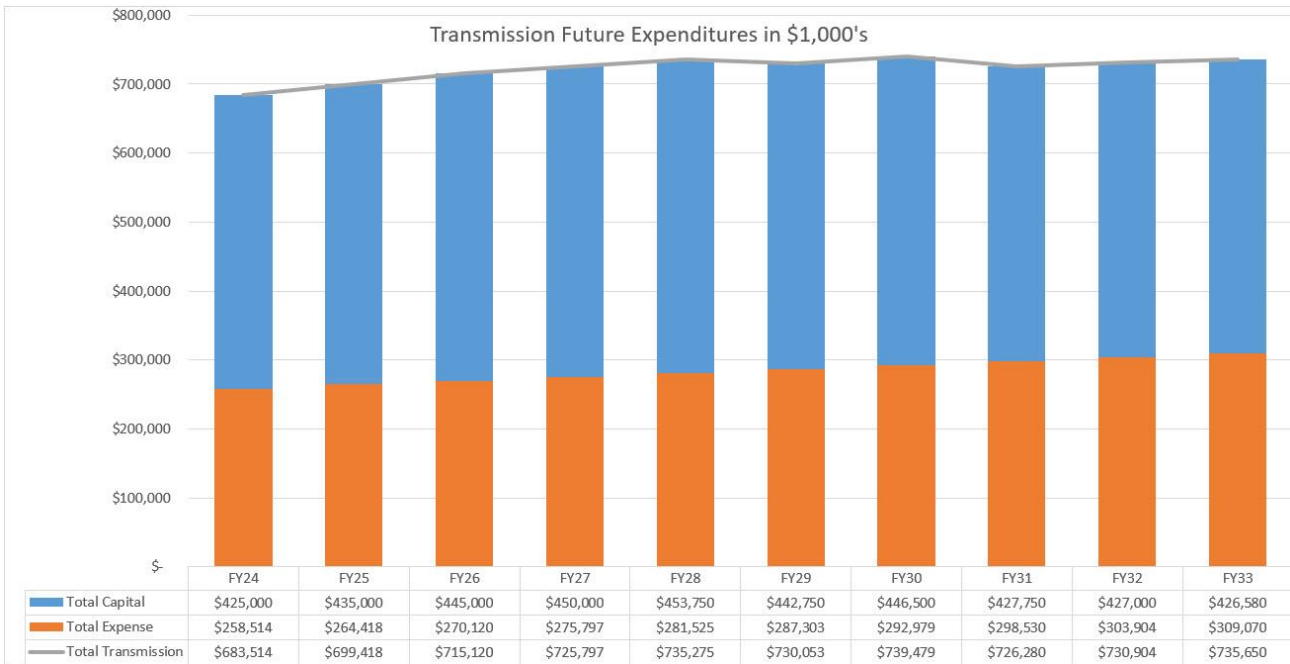


Figure 10.3-1, Capital and Expense Future Spend

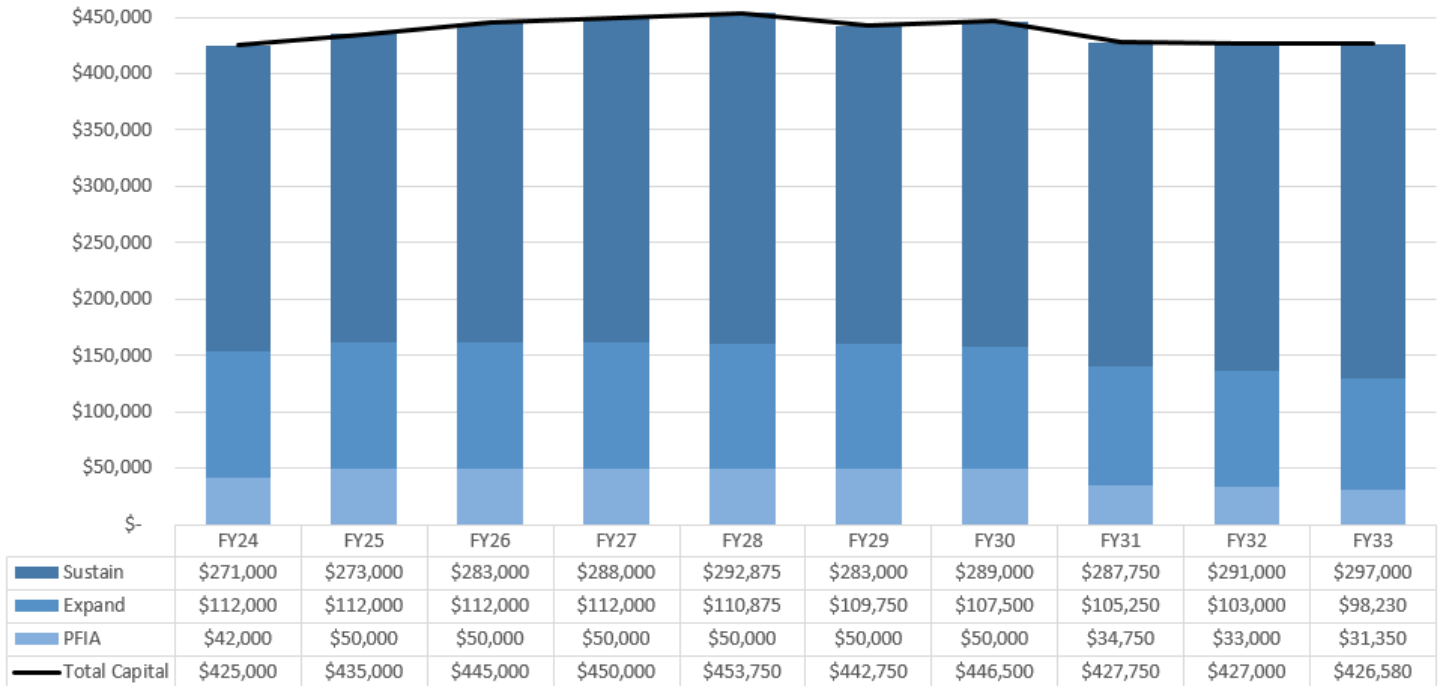


Figure 10.3-2a, Capital Future Spend

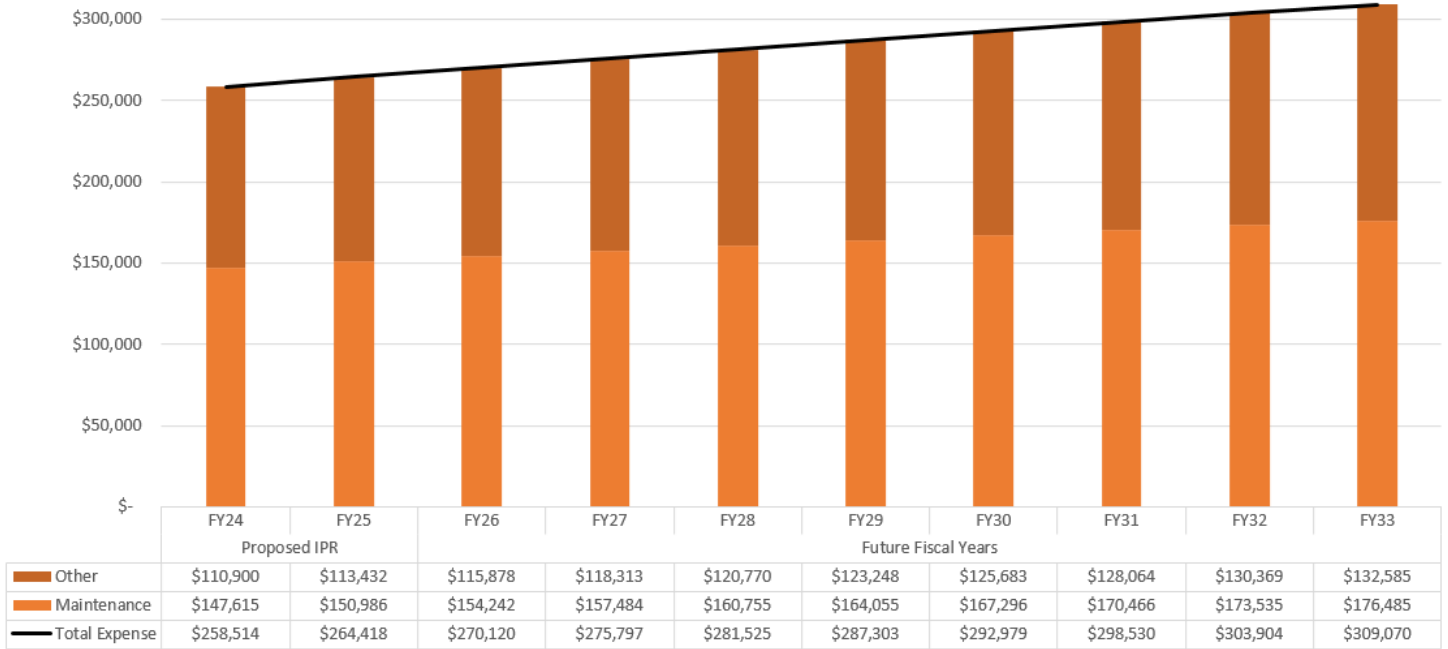


Figure 10.3-3, Asset Management Expense Future Spend

At a high level, the following trends can be seen:

- Ramping up the sustain program, including supporting the Vancouver Control Center as part of the PSC program spending, demonstrates Transmission’s emphasis on managing aging assets.
- Increased PFIA program spending demonstrates support of state Renewables Portfolio Standards and responsiveness to customer interconnection requests.
- Expense spending (Figure 10.3-3) based on funding levels prepared in the previous IPR cycle and will be revisited in the upcoming FY24/25 IPR cycle.

10.4 Implementation Risks

Transmission has identified the following implementation risks for executing on the SAMP/AP, from the following perspectives: investment strategies and maturity initiatives.

Table 10.4-1, Implementation Risks

Risk	Impact	Mitigation Plan
Constraints		
Retirements, labor shortages, and other staffing changes	Additional time may be needed to execute aspects of strategies/maturity initiatives as new employees are trained	Transmission identifies priority positions that must be backfilled, and works to cross train existing employees so that expertise is held more broadly when possible.

<p>Constrained labor and material execution resources, and global supply chain impacts</p>	<p>Cost escalations. Delayed and deferred projects impact system risk and impact strategic planning when replacement pace is not clear</p>	<p>The Secondary Capacity delivery program has been implemented, to provide additional capacity within execution. The Supply Chain organization is working to mitigate material impacts by procuring additional materials and keeping them in inventory. Develop contracting strategies that allow earlier material procurement efforts for long-lead time items. The Asset Management program is currently working on foundational maturity efforts that will also improve line of sight in the coming years.</p>
<p>Constrained outages, constrained budgets, and inflation rates.</p>	<p>Constrained outages and budgets lead to reduced program execution levels, or to delays in execution.</p>	<p>Transmission leads detailed outage planning and budget planning activities. Transmission is an active participant in internal and external efforts related to managing outage and budget constraints. Stage gates process supports cost escalation transparency and adjustments to overall portfolio.</p>
<p>Complexity</p>		
<p>Program complexity leads to delays or confusion in strategy direction and implementation</p>	<p>Delays or confusion result in slower progress in executing the asset management program improvements and strategy work</p>	<p>Transmission has assigned dedicated resources to strategy development work, and has implemented cross functional leadership teams to ensure all requirements are captured, and that complexity is managed. Develop contracting strategies for specific needs such as environmental and cultural work. Develop more contracting options.</p>
<p>Unknowns</p>		
<p>Unknown regional or global impacts</p>	<p>Transmission has been strengthening its resiliency so that it can adapt in case of unknowns</p>	<p>Transmission builds resiliency into its system and programming decisions, but certain unknowns are unanticipated. In the case of weather events and pandemic impacts, Transmission teams are responding in a coordinated and collaborative way.</p>
<p>Wildfire risk</p>	<p>Transmission is impacted by more frequent/severe wildfires in the region</p>	<p>Transmission continues to actively mature its Wildfire Mitigation Plan, including supporting processes, tools, and expertise.</p>

10.5 Asset Conditions and Trends

Future projections of average asset age in time is not yet understood due to the volatility of capital replacement pacing and understanding maintenance refurbishment and how that influences the effective age and health in the future. Premature projections of average asset condition in time have the potential for unsubstantiated focus on the lowest sensitivity indicator for understanding asset performance (age). Transmission continues to refine asset health to a maturity where observed and measured condition project into futuristic probabilistic risk profiles that has direct ties back to the asset register and maintenance management system to track how those maintenance refurbishments influence the health.

The operations and maintenance strategy described in 10.2 will remain unchanged in the next IPR cycle where status quo criteria for prioritization of maintenance and accumulation of net backlog rate will be the only indicators of the future. As previously mentioned, Transmission will continue to evaluate and mature capabilities related to maintenance optimization. CHR is leveraged in these analytics on an as needed basis but not holistically incorporated at this time.

Though Transmission has not implemented the capability to progress the health of a given asset based on all the components of the asset health value, Transmission does incorporate age-based information to understand asset population trends. Figure 10.5-1 represents current Transmission substation assets and provides a view of the current replacement backlog based on Normal Expected Life. The Normal Expected Life defined as: The time (in years) in an assets life when it would be expected to first observe significant deterioration (Health Score 5.5) based on consideration of the asset type alone.

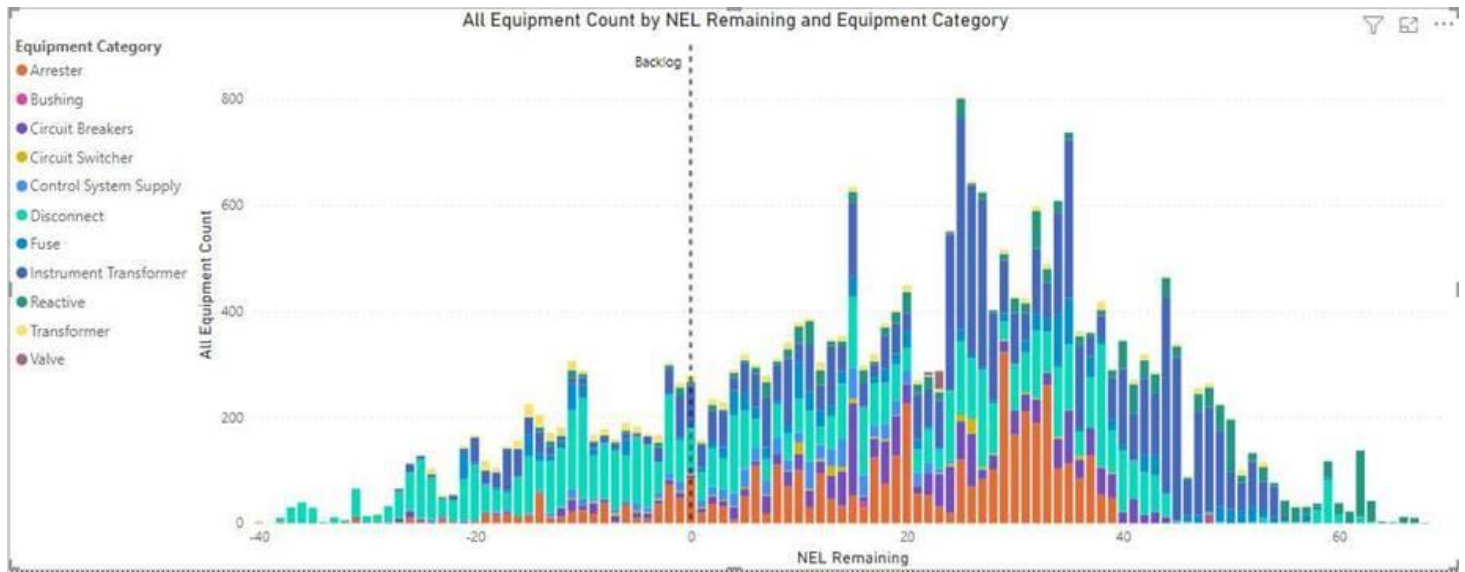


Figure 10.5-1 Normal Expected Life, Substation Assets

Transmission’s Total Economic Cost capability does incorporate asset population age as part of the scenario planning for replacement pacing. This along with more specific data by program, incorporated into the sustain ramp up projections presented in section 10.3.

10.6 Performance and Risk Impact

As mentioned in earlier sections, Transmission does incorporate age, specific program impact, and total economic cost modeling results in projecting future risk based on investment level. However, Transmission is working on developing future health scoring algorithms.

For example, in previous strategy efforts, the SPC program developed two risk maps to represent current and future state risk, based on implementation of a ramped up SPC replacement program. To date, the SPC program is not ramped up to required levels, but the projected financial values in 10.3 do represent increased budget levels to support future SPC ramp up efforts.

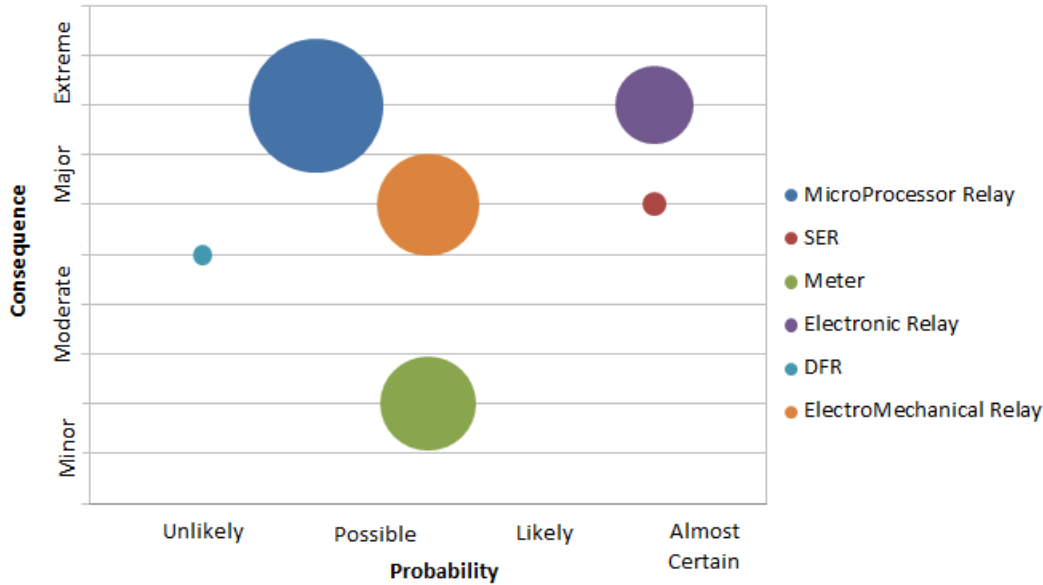


Figure 10.6-1 SPC Current State Risk Map

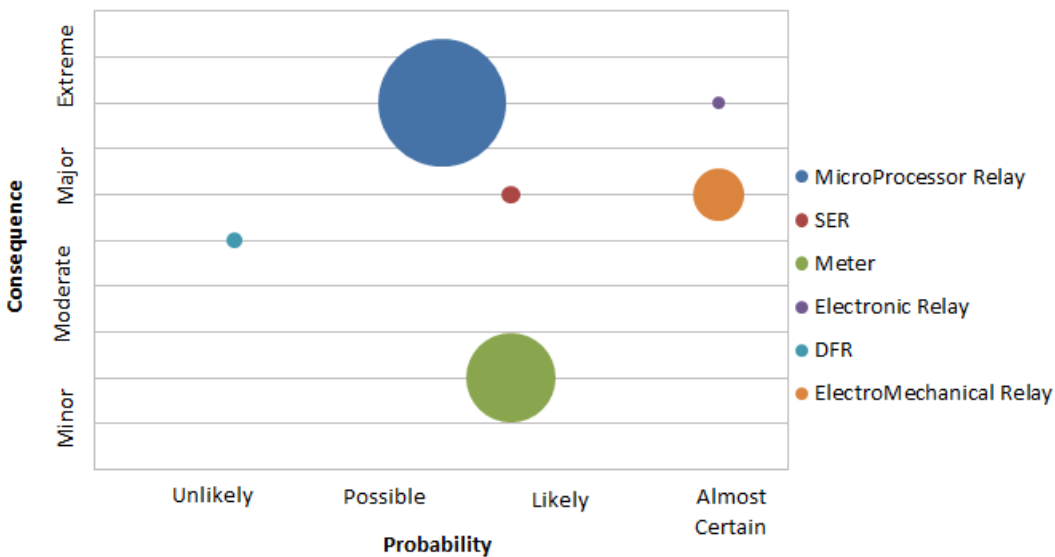


Figure 10.6-2 SPC Future State Risk Map (represents 15 years of ramped up replacement pacing)

The Total Economic Cost methodology provides further support to understanding anticipated impacts of a given replacement pace. The TEC approach to forecasting risk over time is by incorporating outage trends, specific equipment failure trends, and equipment age. Transmission’s assets are aging, and outage risk is modeled to increase based on this understanding. However, the outage risk impacts can be mitigated by focusing replacement decisions on the equipment or equipment components that pose the highest system risk. This analysis is part of the work that individual asset managers do to assess criticality within their programs as they plan new work to initiate. However, even with focused replacements, the Transmission sustain program must ramp up (as demonstrated in section 10.3). This ramp up is necessary due to both aging infrastructure as well as to recent technology with (in some cases) shorter expected life.

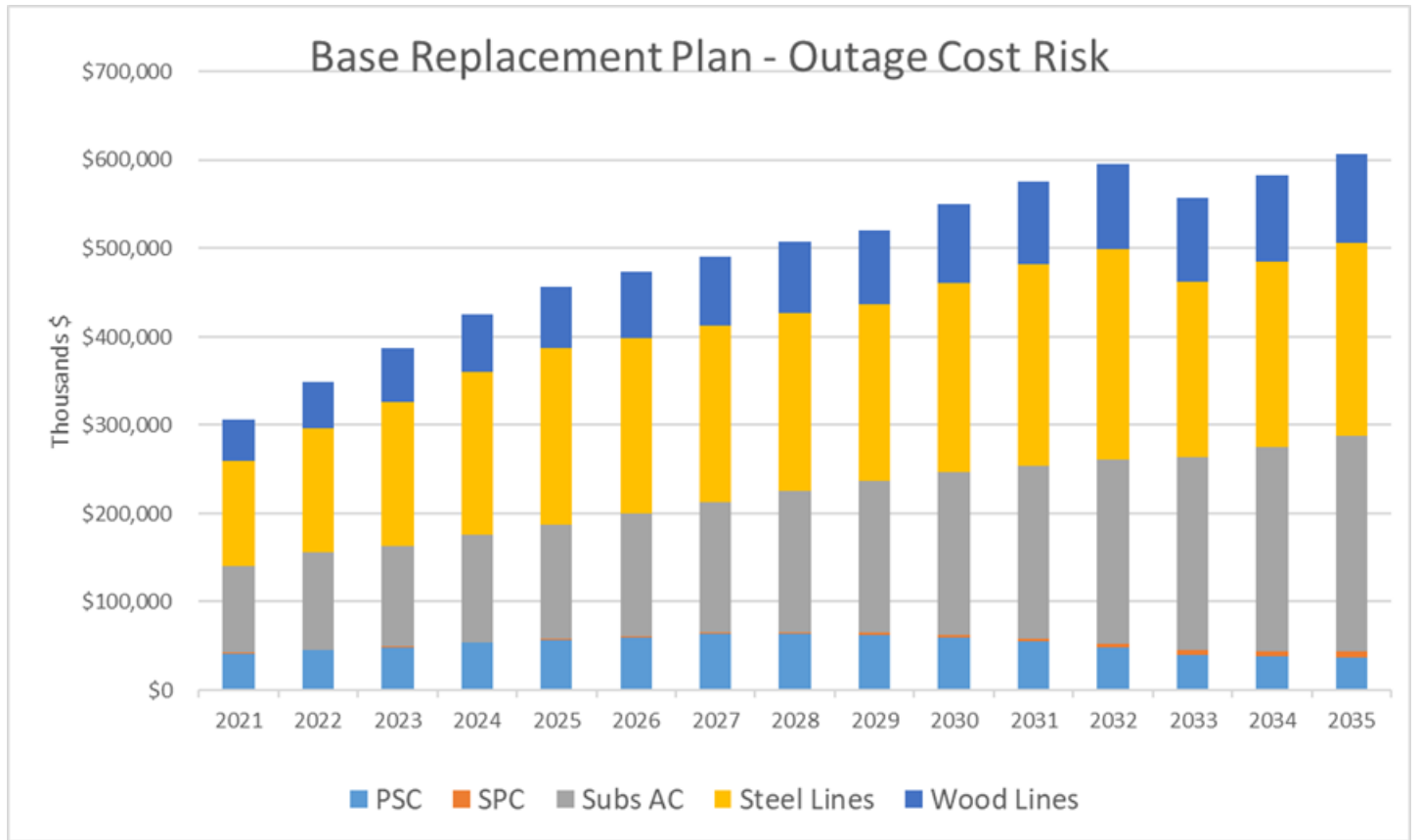


Figure 10.6-3 - Total Outage Cost over time by Asset Type - Base Plan

As Transmission continues to mature its asset management capabilities, data will be refined and capital programming levels, risks, and benefits may shift accordingly. Transmission continues to study and evaluate equipment and perform maintenance to get comprehensive understandings of how best to program asset actions to mitigate risk on the system.

One example of where new data has shifted Transmission’s approach is in the fiber program. Previously, the understanding was that fiber replacements should be performed based on age, leading to a high volume of backlogged replacements. However, additional data from fiber that has been removed and sent to the manufacturer for analysis has found that fiber has been in good condition when there is no visible external damage. This has allowed a refinement in

the fiber program where shorter sections of more critical fiber with external damage targeted to mitigate risk on the system efficiently.

Though specific heat maps by risk dimension are not available to demonstrate future risk profiles due to the implementation of the capital program, Transmission asset managers do incorporate these dimensions in their planning of their individual programs. Examples include:

Reliability: Prioritizing replacement of equipment with demonstrated outage performance concerns, or radial feeds to customers; prioritizing new expand projects based on reliability impacts

Compliance: Incorporating compliance requirements in all program areas, including reprioritizing work based on compliance dates when necessary.

Environment: Incorporating environmental requirements across all Transmission projects, ranging from oil spill containment in substations to comprehensive studies/analysis to identify and mitigate impacts of line work.

Safety: Incorporating safety requirements across all Transmission projects, for example, by incorporating fall protection in line projects.

Financial: Taking action to ramp up the sustain program over time to avoid potential rate impacts from multiple and concurrent asset failures that could result if sustain replacements were not prioritized.

11.0 Addressing Barriers to Achieving Optimal Performance

Transmission has identified disparate asset data/asset management systems as a major barrier to achieving optimal performance. As a result, Transmission will be collaborating with Enterprise Architecture (EA) and IT on the Enterprise Asset Management Maturity initiative

Current barriers:

- Approaching problems in silos rather than integrated across departments and different layers (business, data, technology)
 - Actions: The Enterprise Asset Management Maturity Initiative is being stood up
- Difficulties building sustainable and reusable solutions without a common cross-agency target state architecture for Asset Management (principles, guiding blueprint, incorporating business and IT drivers/strategy)
 - Actions: EA has delivered an initial version to leverage
- Lack of a complete/enterprise understanding of the current state to properly prioritize and scope
 - Actions: EA framework and current state landscape provide a cross-agency method to consistently do this
- IT and business partnership
 - –Actions: the programmatic approach and strengthening business readiness and data/process management will reduce costs and increase success rate of projects and programs

As the effort launches, priorities include:

- Identify key success factors/impediments for the AM maturation activities (application consolidation, data services, integration services, etc.)
- Identify business constraints (based on or derived from SAMP sections with SWOT, Implementation risks, current initiatives)
- Identify “foundational” business requirements such as Asset Hierarchy, Asset Registry, etc.
- Validate & sequence interdependencies within maturation activities/projects
- Training and communication for impacted stakeholders

As a result of this integration and maturity work, Transmission anticipates being able to run dynamic portfolio optimization scenarios, evaluate risk and benefits of various portfolio alternatives, understand impacts of changes in execution rates, and be able to link data across the asset management lifecycle for more integrated decision making.

Transmission has also undertaken several actions to address capability gaps including:

- Receiving allocations to hire additional personal in critical areas, for example, in cyber security and wildfire
- Secondary Capacity Program to support increased delivery of the capital program
- Mitigating contracting and material impacts based on regional and global factors by evaluating contracting strategies and inventory levels
- Project Portfolio Management Modernization effort to improve visibility to potential project impacts, integrating contingency planning into the portfolio, and maintain response flexibility as project needs shift.



Figure 11.1-1 – Addressing Barriers

12.0 DEFINITIONS

Financial Terms:

Indirect Costs: Any costs incurred for common objectives that cannot be directly charged to any single point of cost application. Indirect costs as a class have the character of 'joint' or 'common' costs and, as a group, are usually referred to as 'burden' or as 'overhead'. Indirect costs are often allocated to various categories of work in proportion to the benefit to each category.

Investment Classifications:

Compliance: Must be an executive order/directive requiring the specific investment must be made and that the project as proposed includes only the minimum required to comply with the directive. For example Cyber Security, Highway Relocations, BiOp.

Replacements: In kind replacement of equipment and components. For example, wood poles, transformers, batteries, existing buildings, breakers, reactors, and conductor.

Upgrades/Additions: Replacement of existing assets that provide addition capacity and/or capability. Examples include breakers, transformers, lines, etc. that after replacement have higher ratings to transfer power. Replacement of applications that provide new capability

Expansion: Adding new assets to the system that did not exist before providing new capability. Examples include: new IT applications, new buildings, and new units at existing power generation sites, new line and substations.

ISO 55000:

Management System: Set of interrelated or interacting elements of an organization to establish policies and objectives and processes to achieve those objectives

- A management system can address a single discipline or several disciplines.
- The system elements include the organization's structure, roles and responsibilities, planning, operation, etc.
- The scope of a management system may include the whole of the organization, specific and identified functions of the organization, specific and identified sections of the organization, or one or more functions across a group of organizations.

Asset Management System: Management system for asset management whose function is to establish the asset management policy and asset management objectives

- The asset management system is a subset of asset management.

Asset management plan: Documented information that specifies the activities, resources, and timescales required for an individual asset or a grouping of assets, to achieve the organization's asset management objectives

- The grouping of assets may be by asset type, asset class, asset system or asset portfolio
- An asset management plan is derived from the strategic asset management plan
- An asset management plan may be contained in, or may be a subsidiary plan of, the strategic asset management plan.