



STRATEGIC INITIATIVE BUSINESS PLAN for

Asset Management

Executive Sponsor
Initiative Owner
Project Manager

Bob Lurie
Joe Kessler
Alan Ettlinger

Initiative Team

Carlos Alvarez, Lenny Caputo, Carl Courant,
Ben Ettlinger, Christine Lally,
Patricia Lombardi, Lindsey McCloy,
Katie O'Toole, Donahue Scott

Initiative Start
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EXECUTIVE SUMMARY

Strategic Rationale and Drivers of the Initiative

The New York Power Authority's (NYPA's) generation and transmission (G&T) infrastructure is the foundation from which low cost, clean, reliable electricity is provided to customers in New York State (NYS). The effective management of these assets, in the form of investment and maintenance, is critical to ensuring that NYPA's G&T infrastructure remains in good health and that NYPA can continue to provide a reliable, low cost service to customers. Over the past 70 years NYPA has demonstrated clear capabilities in the management of its assets in the face of changing industry conditions and to meet requirements from the Governor's office to deliver infrastructure projects to support secure power supply in NYS.

As the energy industry enters a period of transformation, with the deployment of new G&T technologies as well as the emergence of new customer consumption patterns, the demands on NYPA's assets are set to change yet again and this will have a corresponding impact on the investment needs of both existing and new assets. It will require a new framework for asset management to ensure NYPA has greater understanding and visibility of the assets installed on its system to allow informed decisions to be made with respect to the allocation of investments required to manage its portfolio of G&T infrastructure. An approach that supports targeted asset management will also increase in importance given that much of NYPA's G&T infrastructure dates to the 1950s and will require significant investment to enable continued operation. This was a key driver of the New York Energy Highway Blueprint and efficient investment in G&T assets will be critical to ensure the continued provision of low cost, clean reliable power to customers in NYS.

The proposed solution

NYPA is proposing to develop and implement an asset management approach aligned to the provisions of the internationally recognized asset management standards, International Standards Organization (ISO) 55000. The ISO 55000 standards provide guidelines for cross-industry, best practice for asset management and takes a holistic approach that encompasses traditional considerations associated with the value chain for managing assets alongside life cycle planning, asset financial / operational performance, and risk profiling. The ISO 55000 provisions will comprise the backbone of NYPA's asset management approach and will be complemented by projects that effectively encompass people, process, technology and data considerations.

The vision for asset management at NYPA comprises three major phases. The first is foundational and focuses on ensuring the key tenets of a strong asset management approach are in place including accurate data, a defined organizational structure and responsibilities, skilled resources and enhanced awareness of asset management across the organization. From this foundation, the approach will be optimized and eventually transformed to allow NYPA to become a best-in-class asset management organization which is able to effectively 'plug and play' new assets into the approach. It will take time to move to this vision but, where NYPA is able to do this, it will place NYPA in a strong position to continue to efficiently operate and maintain its assets even where new challenges arise.

To effectively attain the outcomes envisaged under foundation, optimization and transformation the following four work streams are being proposed as part of this initiative.

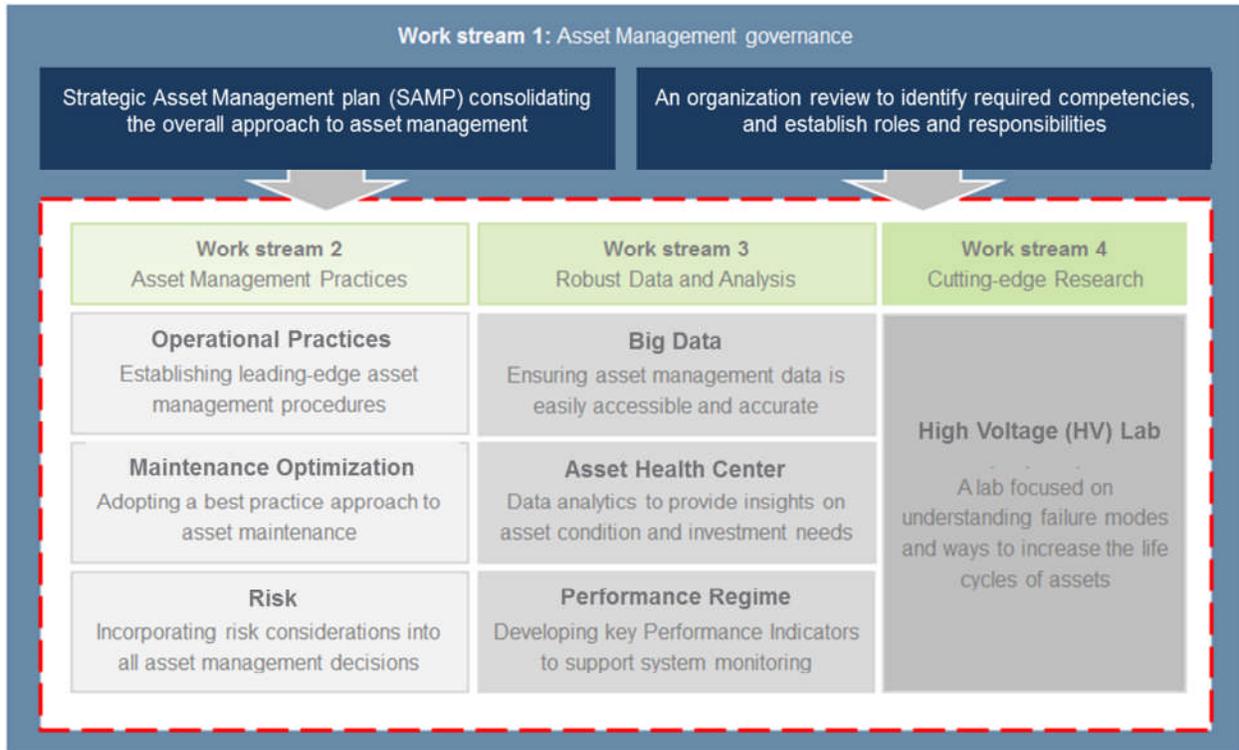
- The first focuses on the establishment of a clear framework of governance for the initiative including a Strategic Asset Management Plan (SAMP) and organizational structure that clearly defines objectives of the asset management initiative as well as allocating roles and responsibilities.
- The second focuses on the development of a set of consistent practices to govern asset management at NYPA. This specifically involves a work stream incorporating the delivery of an optimized maintenance program as well as considerations of risk within all asset management decisions.
- The third focuses on securing robust data and analysis to support asset management decisions. This will require the establishment of asset management systems with accurate and easily accessible

data as well as a health center that supports effective monitoring and diagnostics. It will be supported by Key Performance Indicators (KPIs) to monitor asset performance and the asset management initiative.

- The fourth focuses on establishing a world class research and development laboratory for applied research and testing for high voltage (HV) assets to enable NYPA to take a leading role in HV innovation that will help to minimize degradation and optimizes asset life.

Figure 1 below provides an overview of the way these projects will fit together.

Figure 1: Overview of the projects that comprise the asset management initiative



The long term goal of this asset management strategic initiative is to enable and maintain a flexible process that will allow NYPA to readily adapt to the future, changing operating world. This flexible process will allow NYPA to continue to manage existing assets, have a framework in place for new assets, and will enable the potential expansion of NYPA’s role of asset management with its customers through additional customer services and enhanced energy services projects. With a strong asset management process in place, NYPA can ensure optimal condition of its assets and resources so as to support reliable, flexible, and efficient generation and transmission of low cost energy.

This is the ideal time for NYPA to undertake an initiative and invest in its asset management processes as NYPA is currently involved with several in-flight projects. These projects include, but are not limited to, Life Extension and Modernization Programs (Generation and Transmission), major equipment overhauls, System Hardening and Storm Resiliency, and various Data Collection and Analysis Projects currently being worked on by Research and Technological Development such as infrared monitoring, dynamic rating of transmission lines and development of expert systems.

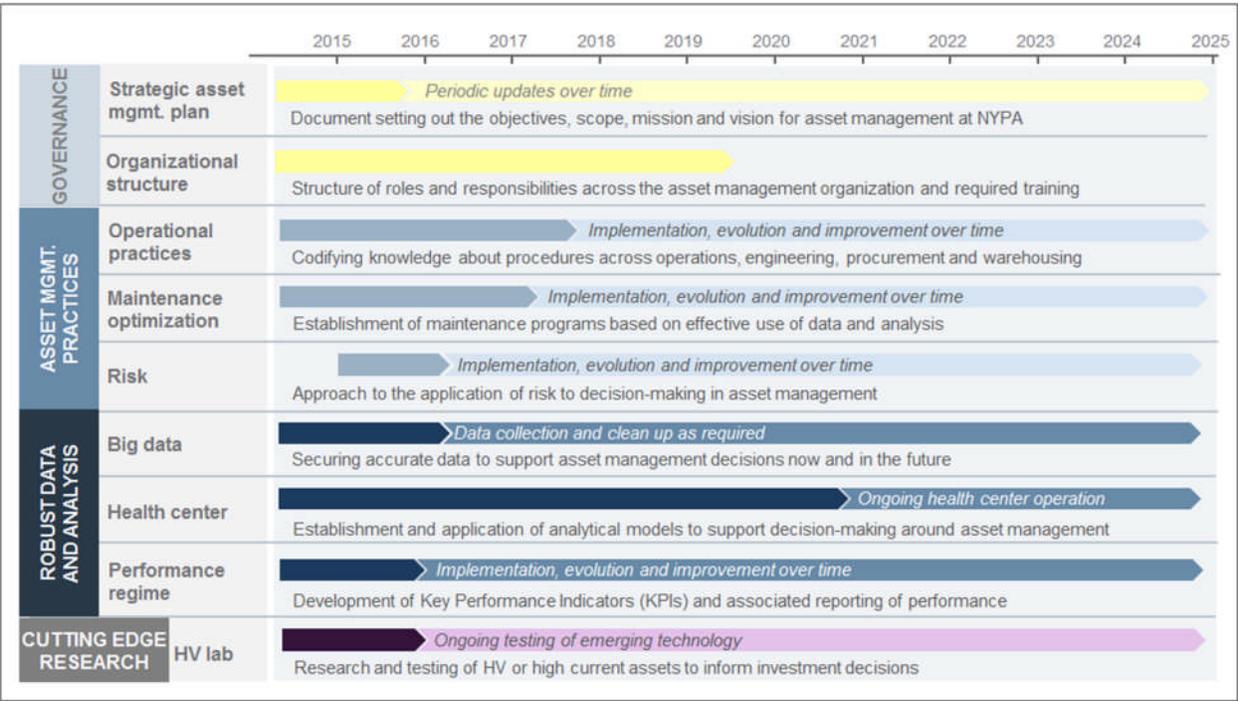
To ensure the success of this initiative as well as the other strategic initiatives being evaluated, the dependencies from and on one another must be clearly understood.

- The Smart Grid and Transmission Initiative that includes the modernization of the transmission grid and the development and implementation of Smart Grid technologies, is complemented by the asset management process. New equipment that will be required to modernize the grid would be new NYPA assets and, as such, will be operated and maintained under the auspices of the asset management initiative. Additional data will also be attained with respect to the operation of G&T assets which will help to inform decisions about asset investment.
- There are clear interdependencies with the workforce planning initiative which is developing processes to support identification of skills and capabilities needed across the organization and will help asset management to identify and recruit additional staff to support the initiative.
- There will be close interactions with the Process Efficiency initiative, the main goal of which is to combine or enhance ongoing efforts to standardize and formalize business process functions across all business units, to ensure that NYPA remains a sustainable, efficient, and flexible organization.
- Knowledge Management will also interact with asset management as the skills and capabilities to maintain assets will need to maintain pace with changing responsibilities and new technologies.
- There may be some interactions with the customer solutions initiative where new assets are deployed at customer sites and the asset management approach is extended to these facilities.

High Level Timeline

Figure 2 below presents a high level timeline for the initiative; illustrating the four work streams that comprise the asset management initiative and the way that these will be implemented over time.

Figure 2: High level timeline for the asset management initiative



Benefits for New York State (for a detailed breakdown of benefits, see table in Benefits section)

The revised asset management approach proposed through this initiative will support greater understanding of and visibility around the condition of G&T assets installed on NYPA’s system. An improved understanding of system condition will, in turn, support the delivery of a range of both qualitative and quantitative benefits. The quantitative benefits will be linked to:

- A reduction in maintenance costs as a result of predictive analytics and maintenance.
- A rationalized asset inventory which will reduce warehousing needs and associated costs.
- Reduced asset failures which will improve fixed asset utilization.

There are also a number of qualitative benefits that it is not possible to fully quantify including improved workplace condition, enhanced sustainability, increased financial control and improved customer satisfaction. However, the costs of implementing the initiative are not insubstantial and therefore the benefits attained need to be considered in the context of the costs incurred. The team has calculated a range of benefits using benchmarking figures that reflect the experience of over 20 utilities in the application of an asset management approaches that are aligned to the principles of ISO 55000.

Figure 3: Initiative Cost-Benefit Analysis 2014-2020

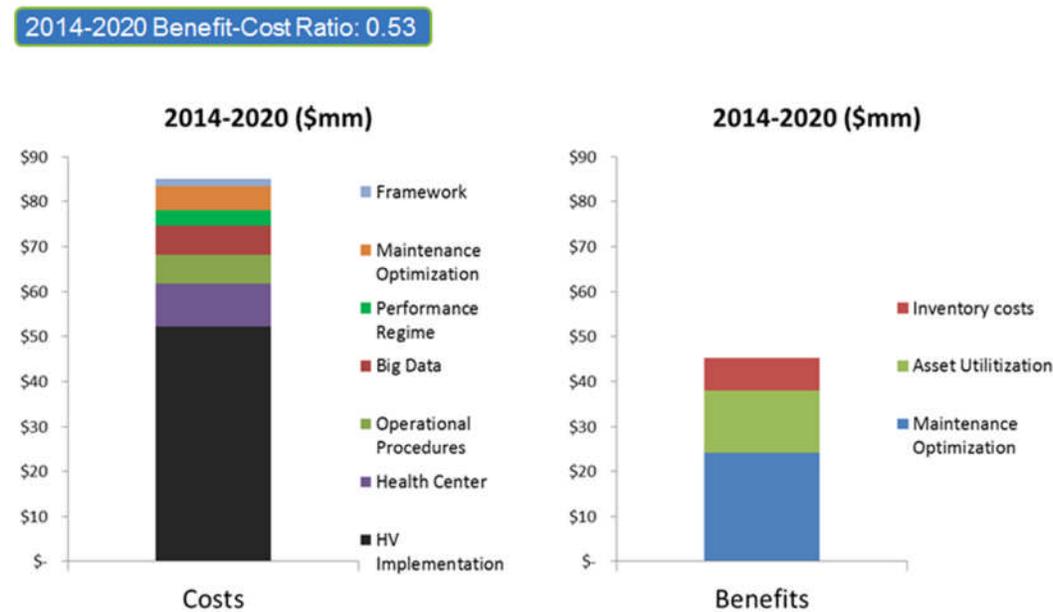
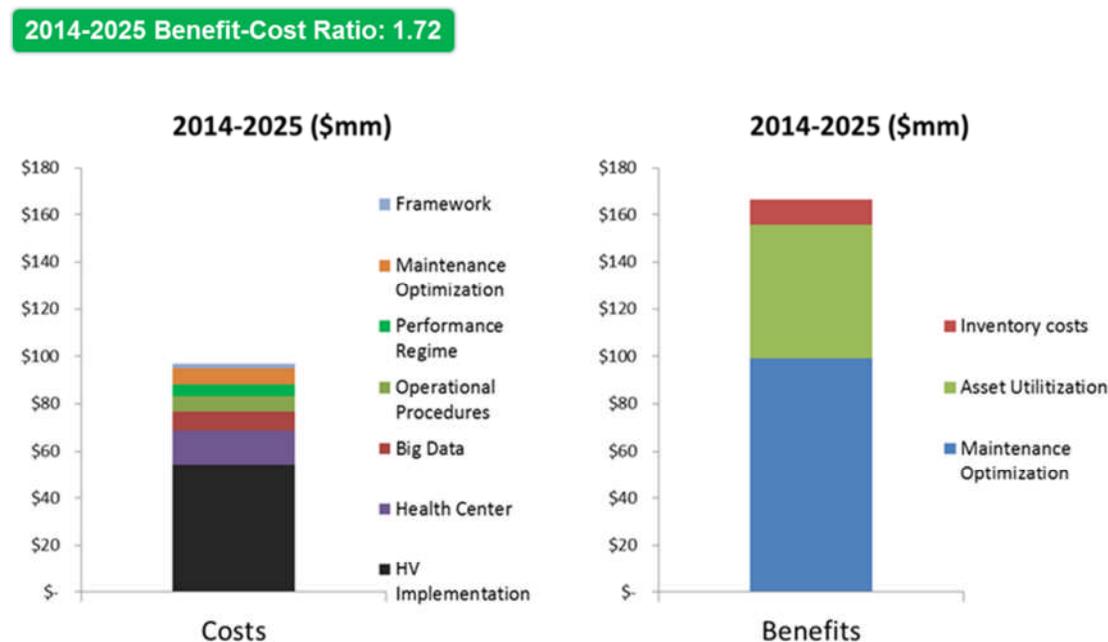


Figure 4: Initiative Cost-Benefit Analysis 2014-2025



Although over the shorter term (2014-2020) the cost-benefit ratio is negative this is largely due to the fact that benefits from the initiative will not immediately accrue. In this respect, benefits will only accrue once the suite of asset management projects proposed as part of this initiative has been fully implemented starting from 2018. Even from this point, the cost-benefit analysis presented below assumes that benefits will take time to ramp up; with 25% of overall benefits accruing in 2018, 50% in 2019 and 100% of potential benefits from 2024 onwards. The stepped release of benefits is largely aligned to NYPA's current 10 year asset management maintenance cycle. Even using these conservative assumptions, over the longer term there are clear financial benefits associated with implementation of the initiative; demonstrated by a cost-benefit ratio of 1.72. When coupled with the qualitative benefits identified above, as well as the understanding that this initiative will provide a strong foundation for the implementation of the remaining elements of the Strategic Vision, this provides a clear rationale for implementation of the initiative. The initiative will start in late 2014 / early 2015 with the development of an Asset Management Framework. It is then expected that the remaining six projects will kick off in 2015 and 2016, depending on agreed phasing as outlined during the framework project. Like any major transformation program, the Asset Management initiative will not necessarily deliver material benefits as soon as implementation commences. Based on benchmarking and historical examples, it is expected that benefits will start to be delivered somewhere between years three and four of the initiative – in this case from 2018 onwards. These benefits will be staggered based on the degree of asset management maturity exhibited by the business, achieving expected levels from approximately 2022 onwards.

Risk of the Initiative

As with any project or initiative there are risks associated with the delivery of benefits envisioned as part of the asset management initiative. It is important that the asset management organization has clarity regarding the main risks that could arise with respect to the delivery of benefits under this initiative and that they have in place mitigating plans to (a) reduce the risk of these outcomes occurring and (b) reduce the impact these risks would have if they were to emerge. The following list provides an overview of the key high level risks associated with this initiative and the actions that will be taken to mitigate the probability and impact.

- **Cultural change:** This initiative will require significant cultural change across NYPA and particularly in the Operations department in terms of the approach that is taken to asset management. If staff have difficulty understanding the need to change their approach to asset management or are unable to embed changes within their day-to-day working lives, this will significantly deplete the benefits that could be attained from the initiative. To address this risk, it will be critical to effectively engage with key staff across the organization from the outset of the initiative and on an ongoing basis. This will be complemented by an extensive program of change management to demonstrate the case for change and the benefits that will be attained from the initiative. It will also provide opportunities for staff to influence the direction of the initiative.
- **Resourcing:** For this initiative to be a success, it will be critical to recruit staff with the required skills and competencies to support asset management on an ongoing basis which could be challenging given the demand for and availability of these types of skills in the market. This underscores the importance of commencing the organizational assessment early to identify skills and capabilities required to support the initiative and implementing a strategy to secure these staff. A targeted program of training will complement these activities by addressing any skills gaps that may still remain.
- **Perception of benefit accrual:** It may take time for benefits from the initiative to accrue and this could lead to questions about the credibility of the initiative. To address this, it will be critical to take forward active engagement with internal and external stakeholders to manage their expectations on this. The use and regular reporting of KPIs will also provide regular updates on the status of the initiative.

STRATEGIC RATIONALE

Business Strategy and Rationale

The management of generation and transmission (G&T) assets has been an integral element of NYPA's operational model for many years. NYPA's focus on the efficient operation and maintenance of G&T assets has helped to secure the delivery of low cost, clean, reliable power to customers. However, transformational changes that are taking place in the energy industry will require a different operating model that moves NYPA from simply managing assets to a proactive asset management organization so as to ensure NYPA continues to provide these benefits to customers.

As Figure 5 illustrates, there are a combination of factors that are changing the demands on NYPA's G&T assets. Greater diversity in the fuel mix, including a higher penetration of distributed generation, requires more cyclic operation of NYPA's generation assets which has led to changing, and in some cases increased maintenance needs. Increased deployment of distributed generation and renewable assets

Figure 5: Drivers of the asset management initiative



places additional demands on transmission infrastructure which may change the maintenance needs of NYPA's geographically distributed system.

These challenges are compounded by changing customer consumption. A range of drivers, including cost, sustainability and reliability, are raising customer awareness and engagement on energy issues which has led to an increase in the range of services offered in areas such as energy efficiency, demand response and on-site generation. These new services are contributing to increasingly complex consumption patterns and two-way energy flows that place new demands on G&T assets. Customer expectations for system reliability continue to increase and, while NYPA has an impeccable reliability record, recent events such as Hurricanes Sandy and Irene, show that NYPA must be increasingly mindful of

the risks that more severe weather events pose to the health and reliability of its assets. Reliability risks also arise as a result of cyber security issues and both of these impacts need to be considered as part of the design of any asset management approach.

Market conditions could complicate the asset management landscape further still. For example, NYS utilities may adopt a collaborative approach toward asset investment such as the Transco initiative which focuses on greater operational coordination. In addition, as NYPA becomes increasingly customer-focused and more assets are deployed at customer facilities, NYPA may have to assume a greater role in managing demand-side assets. NYPA is also accountable to external regulatory authorities and standards in a number of areas, from reliability to cybersecurity to environmental impact which are likely to continue to evolve.

In addition to the external drivers illustrated in Figure 5 a significant internal driver of this initiative is the aging profile of NYPA's G&T assets. The age and condition of NYPA infrastructure has contributed to a number of recent asset failures that have caused unplanned outages on the NYPA system. This includes

failures of the Blenheim-Gilboa Unit 2 Generator Step-Up (GSU) Transformer, the Hellgate 1 GSU, the Harlem River 1 GSU, the Niagara transformer bushing and the turbine rotor at St Lawrence. These incidents suggest that significant investment will be needed either in the form of maintenance or replacement of assets to modernize the network. NYPA has spent \$2million over the last three years on these unplanned equipment failures. Therefore, transforming the way assets are managed will hopefully prevent these kinds of failures in the future while both delivering cost and reliability benefits to NYPA and its customers.

Work in this area has already begun with the transmission and generation Life Extension and Modernization (LEM) programs as well as other large investment projects. However, it is not only aging assets that can experience failure. Some assets simply fail before they should and therefore any asset management approach must provide clear understanding of the health of NYPA’s overall portfolio of assets, to ensure that there is visibility surrounding the location and scale of investment that will deliver the most value. The potential for asset failure during all stages of the asset life cycle also underscores the need to establish effective disaster recovery programs, particularly for new assets such as the proposed, new asset health center.

All of these issues are set within the context that NYPA must provide clarity around its decisions to a number of external stakeholders, including its customers, the NYS government, Public Service Commission, and citizens of NYS, who want to ensure value for money in the delivery of power and energy services. This creates challenges for NYPA in demonstrating that investment into the management of its assets is both economic and efficient.

Given the revolution taking place in the market and the new demands this will create for G&T assets, it is essential that NYPA establish an enterprise-wide, consistently applied, data-led asset management approach. This will support a holistic understanding of NYPA’s portfolio of assets and provide visibility on investment and maintenance needs thereby reducing forced downtime. It will also secure alignment and compliance with new and emerging industry standards. This will also ensure that NYPA’s approach to asset management is flexible enough to maintain continued, strong operational performance in an uncertain future.

Table 1: Alignment with strategic goals

Strategic goal	Type and Degree of impact	Description of impact
Financial Effectiveness: Maximizing the financial capacity of NYPA to make capital investments that help achieve NYPA goals	Positive - high	An asset management approach that utilizes consistent processes and accurate data to assess the health of assets will optimize asset investment. The greater utilization of asset management metrics and dashboards will improve transparency around the effectiveness of NYPA capital and operating (O&M) spending.
Operational Effectiveness: Maximize the efficiency, reliability and flexibility of NYPA assets and organization	Positive – high	Improved transparency about the health of assets will support preventative / predictive maintenance programs that will lead to maintenance optimization, reduce the potential for asset failure and will improve G&T reliability. A structured asset management organization with consistent practices and defined roles and responsibilities will also improve organizational and operational flexibility.
Value From Energy: Maximizing the benefit / minimizing the negative impact of each unit of energy delivered to the state / customer	Positive – high	As the initiative becomes increasingly mature, NYPA will be able to reach more informed decisions about investment in and maintenance of its assets. In turn, this will allow NYPA to provide long term rate stability to customers through a consistent and well defined capital and O&M investment strategy.

Table 2: Alignment with key values

Values	Degree of impact	Description of impact
Sustainability	Positive – medium	A better understanding of the maintenance and investment needs of NYPA assets will ensure continued operation of G&T assets at the most economic cost and minimized environmental impact.
Safety	Positive – high	Effective asset management will reduce the potential for asset failure and have a corresponding positive impact on safety
Compliance	Positive – medium	Clear consistent asset management practices will ensure an agreed process is adopted and reduce the potential for non-compliance. However, consideration needs to be given to compliance with the National Electric Reliability Corporation in the context of the greater collection, communication and storage of asset data and analysis. More effectively, organized and stored information and clear processes may streamline compliance and reporting efforts.
Environmental responsibility	Positive – low	Establishment of a dedicated HV and / or HC research lab and the health center will support NYPA in identifying more efficient and environmentally responsible approaches to asset operation. The improved reliability of assets will also reduce the potential for asset failure and thereby reduce the possibility of corresponding environmental impacts.
Employee Development	Positive – high	The establishment of an asset management organization with defined roles and responsibilities and a formal training curriculum will provide opportunities for employee development and assist in knowledge capture and transfer.
NYS energy plan	Positive – medium	A clear and universally adopted asset management program is a foundation for the continued provision of low cost, reliable power to customers in NYS.

Description of Legal Authority

Maintenance of NYPA’s physical assets is a key component to achieving NYPA’s mission of providing clean, low-cost and reliable energy consistent. NYPA's broad grant of authority in this area is derived from the state's policy declaration of "the need for obtaining and maintaining a continuous and adequate supply of dependable electric power", Public Authorities Law (PAL) Section 1001. The state's grant of powers and duties to NYPA are set forth in PAL Sec. 1005, which includes many references to the maintenance and management of generation and transmission assets.

INITIATIVE OVERVIEW

Description of the Opportunity

Much of NYPA's G&T infrastructure dates to the 1950s. These assets are aging and their effective management is an integral element of NYPA's day-to-day operation. Focus in this area has been increased as a result of the implementation of the Transmission Life Extension and Modernization (TLEM) and Lewiston Pump Generating Plant (LPGP) programs which are specifically targeted to repairing and rebuilding some of NYPA's aging transmission and generation assets to extend their lifetimes. Investment under the LEMs and the future replacement / upgrade programs could be significantly optimized where NYPA implements a process-based asset management approach that enables NYPA to attain a better understanding of the health of its assets in place on the system, and target investment where it will add the most value.

At NYPA, the approach toward managing assets has gradually evolved in a piecemeal manner and therefore key elements are not consistent. For example, processes for managing assets vary by geography and on a site-by-site basis leading to differences across NYPA in maintenance and operational planning methods. Linked to this, there are challenges to the adoption of a consistent approach for assessing asset condition and making informed asset investment decisions which reduce transparency about respective maintenance requirements of assets across the system. In addition, asset databases are not uniformly used across NYPA and differences in interpretation of data fields has led to inaccuracies with the data collected in these systems. Both of these constraints on current data availability reduce the opportunities for NYPA to move toward an approach that supports predictive decision-making with respect to the maintenance of assets. Combined, all of these factors are leading to difficulties in developing and implementing objective, robust cases for investment decisions about the management of existing assets.

Adopting an asset management approach that is consistently applied on an enterprise-wide basis will help to address many of these issues. The establishment of a suite of asset management processes built on existing practices, which are universally applied and consistently understood, will ensure asset-related decisions are based on a uniform and justifiable set of criteria. This will be complemented by improvements in the availability and accuracy of asset management data that supports targeted analysis to provide improved visibility with respect to the assets that are currently in place. Greater understanding of NYPA assets will enable decisions to be made based on key indicators of asset health related to performance, risk and value as well as cost. In addition, clarity regarding respective roles and responsibilities across the asset management organization will ensure there is accountability for key activities and efficiency in the way these key tasks are completed. Each of these components of the approach will be refined over time to help NYPA move toward a culture of continuous improvement with respect to asset management.

By establishing an approach that builds on all of these components and aligns to internationally recognized standards, NYPA will be well positioned to become a best-in-class asset management organization. This best practice-based approach will provide a robust foundation for the transformation of NYPA as envisioned in the NYPA strategic vision. It will ensure that NYPA has full visibility for the investment needs of its assets and allow informed decisions so as to ensure they are effectively maintained. In turn, this will ensure the continued reliable operation of NYPA infrastructure which will support full roll out of the Smart G&T initiative as well as the expansion of services to customers under the customer solutions initiative.

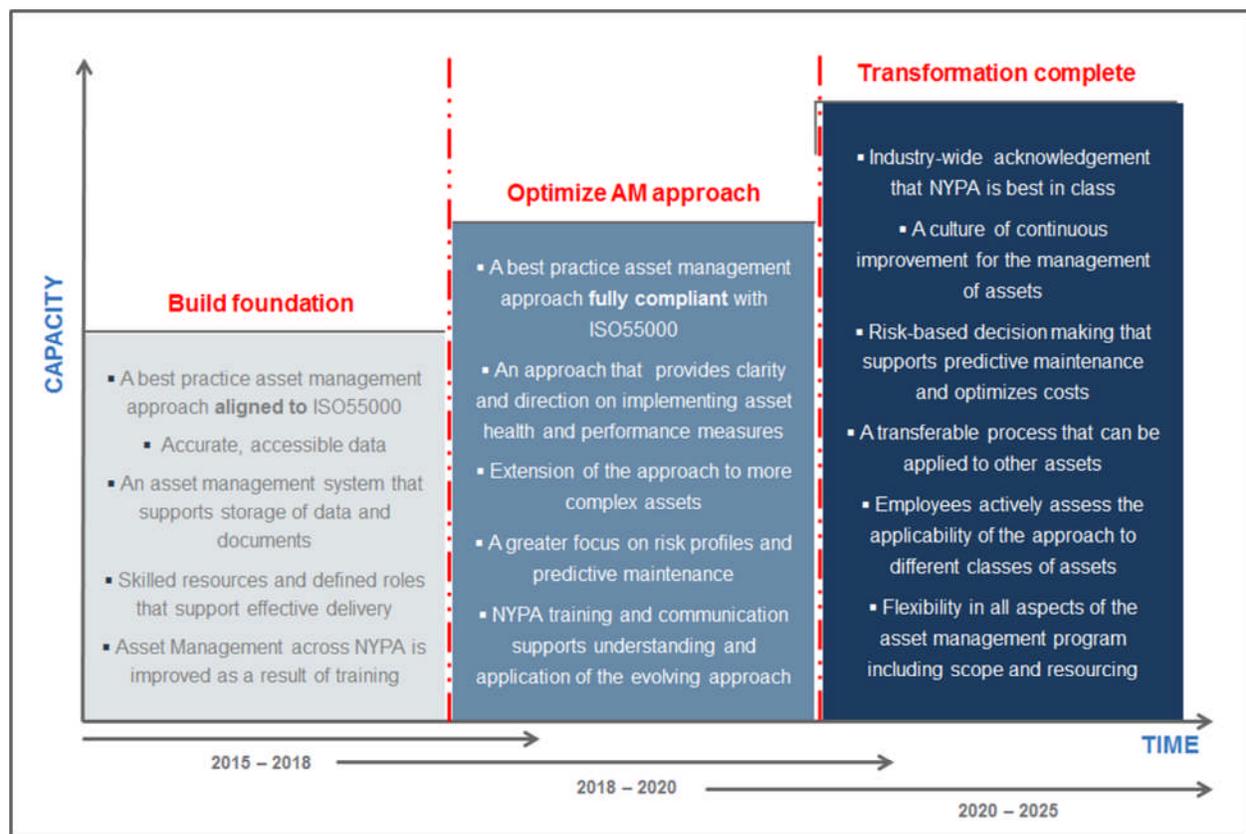
A key challenge to the effective implementation of an approach such as this is to effectively embed the cultural change required to support full adoption of the approach. This will require a full and effective top-down change management approach that focuses on communicating the changes that are taking place from the outset of implementing the new structure.

Initiative Vision (Desired Outcome)

The primary objective of this initiative is to implement an enterprise-wide asset management program that monitors and maintains NYPA assets and enables informed investment decisions to be made based on performance, risk, cost and value to customers. Given the uncertainty around the way that generation and consumption patterns will evolve as well as the impact this could have on NYPA's G&T assets, the program will need to have sufficient flexibility to accommodate a range of future operating environments.

It will take time to establish a fully functional program that transforms asset management at NYPA and positions the organization as an industry leader in this area. To navigate the process toward transformation of NYPA's asset management approach this initiative has been separated into three distinct phases with targeted outcomes related to each phase. This phased process is illustrated below in Figure 6 and discussed in more detail in the following section.

Figure 6: Vision for the asset management initiative



- **Foundation (2015-2018):** The foundation phase will implement the key building blocks from which the initiative will be constructed and is arguably the most important stage of the initiative. In the absence of robust foundations, it will be difficult to attain asset management excellence. The key outcome for this stage will be establishment of a strategic enterprise-wide asset management approach aligned to recognized industry standards that supports consistent practices at all stages of the asset management life-cycle. The approach will be supported by accurate, accessible data to enable informed, cost effective decisions and support robust rate case filings. The asset management organization will be comprised of skilled resources and have defined roles to support effective delivery, helping to increase awareness and integration of asset management processes across NYPA. Asset management considerations will be an integral part of decisions that are made across NYPA.
- **Optimization (2018-2020):** The optimization phase represents an opportunity to consolidate NYPA progress during foundation. During this phase, NYPA will become fully compliant with internationally recognized asset management standards and its approach will evolve to represent best practice within the industry. There will be full clarity about the 'health' of critical assets which will translate into a targeted maintenance approach that helps to optimize asset life and costs by predicting maintenance needs given the performance of assets over time and their risk profile. Awareness of asset management practices will be high and continually reinforced, at all levels of the organization which will facilitate a full assessment of the potential to extend the approach to more complex assets across NYPA. Data will be used predictively to reach decisions on maintenance activities and asset replacement.
- **Transformation (2020-2025):** During the final phase of the initiative, the transformation of NYPA's asset management function will be demonstrated via the optimization of asset costs, performance, risk and value. NYPA will have adopted a culture of continuous improvement and flexibility and assumed the position of industry leader in the application of internationally recognized asset management standards. Other utilities will look to NYPA for best-in-class guidance in this area. All employees across the organization will actively apply asset management principles and will be able to integrate new assets within the approach via 'plug and play' provisions.

Critical to the delivery of desired outcomes during each of these phases is the ability to support effective cultural change within the organization. This includes the need for effective communication to ensure that employees at all levels across NYPA understand the new asset management approach and effectively adopt its provisions in their day-to-day working lives. Effectively implementing this cultural change is a key challenge for the initiative and one that should be met head on with targeted training and change management initiatives.

Initiative Scope

NYPA is proposing to develop and implement an approach aligned to the provisions of the internationally recognized asset management standards International Standards Organization (ISO) 55000. The ISO 55000 standards provide guidelines for cross-industry, best practice for asset management and takes a holistic approach that encompasses traditional considerations associated with the value chain for managing assets alongside life cycle planning, asset financial / operational performance, and risk profiling. The ISO 55000 provisions will comprise the backbone of the asset management approach and will be complemented by projects that effectively encompass people, process, technology and data considerations.

There are six key decision processes that fall within the ISO 55000 framework and these will form the scope of the asset management initiative.

- **Life cycle strategy:** Relates to the whole lifecycle from planning / designing an asset through to its ultimate retirement. Incorporates considerations of capacity planning, asset replacement strategies and optimal asset life cycle ownership costs.
- **Investment management:** Relates to the risk-based approach used to effectively secure value from capital spending. Includes issues around investment cost benefit and value analysis, spending optimization, budget forecasting integration as well as performance monitoring and corrective action.
- **Maintenance optimization:** Relates to the targeting of spending to support continued economic and effective operation of assets. It includes issues around risk profile development and analysis, asset performance monitoring and repair / replacement strategies.
- **Standards:** Relates to the agreed principles that guide decisions about asset management. This includes planning criteria, design standards, construction specifications and material specification.
- **Resourcing strategy:** Relates to the approach that is taken to secure the staff to support deployment of the asset management approach. Includes core skills and competencies definition, retention strategies, internal / external resource balancing and contracting mechanism decisions.
- **Performance management:** Relates to the development and implementation of key metrics that provide insight about how well assets are operating. Includes considerations of reliability, asset performance, process efficiencies and asset management system improvement.

The scope of the initiative will also include the development of a Strategic Asset Management Program (SAMP) that will be implemented to support alignment with ISO 55000. Development of the SAMP will be the first step that the team will take in the roll out of this strategic asset management approach. The focus of this work will be to establish a documented SAMP that defines the asset management objectives and scope including how these relate to corporate objectives and the approach toward stakeholder engagement. The SAMP will be governed by a number of key principles that run through the NYPA strategy including risk mitigation, sustainability and safety. The SAMP will provide guidance to the completion of an ISO 55000 assessment which will demonstrate the strengths and weaknesses of NYPA's current asset management approach and indicate those areas that need to be prioritized to meet the transformational vision NYPA has set out. In turn, this will help NYPA to further develop the scope of the asset management projects presented within this business plan. An overview of asset management and this initiative will be provided to senior management to support a top-down infiltration into the organization.

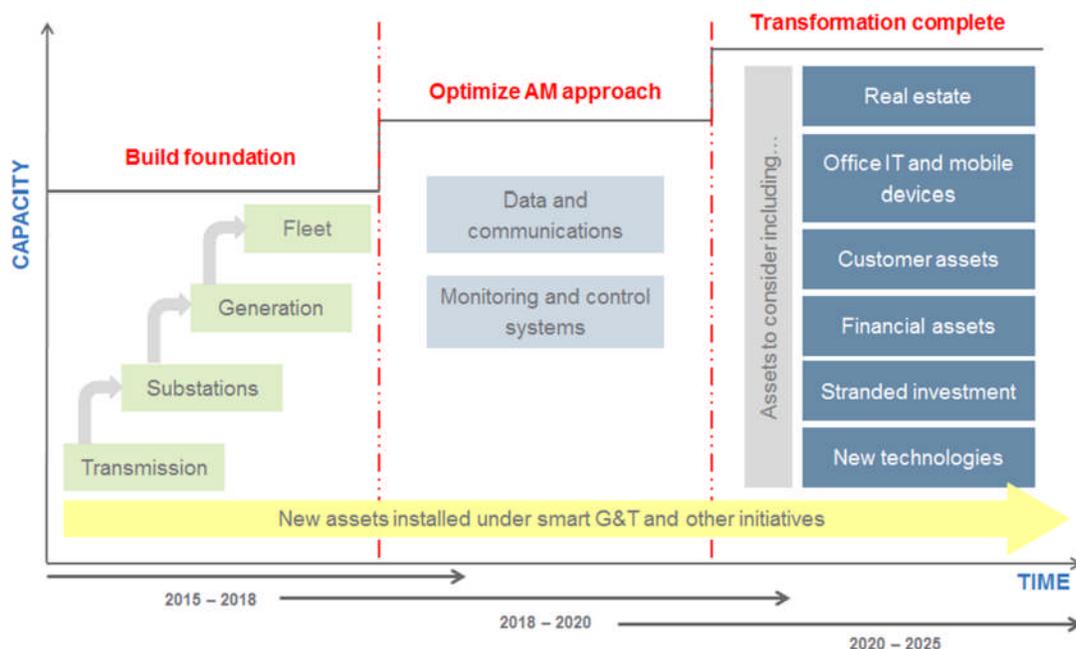
Application of the Initiative

Another factor determining the scope of the initiative is the classes of assets to which the initiative will be applied. Figure 7 illustrates the proposed approach to the application of the initiative.

The scope of the initiative will initially remain focused on the G&T infrastructure that has traditionally been incorporated within NYPA's asset management approach e.g. transmission lines, substations and generation assets. However, as the initiative evolves consideration will be given to potentially extending the approach to new classes of assets including the NYPA fleet e.g. pool cars, field vehicles, marine vessels, airplane, etc. Additionally, toward the end of the foundation phase, an assessment will be completed to determine whether the approach should also be extended to data, communications, monitoring and control assets.

As the transformation phase approaches, greater consideration will be given to the potential of further extending the approach to non-traditional assets such as real estate, customer assets, financial assets and office IT; the latter will complement application of the approach to operations IT systems during optimization. Decisions about the assets to be included during transformation will be made once there is greater clarity about the benefits that could be attained from application of the enterprise-wide asset management approach to G&T infrastructure and there is a better understanding of the impact that this type of approach could have on new classes of assets. However, the initiative is being developed cognizant of the need to maintain flexibility in the approach so as not to preclude its extension to new assets in the future.

Figure 7: Application of the initiative to asset classes



Consequence of Maintaining Status Quo

The approach toward managing assets currently employed at NYPA has helped to ensure continued efficient operation of NYPA’s G&T assets but there is significant room for improvement by utilizing advanced diagnostics and predictive techniques that are becoming increasingly wide-spread across various industries. A number of existing projects have been initiated to improve the management of assets at NYPA including the Maximo system upgrade and the Transmission and LPGP LEM programs. However, while these efforts will position NYPA to more effectively manage assets into the future, they do not take a strategic approach and as a result are not fully enabling a transition from a reactive to a proactive asset management approach. They comprise just part of the wider solution required to move NYPA toward the position of a best practice asset management organization.

Under the status quo NYPA would continue to deliver secure, clean, reliable power to customers across NYS but it may not be possible to optimize asset management costs and therefore support the effective delivery of low cost power. A variety of factors contribute to this:

- **Consistency of processes:** There are differences in the approach to managing assets across sites at NYPA and across each stage of the asset life cycle. While there is some consideration of risk and asset criticality within existing investment and maintenance decisions, it is not formalized and therefore is not treated in the same way by all groups. This leads to inconsistencies in analyzing options related to the management of assets and could mean resulting decisions do not maximize value from investment.
- **Data availability and integrity:** Data related to asset condition and performance is critical to making informed decisions about required investment in the future. NYPA presently has access to significant amounts of asset data, but there is limited clarity across the business about what data is available as well as concerns about the integrity of the data currently in place. In some cases even though data is collected it is not used to the fullest extent to make effective asset management decisions. Additionally, multiple systems are sometimes used to collect similar types of data, which may lead to suboptimal decisions as a result of reduced transparency about asset health and investment needs. Without accessible and accurate data, and an enterprise-wide approach that values and incorporates it, NYPA cannot implement predictive analytical approaches to leverage ongoing deployment of smart sensors and analytical tools

and will continue to experience problems of stranded research and investment in such systems. Responsibility for data needs to be clarified and formalized.

- **Resources and governance:** At present, resources for managing assets at NYPA are constrained and there are difficulties in securing staff with required asset management expertise. In addition, there is no formal governance structure in place in the form of designated roles and responsibilities that clearly indicate where accountability for given activities, assets or data lies. This creates challenges for the implementation of an effective asset management approach as well as a lack of clarity about who has responsibility for the approach.

As the industry revolutionizes and the demands on NYPA's G&T assets change, these issues will only be exacerbated. The asset management approach will need to be flexible to emerging generation and consumption patterns, providing transparency, through the use of metrics, on system performance and asset health to support the delivery of required upgrades to those assets that are critical to continued reliable power supplies. In the absence of this flexibility, long term costs associated with the management of NYPA assets will most likely be higher and these costs will ultimately be passed onto NYPA customers.

Considered Alternatives

The key alternative that has been considered is to continue the current maintenance management practices at NYPA. However, as NYPA assets age, operating conditions change and new technologies emerge, it is critical to deploy an enterprise-wide asset management approach that provides visibility on the health of the assets deployed on the system to support an informed investment strategy. No alternative asset management approaches were considered as part of this initiative given that ISO 55000 is an internationally recognized standard for asset management and many utilities are in the process of aligning their approach to the requirements of this standard.

SOLUTION

Proposed Solution

Through this initiative, NYPA is proposing to implement an enterprise-wide asset management approach that draws heavily upon the principles of life cycle planning, asset financial / operational performance, and risk profiling embodied within the internationally recognized ISO 55000 standards. While some spending is required under this initiative, the primary focus of the initiative is to develop a clear, cohesive strategic program that will ensure the consistent application of data, processes and resources to make sound asset management decisions that will deliver financial and non-financial benefits.

The transition to an approach aligned to the ISO 55000 standards requires a clear understanding of current NYPA capabilities in this area as compared with the capabilities required to deliver the asset management vision set out in this document. Performing such an assessment, will allow gaps in current capabilities to be identified and enable the team to prioritize the work needed to establish the foundations of a best-practice asset management organization that is aligned to ISO 55000. To understand, at a high level, the differences between current NYPA capabilities as compared with ISO 55000 requirements, the team developed a matrix to compare each of the six key decision processes outlined within ISO 55000 against key structural indicators related to process, data, systems and people. The resulting heat map that was produced is illustrated in Figure 8 below.

Figure 8: Current and future state gap analysis

Stage	Process	Data	Systems	People	KEY
Life cycle strategy	Medium gap	Large gap	Medium / large gap	Medium / large gap	 <p>Large gap</p> <p>Medium / large gap</p> <p>Medium gap</p> <p>Small gap</p>
Investment management	Large gap	Large gap	Medium / large gap	Medium / large gap	
Maintenance optimization	Medium / large gap	Large gap	Medium / large gap	Medium / large gap	
Standards	Medium gap	Large gap	Medium gap	Medium gap	
Resourcing strategy	Large gap	Large gap	Large gap	Large gap	
Performance management	Medium gap	Small gap	Small gap	Small gap	
Asset Management System	Large gap	Large gap	Large gap	Medium gap	

The heat map represented above in Figure 6 illustrates that there are currently some large gaps in NYPA's current capabilities and that a targeted program of work will be required to establish a strong asset management foundation that is aligned to the provisions of ISO 55000 and comprises the following elements:

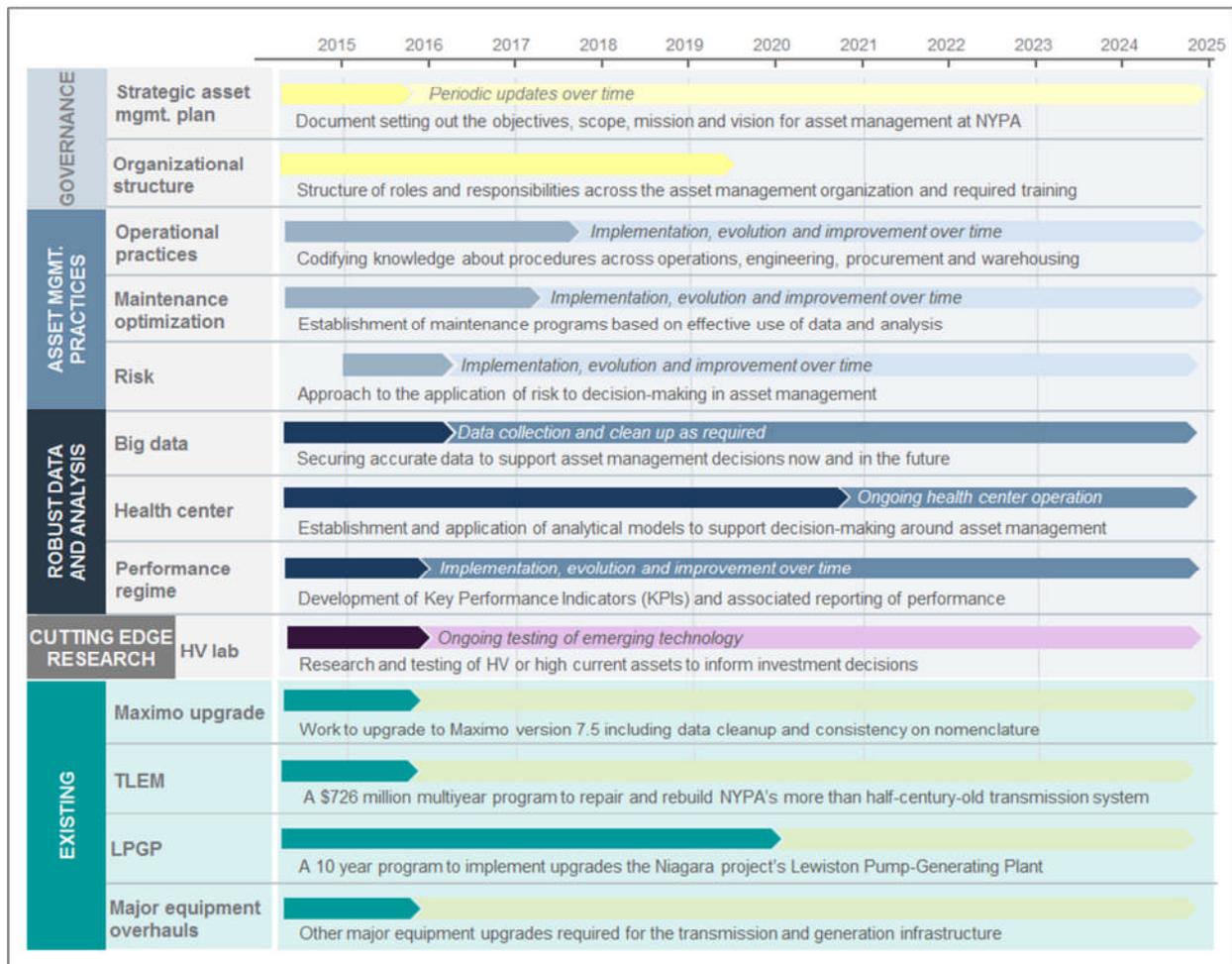
- **Asset management governance:** This work stream comprises two key elements. The first is the establishment of a SAMP which will effectively govern asset management at NYPA and support the transition to ISO 55000. The second is the implementation of a supporting governance structure for the

asset management organization. This will require an assessment of workforce needs now and in the future and the establishment of an organizational structure to provide clarity about asset management roles and responsibilities.

- **Asset management practices:** This work stream will focus upon establishing and securing the adoption of practices that support leading-edge asset management, with a specific focus on optimizing maintenance procedures and incorporating considerations of risk into decision-making.
- **Robust data and analysis:** Accurate data is a critical input required to make decisions at all stages of the asset life cycle and this work stream will focus on ensuring data is both easily accessible and accurate. It will be complemented by an asset health center that will carry out data analytics to provide insights on asset condition and investment needs on both a routine and emergent basis. Performance metrics will also be established to support ongoing system monitoring for making decisions about where additional spending may be required.
- **Cutting-edge research:** Revolution in the power industry is leading to developments in technology and improved understanding of the hardware and software that will optimize asset life. This work stream will support further progress in technology development through the establishment of a High Voltage (HV) lab focused on understanding failure modes and ways to increase the life cycles of assets. At present, there are a limited number of labs that are performing this function. This work stream will also deliver benefits to NYS as a result of the dissemination of findings from the lab to other utilities.

Figure 9 below presents the roadmap of projects that are being proposed alongside the existing efforts being taken forward in asset management.

Figure 9: Asset management roadmap



This figure illustrates the timeframes associated with the implementation of the four work streams and eight corresponding projects that comprise the asset management initiative as well as the way that these work streams compare to the existing projects that are being taken forward by the asset management group. Consideration will also need to be given to the interactions between the asset management initiative and the other strategic initiatives that are being progressed to deliver in line with the expectations set out in the Strategic Vision 2014. These are discussed in more detail in the dependencies section.

The following sections of this business plan provide more detail regarding the asset management projects that NYPA is proposing as part of this initiative.

WORK STREAM 1: Asset management governance

Critical to the implementation of the asset management initiative is a strong governance framework that provides clarity with respect to the drivers and objectives of the program as well as the roles and responsibilities of the respective members of the asset management organization.

A key tool in providing a clear, universally understood governance structure is the SAMP which consolidates the overall approach to asset management. This document will not only ensure that all members of the asset management organization understand and are brought into the approach but will also provide transparency to the rest of NYPA about the context for and objectives of the asset management program. The SAMP will comprise the following elements.

- **The overarching approach to asset management:** Includes a definition of NYPA corporate objectives and how these specifically translate into the need for a strategic asset management approach. It will also reference the policy statement for asset management as well as the scope and objectives of the asset management program.
- **Stakeholder management:** Includes a definition of the stakeholders that will be affected by the asset management system, their expectations and the method that will be used to engage them.
- **A gap analysis:** This will be used to determine what the mismatch or gaps are and where they exist. This analysis will be used as input for senior management review and also used for continuous improvement of asset management.
- **Asset Management plans:** Includes an asset management roadmap setting out activities that will be implemented and resources that will be applied to support delivery against the defined objectives.

The overarching asset management plan presented in the SAMP will provide reference to the projects that will be taken forward to support the foundations of the revised NYPA asset management approach. From this, it will be possible to further refine the scope and detail of the asset management projects detailed in this business plan.

Developing and agreeing on the SAMP will be the first step to progress the asset management initiative following NYPA Board of Trustees approval. It will be a critical tool to provide overall guidance to the development of the program and to inform the direction of the asset management projects outlined in this business plan. Developing an integrated strategic planning framework and associated processes will ensure that NYPA adopts a consistent approach to developing work initiatives and costs across different asset groups to a level of rigor appropriate to the criticality of the different asset types.

The SAMP will provide an overarching framework within which the asset management organization, including respective roles and responsibilities. The transition to an asset management organization that operates in line with the principles of ISO 55000 will only be fully successful where there is clarity about respective roles, responsibilities and accountabilities across both the asset management organization and NYPA more broadly. To achieve this outcome, the team will complete a review of the asset management organization and determine the organizational structure required to achieve NYPA's asset management goals, clearly defining key roles and associated responsibilities. The effective completion of this organizational review will take into

account the proposed activities to be carried out in each of the other asset management work streams and bring together a coordinated view in terms of resources, skills and capabilities needed to secure delivery in line with the agreed vision. A critical consideration within the design of the organization will be to secure flexibility across the asset management organization to build in the capability to adapt to emerging conditions and continue to effectively deliver in line with the asset management vision. There are clear linkages between this work stream and the focus of the workforce planning strategic initiative which are discussed in more detail in the dependencies section.

Table 3 below provides an overview of the scope for each of the activities that will be completed under this work stream and the expected benefits that will be attained.

Table 3: Focus of assessment and expected results from the asset management governance work stream

Project	Areas for assessment	Expected benefits / results
SAMP	<ul style="list-style-type: none"> ▪ Objectives, mission, vision and goals of asset management at NYPA ▪ Guiding principles for asset management at NYPA ▪ Assessment of strengths and weaknesses compared to ISO 55000 ▪ Roadmap for implementation of the asset management projects 	<ul style="list-style-type: none"> ▪ Full understanding across NYPA about the objectives of the asset management initiative / organization ▪ A governance approach that is grounded in clear defensible guiding principles ▪ A prioritized approach to implementing the asset management projects based on current strengths and weaknesses
Organization structure	<ul style="list-style-type: none"> ▪ Current and future role requirements ▪ Capability needs now and in the future ▪ Assessment of current skills and capabilities ▪ Asset management training needs ▪ Formalizing roles and responsibilities ▪ Linking of roles to the performance progress reports (PPRs) 	<ul style="list-style-type: none"> ▪ Clarity about where accountability for the delivery of key outcomes lies ▪ Understanding of current and future resource needs and a strategy for delivery ▪ Flexibility in the asset management organization and resourcing

When this work stream is fully and effectively delivered, it will ensure that there is clarity, both within and outside of the asset management team, about the objectives and guiding principles of the asset management initiative as well as an understanding of where responsibilities for delivery lies. Combined with an effective strategy for securing required resources with the necessary skills and capabilities to effectively complete key tasks, this will support effective delivery of desired outcomes.

As the initiative moves from foundation to optimization and then transformation, the asset management organization will become increasingly mature with better definition of roles and responsibilities which are universally understood across NYPA. The link between Personal Performance Reviews (PPRs) and asset management roles will help to identify potential performance issues and support the development of improvement plans focused on addressing capability needs. Effective forecasting of skill and capability needs will support organizational flexibility by allowing NYPA to quickly identify gaps in resourcing and implement strategies to secure required staff to support key asset management outcomes.

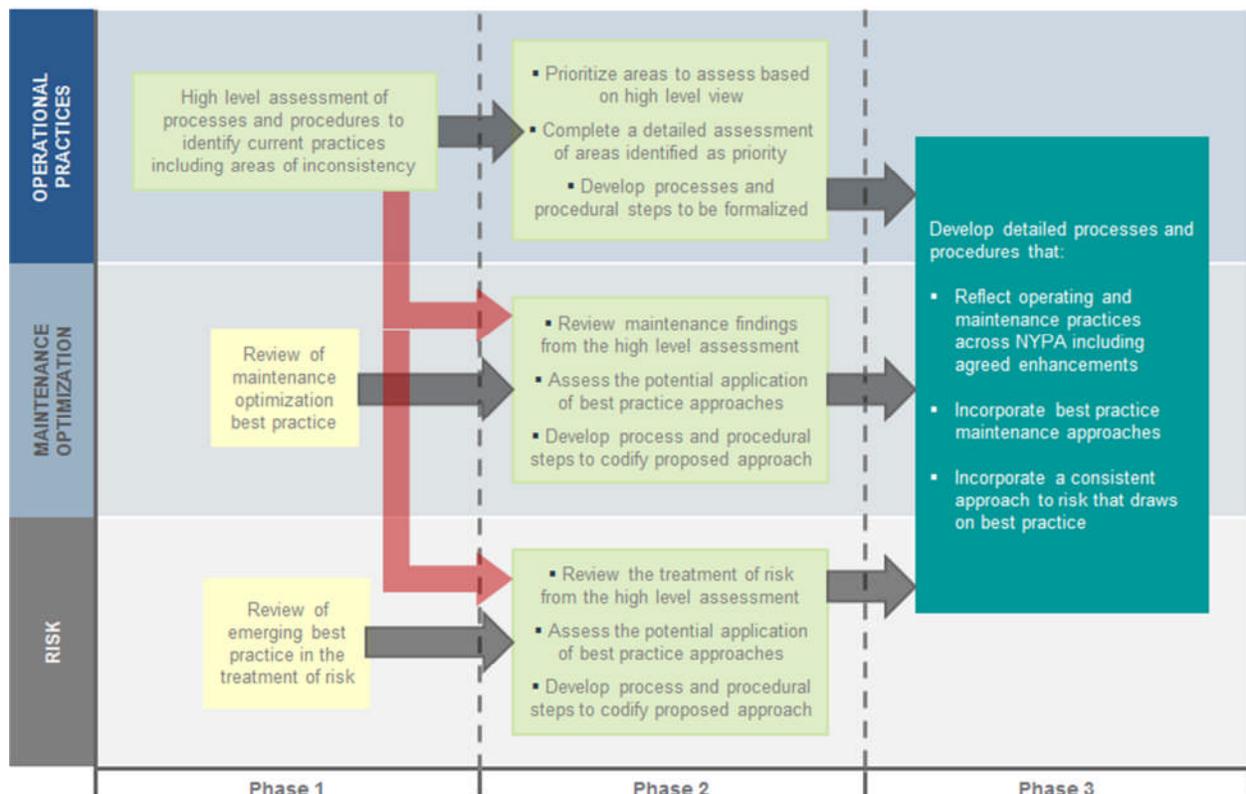
WORK STREAM 2: Asset management practices

Asset management practices include the processes, procedures, job plans and work plans that provide a blueprint for effectively operating and maintaining assets. Where these are standardized and universally applied, it will ensure consistency in the approach toward asset management. This work stream will focus on

establishing a suite of practices that secure consistency in the NYPA asset management approach as well as helping NYPA make the transition toward the principles of ISO 55000 by optimizing maintenance and incorporating risk.

Figure 10 below provides an overview of the three projects that comprise this work stream. It illustrates the clear overlaps between the three projects and highlights the close interactions that will need to be accommodated in the development and implementation of these projects.

Figure 10: The asset management practices work stream



As illustrated in Figure 10 a first step in moving toward a set of consistent practices is to understand the current processes, procedures, job plans and work plans that are in place including an identification of gaps and inconsistencies across the various NYPA sites. This will allow the team to prioritize a more detailed assessment of current operational practices. It will also guide the focus of the maintenance optimization and risk projects. Best practice benchmarking is another key input to all three projects, allowing NYPA to leverage lessons learned by other utilities to support the development of consistent operational practices that facilitate the transition to an asset management organization governed by the principles of ISO 55000. At present there are a significant volume of practices in place in the form of processes, procedures, job plans and work plans and therefore the process of fully assessing and then unifying these practices will be a significant undertaking.

Critical to the success of these projects will be ongoing engagement with NYPA staff that have key roles in developing and applying these practices. This will ensure that the asset management team can draw on the significant institutional knowledge these individuals have about the practices that are currently deployed. To ensure that these key stakeholders are engaged and brought into the new approaches that are developed, they should be regularly consulted about the proposed approach being taken, with their feedback fully considered and addressed. During phase 3 of the work stream, outlined in Figure 10, engagement will need

to be extended to a broader group of NYPA staff to ensure there is universal understanding of the approach that will be taken and that this leads to consistent application. At the end of phase 3, when the revised practices are fully rolled out, staff will need access to ongoing support about how best to implement the approach and to answer difficult implementation questions.

While there are significant interactions between the projects and they share a similar overall objective of developing a suite of asset management practices for which governance, oversight and execution is consistently applied across NYPA, these are distinct projects with defined areas of focus and desired outcomes. Table 4 below provides an overview of the individual characteristics of each of these projects including the areas of focus that they will have and the desired outcomes they will facilitate.

Table 4: Focus of assessment and expected results from the asset management practices work stream

Project	Areas for assessment	Expected benefits / results
Operational procedures	Current practices related to: <ul style="list-style-type: none"> ▪ Operations ▪ Maintenance ▪ Engineering ▪ Configuration management ▪ Procurement and ▪ Warehousing and materials 	<ul style="list-style-type: none"> ▪ Codified knowledge about NYPA practices within NYPA documentation ▪ Full and universal understanding of NYPA practices ▪ Consistent application of the practices across all NYPA sites
Maintenance optimization	<ul style="list-style-type: none"> ▪ Potential to move from frequency-based to condition / predictive maintenance ▪ Use of real-time data to support predictive, risk-based maintenance ▪ Use of Failure Mode Effects Analysis to support maintenance prioritization ▪ Approaches to warehousing / resourcing 	<ul style="list-style-type: none"> ▪ Establishment of an enterprise-wide maintenance program that is consistently applied across all NYPA sites ▪ A defensible maintenance strategy in a heightened compliance environment ▪ Best practice maintenance program that incorporate considerations of risk ▪ Ongoing safe operation of NYPA assets
Risk	<ul style="list-style-type: none"> ▪ Application of risk to support asset management decisions, in line with the ISO 5500 approach ▪ Development of asset risk profiles ▪ Tolerances and thresholds to be applied to considerations of risk 	<ul style="list-style-type: none"> ▪ A clear process to integrate risk into asset management decisions at all stages of the asset life cycle ▪ Delivery of improved customer value using risk based asset management

The combined effect of these projects will be to move NYPA toward the asset management visionary state.

- **During foundation:** This work stream will help NYPA to identify gaps in the existing asset management practices to establish a best practice enterprise-wide approach that incorporates risk and is aligned to ISO 55000 provisions. The adoption of a standardized suite of asset management practices will support a consistent approach at all stages of the asset life-cycle that incorporates considerations of risk and supports the transition toward optimization of NYPA’s maintenance program.
- **During optimization:** This work stream will help NYPA transition to a best practice asset management organization that is fully compliant with ISO 55000 and consistently applied across the organization. A consistent approach to risk profiling will provide full clarity about asset health and enable a predictive maintenance program that helps to support increased asset life and optimize investments.
- **During transformation:** This work stream will help move NYPA toward a culture of continuous improvement for asset management practices, incorporating examples of best practice and lessons

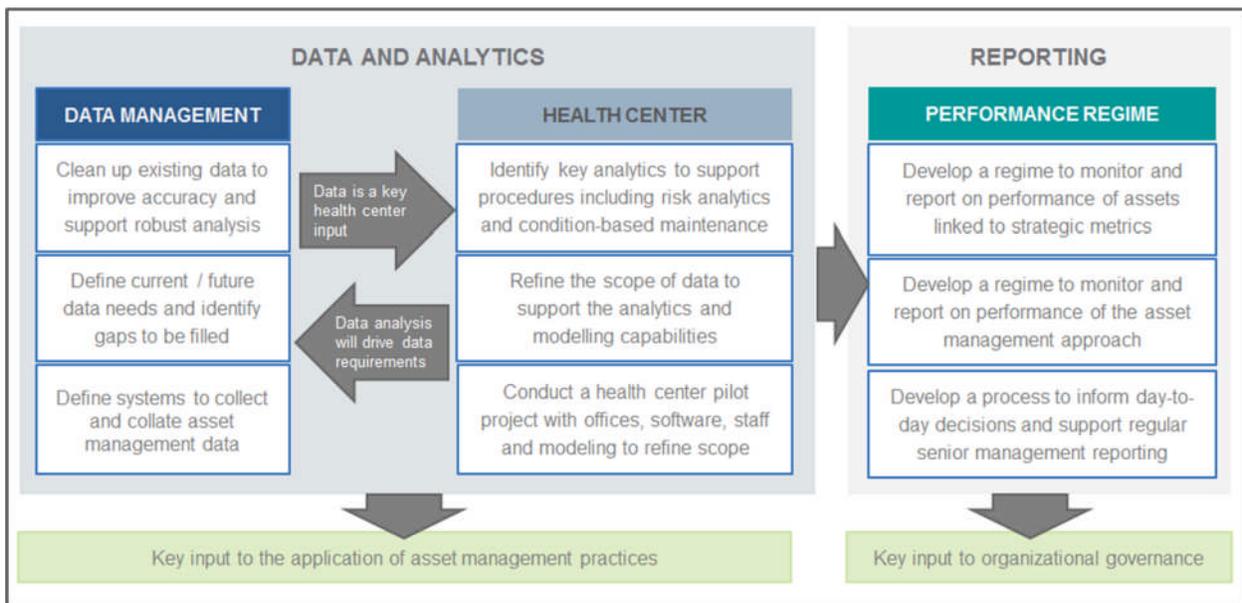
learned from industry leaders. Decisions on investment and maintenance will be based on risk profiles that support predictive maintenance of assets.

WORK STREAM 3: Robust data and analysis

The foundation of any best practice asset management approach is accurate and reliable data that will enable sound operational, investment and maintenance decisions. This work stream focuses on assessing the completeness and accuracy of existing data sources, generating or compiling data where it is not currently captured, implementing arrangements to support analysis of data needed for investment decisions and monitoring performance to identify priorities for investment.

The two key elements of the work stream include (1) data and analytics and (2) reporting. An overview of each of these elements is provided in Figure 11 below.

Figure 11: The robust data and analysis work stream



The data management project is focused on ensuring that the asset management organization has access to required information to support informed decisions about investment and maintenance as well as providing assurances that the data is both accurate and easily accessible. Systems exist throughout NYPA to collect data on installed equipment and operations. The data management project will build upon ongoing data cleanup work and involve a full survey of existing systems to ensure that the static and dynamic data they hold is accurate, complete and available. A range of systems will be included within this survey such as the advanced acoustic and infrared systems used to monitor transformers as well as process data systems like PI which are used at the thermal plants. Accurate data is a key input to making informed decisions about asset management but it needs to be effectively analyzed and manipulated to provide meaningful direction to the decisions that are ultimately made.

The asset health center will form the backbone of the analytical infrastructure required to support asset management. The center will comprise the analytical tools and staff required to interpret data and create useful recommendations to assist in asset management decision-making. The approach will be modeled on that of other utilities who have implemented monitoring and diagnostics frameworks in collaboration with the Electric Power Research Institute (EPRI) and will allow NYPA to develop the analytical capabilities required to quantify asset health and risk based on real-time and historical information.

The asset health center will be staffed with personnel that understand the key information needed to support the ISO 55000 compliant organization including both data and analytics that will provide clarity on asset investment and maintenance needs. The recruitment and development of staff with the skills and capabilities to effectively analyze and interpret asset management data will be critical to the success of the health center. Also critical to the success of the health center will be the selection and customization of appropriate software to perform the analysis required. As the technology in this space continues to evolve, health center staff will collaborate closely with equipment manufacturers, EPRI, and other utilities to ensure that the systems selected and models developed to monitor equipment health remain industry-leading and enable proactive asset management decision-making.

The teams responsible for data management and the health center will work closely together and have significant interactions with the other asset management projects to ensure data is available in the required format to support required decisions. As part of the development of these projects, it will be critical to agree where responsibility lies for decisions required on the basis of asset management insights attained from the data analytics. The hardware required to generate data that is not currently being collected will be installed under the Smart G&T initiative and is expected to include anything from smarter permanent sensors to robotic inspectors.

The remaining project that comprises this work stream is focused on the development of Key Performance Indicators (KPIs) that monitor both asset performance and functioning of the asset management initiative. Insights on the performance of assets as well as the performance of the initiative will help to identify where additional investment or corrective action may be needed to fully deliver against the asset management vision. The agreed KPIs will form the basis of a reporting tool that will allow day-to-day decisions to be made with respect to the management of assets and what, if any, corrective actions may be required. A version of the reporting tool will also be provided to senior management on a regular basis to keep them informed of progress with respect to the asset management initiative and the health of assets installed on the network.

The significant volume of additional data that will be captured and analyzed as part of this initiative is likely to lead to some challenges in terms of data management. To mitigate any potential issues in this area, it will be critical to establish governance, oversight and execution of activities associated with data management.

Table 5 below provides an overview of the individual characteristics of each of these projects including the areas of focus that they will have and the desired outcomes they will facilitate.

Table 5: Focus of assessment and expected results from the robust data and analysis work stream

Project	Areas for assessment	Expected benefits / results
Data management	<ul style="list-style-type: none"> ▪ G&T data needs now and in the future ▪ System needs for the collection and centralization of data ▪ Approach toward data clean up and ongoing maintenance of accurate data ▪ Governance arrangements for data collection and storage 	<ul style="list-style-type: none"> ▪ Universal access to key data sources ▪ Consistent use of data across NYPA ▪ Confidence in the accuracy of data ▪ Use of data as the basis for justifying key asset management decisions ▪ Clarity about responsibilities in data collection and storage

<p>Health center</p>	<ul style="list-style-type: none"> ▪ Analytical models required to support asset management practices across the life cycle ▪ Integration of output information into asset management practices ▪ Software and hardware needs to support required asset modelling and analysis ▪ Scope and timing of a pilot / testing for the health center ▪ Staffing / training for the health center ▪ Areas where NYPA aspirations exceed the capability of available technologies 	<ul style="list-style-type: none"> ▪ Provision of accurate, timely and targeted information based on a variety of real-time and static inputs ▪ Analytic and predictive capabilities enable proactive planning and operation ▪ Enhanced visibility of key indicators related to system operation ▪ Defensible information to support decisions ▪ Collaboration with research entities, other utilities, and private sector organizations on the next generation of asset health analytics and indicators
<p>Performance regime</p>	<ul style="list-style-type: none"> ▪ Scope and detail of key performance indicators (KPIs) related to (a) organization and asset performance (b) performance of the asset management initiative and (c) benchmarking of the performance of NYPA staff ▪ Links between the KPIs and strategic NYPA metrics ▪ Optimal reporting approach to NYPA senior management including the process to flag emerging concerns 	<ul style="list-style-type: none"> ▪ Insights into the performance of assets and the asset management initiative at all levels of the organization ▪ A clear understanding of how the asset management initiative contributes to high level strategic metrics ▪ A defined escalation process for any issues related to implementation and ongoing operation of the initiative

The combined effect of these projects will be to move NYPA toward the asset management visionary state.

- **During foundation:** The work stream will support the collection of accurate, accessible data to inform targeted, cost effective decisions for in-scope assets and support robust rate case filings and cost-of-service. Part of this work will be focused upon continuing the clean-up of existing data sources to provide confidence in the accuracy and reliability of the data upon which decisions are based. A dedicated asset management system(s) will support storage of data and software will be secured to facilitate required modelling / analysis to attain information that helps to direct investment and maintenance decisions. There will be clarity about performance of assets and the resources required to maintain the assets over time across all levels of the organization and decisions on corrective action can be made and taken based on the insights provided by the KPIs.
- **During optimization:** As the asset management initiative is extended to more complex assets, new data will be collected and stored within dedicated systems. There will be a high degree of accuracy of data saved within systems and the culture at NYPA will have shifted toward data-led decision making. The scope of the health center and the KPIs will also be extended to incorporate modeling and analytics related to new assets. NYPA will have in place a best practice approach to data analytics that provides valuable insights to other utilities about how to prioritize investment and maintenance that is applied consistently across NYPA's asset base.
- **During transformation:** NYPA will periodically consider the potential to extend application of the initiative to new, innovative assets and will carry out targeted data analytics to understand benefits that could be attained from this broader application. There will be continued emphasis on securing the integrity of data and streamlining analytics to ensure the rationale for decisions is easy to explain to observers e.g. NYPA colleagues and regulators. NYPA will be universally recognized by other utilities as the model for data capture, analytics and reporting related to asset management, regularly receiving requests to share lessons learned via presentations at industry events.

WORK STREAM 4: Cutting-edge research

The volume of energy industry innovation has increased markedly in recent years. The increased deployment of renewable and decentralized generation combined with new patterns of customer consumption is placing new demands on generation and transmission assets. This has spurred innovation on the asset infrastructure side to identify ways to better accommodate new forms of generation and patterns of consumption in the most efficient way. Emerging technology will support 'smarter' operation and maintenance of NYPA's assets to secure cost efficiencies and deliver value for customers. NYPA wants to play a key role in the development and subsequent deployment of these types of emerging technologies.

This work stream is proposing to establish a world class research and development laboratory that is focused upon applied research and testing for high voltage (HV) or high current assets. The HV Lab will provide the ability to understand failure modes and as a result ways to increase the life cycle of our assets. Preliminary investigations identify that there are very few existing HV facilities that provide this capability and therefore the work stream will enable NYPA to take a leading role with respect to HV innovation, providing insights on asset operation that minimizes degradation and optimizes asset life. Establishing a NYPA HV Lab will enable NYPA to engage in cutting-edge research that will deliver resulting benefits to NYS as well as providing benefits to colleges and universities across the state.

The focus of lab research would be in the following areas.

- Condition monitoring of generation, transmission and distribution assets;
- Development of operational models to explore ways of reducing degradation of asset performance or asset failure; and
- Exploration of the use of solid / liquid electrical insulators and thermal conductors to reduce losses.

The HV lab will allow NYPA to support applied research in these areas, test emerging technologies and operational models to better understand their applicability to NYPA and evaluate the potential benefits they could deliver with respect to effective operation and maintenance of NYPA assets. In turn, the results from this research will help to strengthen investment planning. NYPA will better understand the impact of

deploying certain technologies and techniques which will support development of more robust business cases related to new investments that are based on empirical data and analysis attained from testing. The ability to utilize the results of tests completed by the HV lab will be enhanced by the advanced data and analytical capabilities that are developed through the work stream on robust data and analysis. Establishment of a HV lab will also provide indirect benefits to NYS by placing NYPA in a position of leadership with respect to emerging asset management techniques which, in turn, is likely to lead to job creation in NYS.

It is recognized that work is being taken forward by universities and industries in this area. To maximize the contribution that NYPA makes to discussions about emerging techniques and technologies that could enhance asset management, this project will explore options to collaborate with other educational facilities or businesses. Not only will this enable NYPA to coordinate work in this area but will also ensure that the results of the research that is completed are effectively shared. In the spirit of sharing the results more broadly across NYS, NYPA will also explore the potential to run short courses and seminars regarding high voltage engineering to stimulate discussions and disseminate key lessons learned.

Table 6 below provides an overview of the characteristics of the HV lab including the areas that will be assessed in establishing the lab and the desired outcomes the lab will facilitate. Other advanced technology projects for managing assets may be included in this work stream as they are identified.

Table 6: Focus of assessment and expected results from the cutting-edge research work stream

Project	Areas for assessment	Expected benefits / results
Cutting-edge research	<ul style="list-style-type: none"> ▪ Focus areas for research and testing of HV or high current assets ▪ Effective integration of lab results with investment decisions ▪ Collaboration with other utilities and educational facilities 	<ul style="list-style-type: none"> ▪ Understanding of potential benefits from deployment of emerging technologies ▪ Effective deployment of technologies to improve HV reliability ▪ Informed business case for investment in new technologies which will optimize costs and deliver value to customers

Roll-out Plan

Following approval of the initiative by the Board, a first step will be to begin to develop the SAMP. This document will contain the objectives, scope, mission and vision for asset management at NYPA as well as guiding principles that will support delivery in line with desired outcomes. The SAMP will demonstrate the way that the projects presented in this business plan align to the guiding principles of the initiative and will be the roadmap for delivery of the asset management vision. It will represent an objective source of information for the asset management team as well as interested staff members that are impacted by the change in approach to asset management. The SAMP will be a ‘living’ document that is updated regularly to reflect changes to the approach that have been agreed upon, particularly with respect to the four work streams outlined in the previous section. This will maintain transparency across the organization and support universal understanding of the approach.

Once the SAMP has been developed and agreed, further work will be taken forward to obtain a full and detailed understanding of the strengths and weaknesses of the current asset management approach at NYPA as compared with the ISO 55000 principles. This assessment will identify the gaps in the current NYPA approach to asset management and provide valuable guidance on the areas of the initiative that need to be prioritized. This will provide critical information to shape the projects that have been agreed reflecting on those areas that should be prioritized to address the gaps, strengths and weaknesses identified.

Once there is clarity about and agreement on the form that the SAMP will take including the implications that this will have in terms of the roll out of the projects detailed in this business plan, additional recruitment of

required resources will take place. The team will work closely with the workforce planning initiative to draw on the agreed processes developed as part of this linked strategic initiative and to identify the training needs of the newly recruited asset management staff. As the initiative is more widely rolled out across the organization, consideration will also need to be given to change management activities to effectively embed the new approach to asset management across NYPA. This is discussed further in the section on organizational impact.

Suggested Business Model

A critical component of this initiative will be the establishment of a fully staffed asset management organization responsible for developing and adopting a cohesive SAMP that incorporates all of the projects proposed within this business plan. Governance of the asset management organization as well as the respective roles and responsibilities of the team will be determined through the asset management governance work stream discussed in the preceding section. An initial estimate of resourcing needs suggests that additional Full Time Equivalents (FTEs) will be required to support the projects presented in this business plan. These may comprise existing NYPA employees that are redeployed to the identified positions or may necessitate recruitment to secure additional staff. This will be explored once there is greater clarity with respect to the skill and capability needs of the asset management organization.

Ideally, the full complement of FTEs required to staff the asset management organization would be recruited into the open team positions immediately but the team recognizes that the skills and capabilities of these resources are likely to be in demand within the industry. Therefore, in the short-term external consultancy and / or contractor support will be needed in the form of asset management subject matter experts (SMEs). This will have three key purposes.

- Firstly, it will help to ensure that the team has access to the critical knowledge and capabilities needed to guide the development of a robust foundation for asset management. The SMEs will not only be able to draw on the theory that underpins asset management and the application of the ISO 55000 principles but will also draw on their experience in the practical application of these principles.
- Second, it will support the delivery of on-the-job training for the asset management team, building their skills and capabilities by learning from consultants that have worked on industry-leading asset management programs.
- Third, it will allow the initiative to be kicked off immediately after receipt of approval from the Board utilizing knowledgeable staff to support the establishment of robust asset management foundations.

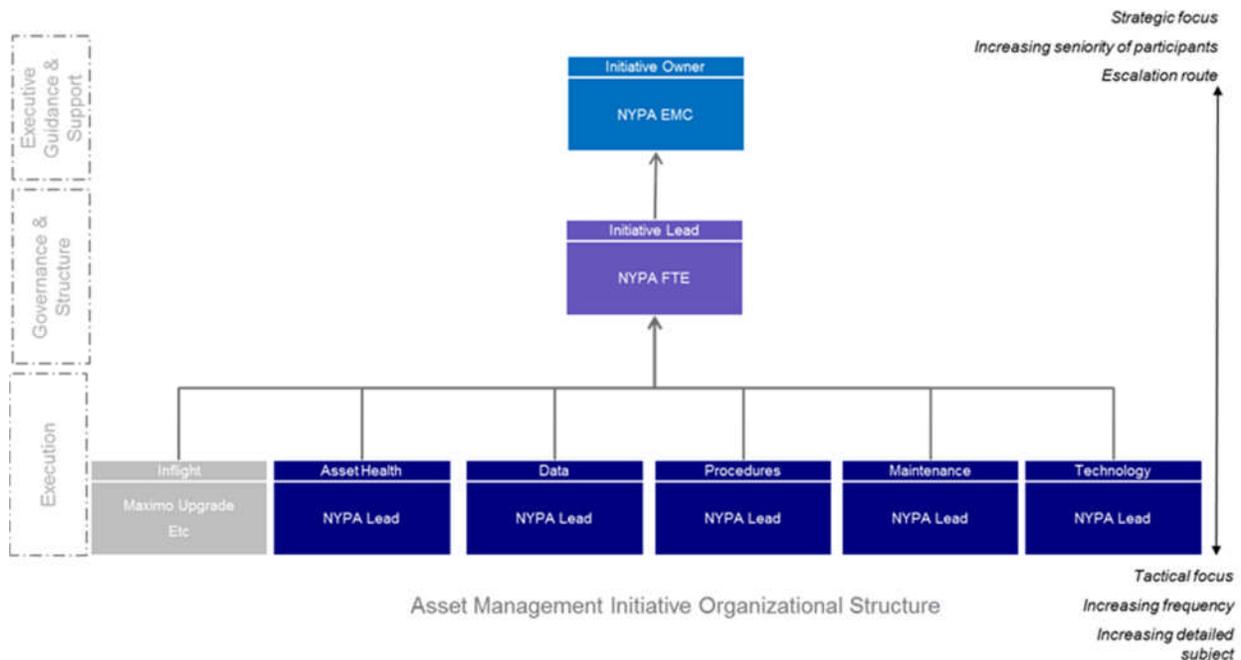
A longer term objective of this initiative is to develop subject matter expertise in-house. Building internal capability related to the development and application of a robust asset management approach will place NYPA in a strong position to effectively maintain the program over time. This will be supported by the effective use of consultants with asset management subject matter expertise to provide on-the-job training as well as the development of a comprehensive training program that will help staff to develop their asset management skills and capabilities.

An enterprise-wide awareness and understanding of the revised asset management approach will also be critical to make sure that staff across NYPA, appreciates the value of the SAMP as well as the implications that this change in approach will have for their work. Benchmarking has identified that critical importance should be attached to change management when implementing a new asset management approach. This includes behavior and cultural change on the part of all staff across NYPA will be necessary to embed the new SAMP. For this reason, as part of this initiative a targeted change management program will be rolled out focused on identifying influential stakeholders across NYPA, communicating key messages about the changes set to take place and encouraging their input in developing the approach to asset management.

Suggested Governance Structure

During the Foundation stage, the asset management organization will be located within the Operations department. Over time, as the initiative matures, consideration will be given to the potential to include additional asset classes within the asset management strategy. At this point, an assessment may need to be completed to determine whether the asset management organization should remain within Operations or whether it would be better to relocate the group. A suggested initiative organization structure is shown in Figure 12.

Figure 12: Initiative organization structure



A key work stream within this initiative is focused on developing a governance structure for the asset management organization which will be achieved via the development of the SAMP and associated roles and responsibilities of the various members of staff recruited to support this initiative. The governance structure will also need to consider interactions that the initiative will have with other departments across NYPA, e.g. IT and procurement, and what this will mean in terms of broader changes to roles and responsibilities. Following the ISO 55000 current state assessment, discussions around governance of the asset management initiative will be progressed as a priority to ensure that there is clarity about respective roles and responsibilities. This will allow the team to draw on the findings of the ISO 55000 assessment to make decisions about the areas of the asset management approach that should be prioritized including the roles and responsibilities needed to support this work. In the interim period, the work required to progress the asset management initiative will be taken forward by the existing asset management office.

Dependencies

There are multiple dependencies and linkages between the asset management initiative and the other strategic initiatives which are currently in various stages of development / implementation. The exact nature of these dependencies will only be fully apparent once all the initiatives are fully scoped and in the process of being implemented. However, in the interim, it will be critical that asset management remains joined up with these initiatives to ensure that any links are fully understood and addressed to avoid any overlaps or contradictions. Table 7 provides an overview of the key interactions that are foreseen between the initiatives.

Table 7: Dependencies between asset management and the other strategic initiatives

Initiative	Degree of impact	Description	Approach
Smart G&T	High	<ul style="list-style-type: none"> • Smart G&T is proposing a series of projects focused on deploying smart grid hardware • Smart grid hardware will provide valuable new information about NYPA’s G&T assets • Smart G&T data will be a key input to the asset management approach. This business plan assumes that additional hardware to capture this data will not be required. • Smart G&T projects may increase the number or types of assets to be managed • Asset management practices, especially those that incorporate predictive analytics, will drive requirements for new asset data and infrastructure to be provided by Smart G&T 	The collection, storage and analysis of data will need to be explored to secure a clear delineation of responsibilities. Any new assets will be deployed and managed using asset management practices, where applicable.
Customer Solutions	Medium	<ul style="list-style-type: none"> ▪ A clear asset management approach will help to support rate clarity and stability ▪ An enhanced asset management approach will improve the reliability of service delivered to customers ▪ Greater visibility of asset health will enable faster response to customer requests for bespoke services ▪ During transformation the asset management approach may be extended to customer assets 	Engagement with the customer solutions initiative to identify emerging interactions in terms of the proposed suite of services that will be offered.
Workforce Planning	High	<ul style="list-style-type: none"> ▪ Key tools being developed to support effective workforce planning will be valuable to establish the asset management organization e.g. the skills assessment and forecasting tools ▪ Workforce planning may be able to support processes to effectively recruit a number of new staff to support agreed projects ▪ Targeted training of staff that work in the asset management organization will be needed 	Coordination to understand and apply workforce planning processes / templates
Process Excellence	Medium	<ul style="list-style-type: none"> ▪ Asset management will be setting up new practices ▪ Process excellence could provide guidance to effectively set up the practices ▪ Process excellence could use asset management as one of its initial practices for assessment 	Coordination with the process excellence team to understand the scope for support and ways to attain ongoing guidance

Knowledge Management	Medium	<ul style="list-style-type: none"> ▪ Knowledge Management is proposing to implement a search engine that will improve access to knowledge saved on shared drives ▪ Knowledge management will facilitate the informal transfer of knowledge via communities of practice and expertise location ▪ These tools will help to establish an enterprise-wide asset management approach that is universally understood and consistently applied 	Engagement with knowledge management to ensure asset management systems are compatible with the enterprise search tool and that asset management is considered for community of practice discussions, and that personnel have and maintain the right level of knowledge to implement asset management.
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In addition to the strategic initiatives that are being taken forward as part of the transformation of NYPA in line with the 2014 Strategic Vision, a number of projects are being progressed by the asset management office which will need to be effectively integrated within this revised asset management approach.

- NYPA is currently in the process of upgrading its Maximo asset management system. This upgrade will provide a tool to support the transition to ISO 55000 and a life cycle approach to asset management as it will provide a repository to house a significant proportion of asset management data. This will support an enterprise-wide asset management approach. Maximo also allows an integrated approach for both short and long term planning as well as controlling inventory, purchasing and condition based maintenance implementation.
- NYPA is currently implementing a TLEM and LPGP program which are focused on upgrading NYPA’s aging G&T infrastructure. The expenditure associated with these programs is significant and therefore they represent ideal opportunities, to view capital expenditure decisions from the asset lifecycle lens. Opportunities will exist during their implementation to build on the foundational elements of technology, data, people, and processes.

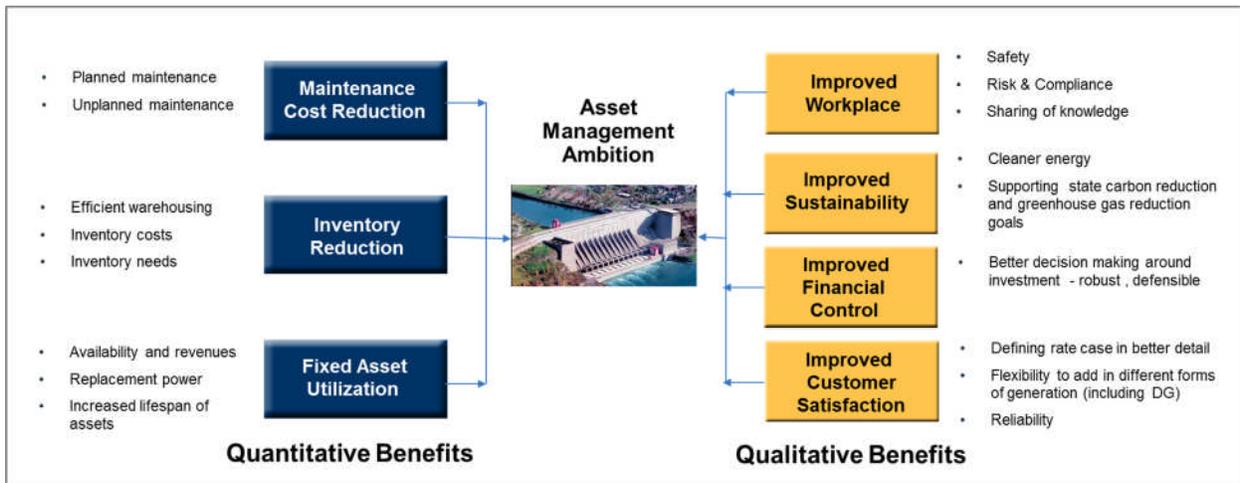
BENEFITS AND REVENUE

High-level Benefit Description

The overarching benefit of this initiative is that it will support the continued effective management of NYPA’s G&T assets and ensure that the organization is able to continue to deliver clean, low cost and reliable electricity to customers across NYS. The continued efficient and reliable operation of NYPA’s G&T assets is also a critical foundation required to support implementation of the Smart G&T and customer solutions strategic initiatives.

Some of these benefits can be quantified by reference to the reduction in costs that NYPA will incur over time while others are difficult to measure objectively and therefore need to be considered from a qualitative perspective. Figure 12 below provides an overview of both the qualitative and quantitative benefits that are anticipated to accrue from this initiative.

Figure 13: An overview of quantitative and qualitative benefits



As outlined in figure 12 above, there are a range of quantitative benefits that can be considered to fall within three key categories.

- **Maintenance cost reduction:** The use of data analytics to enable a broader understanding of asset performance, cost, risk and value will allow NYPA to make the transition toward predictive analytics and optimize spending on both planned and unplanned maintenance.
- **Inventory reduction:** A rationalized inventory based on long term asset maintenance and replacement planning will reduce warehousing needs and associated costs.
- **Fixed asset utilization:** Greater visibility of asset performance and associated risks will reduce asset failures as well as the need to enter spot wholesale markets to secure replacement power to fulfill customer contracts. More intelligent operation of infrastructure recognizing potential risks will also help to increase the lifespan of NYPA assets.

In addition to these quantitative benefits, there are also qualitative benefits which need to be taken into account in assessing the asset management initiative. These include:

- **Improved workplace:** A greater understanding of the G&T assets installed on NYPA's system will help to reduce asset failures with a corresponding impact on safety at NYPA. Improved consideration and enhanced visibility of risk will also help to improve compliance with regulatory requirements including, amongst others, the NERC Critical Infrastructure Protection (CIP) standards. In addition, the process of codifying asset management practices will help to facilitate effective knowledge sharing and transfer within NYPA as well as supporting ongoing on-the-job training.
- **Improved sustainability:** An overarching benefit of the initiative is that it will support continued effective operation of NYPA's G&T assets and help to avoid potential catastrophic failures. In addition, the greater use of system data will provide clarity about the demands that new generation and consumption technologies will place on NYPA assets. This will allow informed asset investment decisions required to support deployment of clean energy and energy services.
- **Improved financial control:** Clear asset management practices and greater use of data will ensure that all asset management decisions are reached on the same basis using a consistent approach. This will improve the credibility and robustness of decision making, enhancing the defensibility of investment.

- Improved customer satisfaction:** Greater understanding of NYPA assets and clarity about longer term asset investment needs will support a consistent and well defined spending program which will help to secure long term rate stability for customers. In addition, greater knowledge of the risk associated with NYPA assets will provide insights around the capability of our assets to support additional generation and customer assets which will enhance responsiveness to requests for customized service from customers. Both factors will improve overall customer satisfaction.

Table 8 below presents a complete list of the projects under this initiative are mapped to the appropriate benefit categories, both financial and non-financial.

Table 8: Overview of Projects and benefits that accrue

Benefits		Projects								
		Framework	Operational Procedures	Maintenance Optimization	Risk	Big Data	Health Centre	Performance Regime	HV Lab	Org Design
Quantitative	Maintenance cost reduction	•	•	•	•	•	•	•	•	•
	Inventory reduction	•	•	•		•		•		•
	Fixed asset utilization	•	•	•		•	•	•	•	•
Qualitative	Improved workplace	•	•	•	•			•		•
	Greater sustainability	•	•	•			•	•		•
	Improved financial control	•	•			•		•		•
	Improved customer satisfaction	•	•					•		•

Financial benefits

Table 9 below is a summary of the financial benefits anticipated from rolling out the Asset Management initiative. Subsequent material presents detail on how these benefits were estimated.

Table 9: Summary of projected benefits from implementing the Asset Management initiatives

Cost savings for NYPA (\$ '000)									
Category	2014	2015	2016	2017	2018	2019	2020	Post 2020	
Maintenance Optimization	\$ -	\$ -	\$ -	\$ -	\$ 4,162,500	\$ 8,325,000	\$ 11,655,000	\$ 14,985,000	
Inventory costs	\$ -	\$ -	\$ -	\$ -	\$ 2,610,000	\$ 2,610,000	\$ 2,088,000	\$ 626,400	
Total (\$ '000)	\$ -	\$ -	\$ -	\$ -	\$ 6,772,500	\$ 10,935,000	\$ 13,743,000	\$ 15,611,400	

Incremental revenue (\$ '000)									
Category	2014	2015	2016	2017	2018	2019	2020	Post 2020	
Asset Utilization	\$ -	\$ -	\$ -	\$ -	\$ 2,385,000	\$ 4,770,000	\$ 6,678,000	\$ 8,586,000	
Total (\$ '000)	\$ -	\$ -	\$ -	\$ -	\$ 2,385,000	\$ 4,770,000	\$ 6,678,000	\$ 8,586,000	

Total NYPA savings & revenue (\$ '000)	\$ 166,270,500
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Benefit Assumptions

Financial benefits associated with initiatives of this type are traditionally difficult to quantify at the business planning phase. In order to identify some indicative numbers at this stage we have relied heavily on benchmarking against other organizations that have implemented similar Asset Management strategies as well as vendors who typically operate in the Asset Management optimization space.

Table 10: Benefit category detail and assumptions by capability roadmap area

Benefit Category	Benefit Detail	Assumptions
Maintenance Optimization	Reduction in labor costs	labor cost of 15% (range based on IBM assessment of multiple utilities and Scottish Power program (10-20 percent average) average maintenance costs for NYPA over last 3 years is \$111 million)
Inventory costs	Reduced inventory value and carrying costs	12% reduction in inventory costs IBM assessment of inventory costs savings associated with initiatives of this type for other utilities ranging 5%-20% average inventory costs over last three years of \$87mm
Asset Utilization	increased revenues through capacity	1% additional availability in capacity based on a range provided by IBM for similar initiatives undertaken at 20+ other organizations IBM range was 2% to 5% but because of uncertainty in market prices and the fact that some of NYPA's hydro generation facilities are rarely running to capacity anyway, it is felt that we should be prudent in our estimates) Average revenue over the last 3 years is \$954 million

Confidence level of benefit realization

Across the initiative project portfolio we have identified projects and associated benefits through the employment of assumptions, market knowledge and NYPA specific data points.

While the numbers for initiative costs have a higher confidence level attached than the benefits at this stage, we believe the assumptions are both directionally correct and provide a positive benefit-cost ratio for NYPA to proceed with investment.

To ensure that we are not overestimating benefits, we have taken a conservative approach to their value – not just in the assumptions developed but also in the staggered release of those benefits over time. This is particularly important given NYPA's current 10-year annual cycle for the maintenance of assets.

The following represents the overall confidence that the specified revenue and benefits will be realized, using the scale that follows.

Confidence level	Benefit/revenue realization range
Very high	+/- 5% of expected benefits
High	+/- 10% of expected benefits
Medium	+/- 20% of expected benefits
Low	+/- 30% of expected benefits
Very low	+/- 50% of expected benefits

NYS Benefits	Low	
NYPA Savings & Revenue	Low	
	Low	High
Total NYS Benefits (\$'000)**	\$ -	\$ -
NYPA Savings & Revenue (\$ '000)	\$ 116,389,350	\$ 216,151,650

***Note: We have not identified any direct quantitative benefits for NYS as part of this initiative. Qualitative benefits have been identified and are addressed in the external stakeholder and marketing section of this document.*

FUNDING FOR THE INITIATIVE

Intended Sources of Funding

The Asset Management initiative will be funded via a combination of NYPA’s O&M and Capital budgets, as well as debt. As the initiative matures, it is anticipated that benefits such as decreased O&M spending and prolonged asset life will offset a significant portion of initiative costs in the long-term. Much of the initiative’s costs and benefits will ultimately be shared with NYPA customers through existing rate structures.

NYPA has engaged EPRI to provide advice on the implementation of the High Voltage Lab. Among the open items are collaboration opportunities (educational and business), management and governance structure and extent of the lab’s capabilities. Ultimate financing and cost recovery will be finalized once these matters are determined and will include some combination of NYPA investment and investment from external partners.

Table 11: Funding sources

Intended total funding sources				
Source	Selected		Value (\$ '000)	Percentage of funds
Bond issuance	Yes	✓	\$ 32,266,733	33%
Cash reserves	Yes	✓	\$ 64,533,467	67%
Third-party funds	No	✓	\$ -	0%
Other	No	✓	\$ -	0%
Total			\$ 96,800,200	100%

Any values that have been entered for one or more subinitiatives will be automatically included in the table below at the aggregate level.

Expected annual funding profile									
Category	2014	2015	2016	2017	2018	2019	2020	Post 2020	
Bond proceeds	\$ 178,367	\$ 3,296,700	\$ 11,066,667	\$ 10,758,333	\$ 1,100,000	\$ 1,216,667	\$ 775,000	\$ 775,000	
Third-party funds									
Total external funds	\$ 178,367	\$ 3,296,700	\$ 11,066,667	\$ 10,758,333	\$ 1,100,000	\$ 1,216,667	\$ 775,000	\$ 775,000	
Interest payments									
Debt retirement									
Other									
Net external funds impact	\$ 178,367	\$ 3,296,700	\$ 11,066,667	\$ 10,758,333	\$ 1,100,000	\$ 1,216,667	\$ 775,000	\$ 775,000	
NYPA cash	\$ 356,733	\$ 6,593,400	\$ 22,133,333	\$ 21,516,667	\$ 2,200,000	\$ 2,433,333	\$ 1,550,000	\$ 1,550,000	
<i>Total annual cost</i>	<i>\$ 535,100</i>	<i>\$ 9,890,100</i>	<i>\$ 33,200,000</i>	<i>\$ 32,275,000</i>	<i>\$ 3,300,000</i>	<i>\$ 3,650,000</i>	<i>\$ 2,325,000</i>	<i>\$ 2,325,000</i>	

Total external funding (\$ '000)	\$ 32,266,733
Total NYPA cash (\$ '000)	\$ 64,533,467

Confidence level of external funding

Please indicate the overall confidence that the indicated external funding levels will be realized, using the scale specified to the right. Using the specified confidence level, a confidence-adjusted range of external funding is then estimated.

Confidence level	Low
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Confidence level	External funding range
Very high	+/- 5% of expected funding
High	+/- 10% of expected funding
Medium	+/- 20% of expected funding
Low	+/- 30% of expected funding
Very low	+/- 50% of expected funding

	Low	High
External funding (\$ '000)	\$ 22,586,713	\$ 41,946,753
Residual NYPA cash funds (\$ '000)	\$ 74,213,487	\$ 54,853,447

COSTS AND RESOURCES

Initiative Cost and Resources

Table 12: Costs and Resources

O&M expenses (\$ '000)								
Category	2014	2015	2016	2017	2018	2019	2020	Post 2020
Framework	\$ 450,100	\$ 990,100	\$ 100,000	\$ 100,000	\$ -	\$ -	\$ -	\$ -
Operational Procedures	\$ -	\$ 2,150,000	\$ 2,150,000	\$ 2,150,000	\$ -	\$ -	\$ -	\$ -
Maintenance Optimization	\$ -	\$ 1,750,000	\$ 1,675,000	\$ 950,000	\$ 350,000	\$ 350,000	\$ 350,000	\$ 350,000
Big Data	\$ -	\$ 1,875,000	\$ 975,000	\$ 775,000	\$ 250,000	\$ 250,000	\$ 250,000	\$ 250,000
Health Center	\$ -	\$ 425,000	\$ 600,000	\$ 1,025,000	\$ 1,025,000	\$ 1,375,000	\$ 1,050,000	\$ 1,050,000
Performance Regime	\$ -	\$ 700,000	\$ 350,000	\$ 325,000	\$ 325,000	\$ 325,000	\$ 325,000	\$ 325,000
HV Implementation	\$ -	\$ 350,000	\$ 350,000	\$ 350,000	\$ 350,000	\$ 350,000	\$ 350,000	\$ 350,000
Total annual O&M expenses	\$ 450,100	\$ 8,240,100	\$ 6,200,000	\$ 5,675,000	\$ 2,300,000	\$ 2,650,000	\$ 2,325,000	\$ 2,325,000

Total O&M expenses (\$ '000) \$ **39,465,200**

Capital expenses (\$ '000)								
Category	2014	2015	2016	2017	2018	2019	2020	Post 2020
Framework	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Operational Procedures	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Maintenance Optimization	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Big Data	\$ -	\$ 400,000	\$ 1,000,000	\$ 600,000	\$ -	\$ -	\$ -	\$ -
Health Center	\$ 50,000	\$ -	\$ 1,000,000	\$ 1,000,000	\$ 1,000,000	\$ 1,000,000	\$ -	\$ -
Performance Regime	\$ -	\$ 1,000,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
HV Implementation	\$ 35,000	\$ 250,000	\$ 25,000,000	\$ 25,000,000	\$ -	\$ -	\$ -	\$ -
Total annual Capex	\$ 85,000	\$ 1,650,000	\$ 27,000,000	\$ 26,600,000	\$ 1,000,000	\$ 1,000,000	\$ -	\$ -

Total initiative Capital expenses (\$ '000) \$ **57,335,000**

Total initiative costs (\$ '000) \$ **96,800,200**

Resources (FTE)								
Category	2014	2015	2016	2017	2018	2019	2020	Post 2020
Framework	2	2	0	0	0	0	0	0
Operational Procedures	0	3	3	3	0	0	0	0
Maintenance Optimization	0	2	2	2	2	2	2	2
Big Data	0	3	3	3	0	0	0	0
Health Center	0	1	2	5	5	7	6	6
Performance Regime	0	1	1	1	1	1	1	1
HV Implementation	0	2	2	2	2	2	2	2
Total annual FTE	2	14	13	16	10	12	11	11

Initiative Cost Assumptions

Costs for this initiative have been derived through a combination of:

- Internal and external resource estimates based on cross initiative rates
- Working with industry vendors who have provided indicative cost estimates for the projects outlined in the business plan
- Benchmarking against other utilities such as Duke Energy, Con Edison, Scottish Power and Puget Sound Energy who have undertaken similar initiatives - readjusting costs based on comparable sizes

IMPACT TO MARKET

Overview of Marketing Approach

This initiative is primarily focused on establishing internally-focused enterprise-wide provisions that optimize the management of NYPA assets. While the focus is on internal arrangements, the initiative is expected to have impacts on NYPA customers and the services that NYPA offers in the following areas.

- **Optimized customer costs:** Adopting an asset management approach that effectively and consistently utilizes data to understand asset health and risk will allow NYPA to maximize the life of its assets and optimize maintenance costs. Initially, the team anticipates that the implementation of an asset management approach that provides greater visibility on asset health will likely lead to increased costs as asset performance, risk and value become more visible and this highlights the need for asset investment / replacement. However, as NYPA moves into the optimized phase of the initiative, these investments will begin to pay off and the approach will deliver longer-term efficiencies to customers in the form of optimized capital investment and maintenance costs. Costs will also be reduced through the development of consistent practices that enable staff to focus on tasks that add value and thereby improve efficiency. Over the longer term both of these elements will contribute to the continued delivery of high quality services to customers at low cost.
- **Improved reliability:** A more sophisticated asset management approach that uses asset health to determine required maintenance will support the transition from a traditional 'run to failure' approach, to preventative or predictive maintenance programs. This will ensure investment is targeted and costs optimized as well as helping NYPA to avoid unplanned transmission and generation outages. Even where forced outages take place, the improved understanding that NYPA has of its assets, from accurate data and robust analysis, will secure faster equipment restoration. This enhanced reliability will translate into improved quality of supply for NYPA customers and will increase the value they receive from NYPA services.
- **Greater responsiveness to customer service requests:** Improved understanding of asset condition and criticality will support greater transparency about the ability to accommodate additional / altered system loads. In turn, this will enable NYPA to explore the potential to offer more sophisticated services that deliver in line with customer needs. Easier access to data to allow NYPA to more quickly understand the capacity to deliver certain services will improve responsiveness and enhance NYPA's credibility in the customer services area.

Each of these areas will help to further delivery of low-cost, clean, reliable power as well as the innovative energy infrastructure and services NYPA customers' value.

ORGANIZATIONAL IMPACT

Overall Degree of Change

This initiative will fundamentally change NYPA’s approach toward asset management and move the organization toward the principles contained in ISO 55000 which focus on the value chain for managing assets alongside considerations of life cycle planning cost, performance and risk. The approach will provide greater transparency about asset health and allow investment to be targeted to those areas in which it will deliver most value to customers. Resulting changes across the organization will accrue in three key areas.

- Capabilities:** The skills and competencies of staff within the asset management organization will need to change to reflect the new approach. An exact understanding of the required skills and capabilities of these personnel will be attained during the completion of work stream 1 related to governance of the asset management approach. However, at a high level, it is anticipated that additional staff with an understanding of ISO 55000, advanced data collection and analytics capabilities and experience of HV lab testing will be beneficial to the implementation of this initiative. In addition, there may be some change of capabilities required in terms of staff in other departments that support this initiative, particularly IT. As part of the organizational review, impacts on this department, and others, will need to be fully considered and addressed.
- Culture change during foundation:** Full adoption of the initiative during the Foundation phase will require a mindset change on the part of many staff involved in asset management that have used the existing approach for a significant period of time. It is likely that it will take time for these members of the Operations organization to fully buy into the revised approach particularly given that the benefits of a risk based asset management approach will take time to accrue. In light of these issues, it will be important for the team to be able to clearly and robustly explain the rationale for the change and point to the benefits that will ultimately be delivered as a result of this initiative. Where possible, the team should also be able to highlight best practice examples where other utilities have implemented these principles and attained benefits.
- Change management to embed the approach:** Under the principles of ISO 55000, there is a desire to move to an enterprise-wide asset management approach that straddles the entire organization. This will emphasize the importance of proactive engagement with staff across NYPA to increase their awareness and understanding of this initiative. This engagement should take a variety of forms, drawing on the shorter term communications events related to the strategic vision, as well as opportunities such as the communities of practice that will be taken forward by knowledge management. This will not only allow the asset management team to proactively communicate progress made on the implementation of the initiative but also seek feedback from staff across NYPA around areas that could be amended or improved. It will also support greater awareness across the organization with respect to the new asset management approach.

Table 13: Internal impact

Internal impact overview		
Business Unit	Description of impact	Impact
Operations/ Transmission	Improving the operational performance of the organization by moving to an Enterprise-wide AM approach, which will require NYPA to undergo a culture change. A big driver of the AM changes are the new international requirements described in the ISO 55000.	Positive - High
Economic Dev. & Energy Efficiency	While there is no immediate impact to Economic Development and Energy Efficiency (EE), there could be	Positive - Low

	<p>potential involvement in the future. If NYPA decides to develop contracts with its customers to maintain their assets that would be a huge impact to the way EE does business right now. This would involve a culture change in the way NYPA conducts business with its customers and ensuring that the right skill set to maintain customer assets resides within EE.</p>	
Business Services	<p>The Business Services Unit will be impacted by:</p> <ol style="list-style-type: none"> 1. The HV lab - interacting with the university and establishing NYPA's role in its development. 2. Culture changes involved with the enterprise-wide AM approach - Staffing the Health Center and AM office with the right skill sets, training all NYPA employees on the new AM approach, and standardizing AM processes /procedures / maintenance practices across NYPA. 3. Customer Assets - If NYPA decides to take on maintaining customer assets in the future that will be a huge change in the way NYPA does business with its customers. 4. Cyber Assets - If NYPA decides to take on maintaining cyber, software or hardware assets, compliance and cyber security will need to get involved in the AM process 	Positive - High
Information Technology (IT)	<p>While there is no immediate impact to IT, in the future cyber, hardware and software assets could fall under the AM program. In that respect NYPA will need people who have a skillset in data recovery.</p>	Positive - Medium

EXTERNAL STAKEHOLDER IMPACT AND MARKETING PLAN

The proposed HV lab, the most externally-oriented component of this initiative, will provide benefits in the form of increased high voltage research and education ability for state universities, creation of jobs in high voltage research, education and practice, and increased ability for public and private sector collaboration on high voltage equipment testing and certification. In addition to contributing to the body of knowledge around the design, implementation, operation, and maintenance of power system equipment at rated voltages, NYPA can benefit from the presence of the facility by validating equipment, increasing knowledge around failure modes and optimal operation, training existing staff, and developing a pipeline for future staff in these areas.

Table 14: External impact overview

External impact overview			
Stakeholder	Description of impact	Impact	Suggested action
Customer	Better asset management planning will increase reliability for the customers. A clear asset management approach will also help to support rate clarity and stability.	Positive - Low	Work closely with the Customers Solutions initiative to identify new, proposed services that will be offered.
Distribution Utilities	Better asset management planning will likely reduce outage times making generation and transmission more reliable in turn making distribution utilities more reliable.	Positive - Low	Work closely with distribution utilities such as Con Ed and National Grid so that planned and forced outages are clearly communicated to mitigate generation and distribution issues across NYS.
NYISO	Through better asset management planning, the number of planned and/or forced outages and associated durations will likely be reduced, in turn reducing the length of the outage requests to the NYISO.	Positive - Medium	Work closely with the NYISO to ensure that outages required for equipment maintenance / replacement are properly planned and that the number of forced outages is reduced.
Transmission Operators (TO)	In close collaboration with the Smart Generation & Transmission (G&T) initiative, the asset management Health Center will utilize data from technological devices installed on NYPA's transmission equipment. More access to and better use of such data could minimize planned and/or forced outages.	Positive - Low	Work closely with the Smart G&T initiative to have a clear understanding of available data from our transmission systems which can be used to support other TOs.

Description of Marketing Strategy

The primary impact of this initiative will be internally focused on improving the operational performance of the organization. However, the agreed vision for the asset management initiative positions NYPA as an industry leader in this space in the transformational phase. Achieving this outcome will require external discussion of the approach that NYPA has taken, the benefits that are achieved and the lessons that have been learned. The team will therefore establish a program of industry events, including presentations and seminars as well as participation in articles for industry journals to discuss the approach that has been taken to asset management at NYPA and the outcomes that have been delivered. Consideration will need to be

given to the appropriate timing of this work in light of progress made and best practice examples that can be shared with industry colleagues.

RISKS AND ASSUMPTIONS

Risks to the delivery of outcomes anticipated

There are a multitude of potential risks that could affect the benefits delivered by the asset management initiative. The most significant of these relates to the cultural change that needs to take place within NYPA for the new asset management approach to become fully embedded. In many cases, asset managers across the organization have adopted the same informal asset management approaches for many decades and have observed the successful continued operation of NYPA assets. It is likely that significant change management efforts will be required to demonstrate the benefits of moving to an enterprise-wide asset management approach that is aligned with the principles of ISO 55000. Indeed, benchmarking has indicated that critical importance should be attached to change management when implementing a new asset management approach given that the benefits of an enterprise-wide program will only be fully realized where it is universally adopted.

This issue needs to be considered alongside other key high level risks that could threaten the delivery of benefits envisaged under this initiative. In each case, a suggested action needs to be identified to mitigate the potential effect of these risks in the event that they do emerge. The table below provides an overview of these risks alongside the potential impact they could have and suggested mitigating actions.

Table 15: Risks

Category	Description	Probability	Impact	Suggested actions
Cultural change	During foundation operations staff that have worked for decades under the existing asset management approach may not understand the need for change or may be unable to transition to the new approach	High	High	<ul style="list-style-type: none"> Engagement with key staff immediately following Board approval to seek their views Extensive program of change management Assess best practice examples Link PPRs to asset management
Cultural change	During transformation other departments responsible for assets that have not traditionally been included in a formal asset management program may not fully understand the need for change and / or may be unable to transition to the new approach	High	Medium	<ul style="list-style-type: none"> Extensive program of NYPA-wide change management Use of KPIs from the performance regime to measure and demonstrate benefits of an enterprise-wide approach Identify best practice case studies that demonstrate benefits achieved by others

Resourcing	NYPAs are unable to secure required resources to support full implementation of the initiative due to the scarcity of required skills and capabilities	Medium	High	<ul style="list-style-type: none"> • Prioritize development of the organizational structure to enable recruitment to start • Engage the workforce planning team to develop a targeted recruitment / retention program • Develop targeted training to address any skills gaps identified
Observer perceptions	It may take time for benefits from implementation of the initiative to accrue leading to concerns, internally and externally, that the approach is not delivering in line with expectations	Medium	High	<ul style="list-style-type: none"> • Initiate a full program of internal and external engagement to manage expectations on benefit accrual • Identify case studies that demonstrate trends in the accrual of benefits under ISO 55000
Misinformed decisions	During roll out of the initiative asset management decisions may be taken which are then shown to be flawed which could impact the credibility of the approach	Medium	High	<ul style="list-style-type: none"> • Full staff training on new practices and data analysis • Full review of decisions made that is periodically revisited to monitor outcomes delivered • Reference to lessons learned from best practice case studies in initiative roll out
NERC CIP concerns	The increased collection and transfer of data could lead to greater risks associated with cyber security incidents	Medium	Medium	<ul style="list-style-type: none"> • Maintain engagement with the compliance team • Implement appropriate measures to protect data
Data ownership	Lack of clarity about the ownership of data and systems within the asset management organization could lead to inconsistencies or discrepancies in the data	Medium	Medium	<ul style="list-style-type: none"> • Develop a clear governance structure and defined roles and responsibilities for the asset management organization • Provide training to all members of the asset management organization on data ownership and roles and responsibilities.