high performance executive counsel

PROJECT TITAN

DISTRIBUTION ASSETS DUE DILIGENCE REVIEW

Report prepared for:

Jim Harbell, Stikeman Elliott
Mark Rodger, Borden Ladner Gervais
Robert Hull, Gowling Lafleur Henderson

VANRY + ASSOCIATES

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Vanry + Associates, Inc. (VAI) was engaged through Horizon Utilities, on behalf of counsel, to undertake an independent, third-party review in support of the due diligence process related to the potential merger of four Local Distribution Companies (LDCs). The four LDCs are: Enersource Hydro Mississauga (EHM), Horizon Utilities Corporation (Horizon), PowerStream Inc. (PS), and Hydro One Brampton Networks Inc. (HOBNI). The scope of the review was to evaluate the respective Asset Condition Assessment (ACA) methodologies and resulting capital investment planning processes, as well as to assess the overall asset health and subsequent 20-year investment for each of the four LDCs.

The review was conducted under a compressed time frame. VAI's proposal was accepted on May 8, 2015. The Non-disclosure agreement (NDA) necessary to enable VAI to have access to the LDCs' documentation to conduct the work was provided to VAI on May 13, 2015 and executed by both parties that same day. Horizon, on behalf of the LDCs, began uploading copies of the respective ACA reports as well as the distribution system plans (DSP) containing the capital investment plans to VAI's document storage on May 14, 2015. The final ACA was uploaded to the site on May 19, 2015.

VAI conducted in person interviews at each of the LDCs May 19, 2015 through May 21, 2015. During these interviews additional supporting documents were provided. The initial draft report was delivered May 22, 2015 for review by counsel.

The ACA practices at Horizon, HOBNI, and Enersource are generally well aligned. The approach at PowerStream is somewhat different, but consistent in the sense that it is a more advanced version of the same concept in use at the other three. There is no reason to believe that a merger would result in any major philosophical change of any of the ongoing renewal approaches. It is possible that applying the economic life methodology used at PowerStream to the assets at the other three utilities (and to PowerStream's cable program) would result in somewhat lower renewal spending, although this is hard to predict with certainty.

All four utilities are aligned in terms of pursuing minimum life-cycle cost as the basis for renewal spending. All are committed to a customer-focused business case approach to making spending decisions. This is important because it means that changes that come about from a possible merger of the asset management practices will tend to be improvement opportunities at the margin due to minor variations in expertise. The asset classes considered, the approach to condition assessment and failure projection, and the resulting capital spending recommendations are generally compatible.

There is a range of variation among the methodologies used by the four LDCs. In most cases the variation is due to differences in their stages of evolution in a particular area. One result of the variation is that there are a number of complementary strengths among the four LDCs. Where more than one LDC is using best practice methodologies or approaches, they are generally consistent though not necessarily the same.

In our review, we did not identify any aspects of an individual LDC's approach, or anything in the potential combination of LDC's that we would expect to result in dramatic changes in overall spending levels in a combined LDC. We do believe that certain approaches among the LDCs are sufficiently different that combining the four could lead to the potential for reductions in overall spending. We also see a distinct possibility that a merged LDC, adopting a common set of leading practices, could lead to the overall capital investment program being redistributed among the respective systems in proportions that are different than the current allocations. This is due in part from different assessments of criticality and in part in recognition of the current variations in system performance and failure rates among the four LDCs. In short a merged entity would expect to see funding flowing to the areas of greatest value, or greatest risk potential. We observed from the reports that the range of need among the systems varies sufficiently that spending might flow to the portions of the combined system with the greatest need.

The Asset Management philosophies among the four are consistent and generally well aligned. The skills and capabilities that we observed also appear to be complementary. Given that several of the AM organizations appear to be resource constrained, there is the potential for a combined LDC to be able to produce significantly better AM results through a combination of talent that has sufficient resources to address a broader scope of AM activities.

Each of the four LDCs has processes in place to address Renewal, Access and Service investments. The processes in use by the LDCs to assess and validate Access and Service investments are generally consistent, with minor variations. Each of the LDCs appears to have applied a sound set of standards and criteria to evaluating the Access and Service investments, including them in their optimization/prioritization processes. These investments are largely non-discretionary with limited latitude in timing. Given the levels of rigour and consistency within each of the LDCs with regard to these investments, we focused the majority of our findings and conclusions on those areas where differences exist and where insights may be gained for a merged entity.

The capital renewal spending plans at all four utilities are increasing based in part on the application of their ACA processes. This is consistent with industry experience: implementation of asset management helps utilities identify and justify the need for increased spending to renew aging infrastructure. All four utilities have applied sound judgment and methodologies to develop achievable plans to meet this need.

INTRODUCTION AND APPROACH

Vanry + Associates, Inc. (VAI) was engaged through Horizon Utilities to undertake an independent, third party review in support of the due diligence process related to the potential merger of four Local Distribution Companies (LDCs). The four LDCs are: Enersource Hydro Mississauga (EHM), Horizon Utilities Corporation (Horizon), PowerStream Inc. (PS), and Hydro One Brampton Networks Inc. (HOBNI). The scope of the review was to evaluate the respective Asset Condition Assessment (ACA) methodologies and resulting capital investment planning processes, as well as to assess the overall asset health and subsequent 20-year investment for each of the four LDCs.

The review was conducted under a compressed time frame. VAI's proposal was accepted on May 8, 2015. The Non-disclosure agreement (NDA) necessary to enable VAI to have access to the LDCs' documentation to conduct the work was provided to VAI on May 13, and executed by both parties that same day. Horizon, on behalf of the LDCs, began uploading copies of the respective ACA reports as well as the distribution system plans (DSP) containing the capital investment plans to VAI's document storage on May 14. The final ACA was uploaded to the site on May 19.

VAI conducted in person interviews at each of the LDCs May 19 through May 21. During these interviews additional supporting documents were provided. The initial draft report was delivered May 22, 2015 for review by counsel.

Summary of Approach

In undertaking the review, VAI applied a methodical approach consisting of:

1. document review
    a. ACA
    b. DSPs containing capital investment plans
    c. Other supporting documents provide by the LDCs
2. development of lines of inquiry specific to each LDC regarding their respective
    a. ACA
    b. DSP
        i. Capital investment planning including investment optimization or ranking
    c. AM processes and philosophies
    d. Resources and competencies related
3. interviews with the respective LDCs
    a. ensured that VAI has a clear and accurate understanding of the processes used by each of the LDCS,
    b. the ACA and capital investment planning process was investigated in sufficient detail to enable VAI to make meaningful assessments
4. review of additional supporting documents provided during the interview
5. generate observations and assessments for each LDC
6. generate comparisons of the processes and results produced by the LDCs

Based on the results of our reviews and discussions with the utility personnel, this report provides observations, assessments and conclusions regarding:

1. The development of ACAs and capital investment plans by each of the LDCs
2. The alignment of the methodologies employed by the LDCs with reference to:
    a. each other
    b. industry leading practice

Scope of Due Diligence Review

The scope of the review was a narrow band, high focus review. The following paragraphs provide more detail regarding what was included and excluded from the detailed scope of the review of the ACA and capital investment planning processes.

Asset Health Assessment Methodology Review Distribution and General Plant Assets

The scope of the review of the ACA methodology and results consisted of the following:

- Reviewed and compared the methodology used by each LDC's ACA to undertake a probable determination of remaining asset life against current methodologies employed by leading practitioners of asset management;
- Reviewed and compared the asset categories employed by each LDC in their respective ACAs;
- Developed assessments based on our review of the shared materials and our own professional experience, as to whether the asset categories identified by each LDC in their respective ACA adequately represent the assets health which could materially impact the total renewal investment;
- Compared the condition parameters utilized by each LDC in calculating asset health and the asset health distributions for each asset category; and
- Compared the assumptions used by each LDC to develop the failure curves for each asset category.

The following activities were specifically excluded from the scope for this phase:

- Validation of the raw data quality (accuracy and completeness) used in the ACA calculations;
- Validation or re-creation of the asset health calculations used to determine the asset health distributions and the 'flagged-for-action' values;
- Detailed calculations or detailed assessments regarding the impact of changes to the assumptions in any of the ACAs; and
- Analysis of and/or development of combined ACAs for the potential merged entity.

Capital Investment Review

The LDCs also required an assessment of the appropriateness of the proposed renewal investment of each LDC given the results of their ACAs. System Access and System Service historical expenditures, known projects, and project prioritization methodologies were investigated for this review.

The detailed scope for this task consisted of:

1. Interviews with the relevant participants that developed the capital investment plans identified in the DSPs and/or AMPs.
    a. We spoke with at least one representative from each of the utilities and spent a half day discussing:
        i. Assumptions and approaches to translating corporate objectives into ACA inputs and performance outcomes;
        ii. Methodologies for translation of ACA into capital investment plans;
        iii. Assumptions used in both the ACA and in the capital investment plans including those related to constraints on spending, systems and resources; and
        iv. Other questions that surfaced during our review of the ACA.
2. A review of existing supporting documentation utilized in the development of each of the investment plans. We received what we understand to be each LDCs foundational documentation and defined methodologies for developing capital investment plans;
3. Using our experience in Asset Management and work with other utilities we undertook reasonability test and assessment of the planned outcomes (such as future asset conditions) contained in each of the plans, based on information provided by the LDCs; and

4. Validation of the assumptions (such as capacity constraints) used to tailor the optimal investment profile identified in each of the ACAs, based on the information and fact base supplied by the LDCs in their documentation and through our discussions with utility personnel.

The following activities are specifically excluded from the Scope of Work for this phase:

- Re-engineering the process used to develop the proposed investment plan;
- Providing an opinion of the appropriateness of corporate and business units' strategic and tactical targets; and
- Reviewing the content and completeness of the DSP and/or AMP.

OBSERVATIONS AND ASSESSMENTS

In preparing our findings we adopted a format that we believe will enable a ready comparison between the four LDCs. While each of them demonstrates areas of strength, there are opportunities for each of the four to learn from and support the others.

Three of the four companies use the same external consultant for either conducting or auditing their ACAs. PowerStream had previously used the same consultant but has since moved the work in-house and has engaged with other consultants to provide input into its ACA process. References to the external consultant in the paragraphs below are to the consultant used by Enersource, Horizon and HOBNI.

PowerStream

The VAI consultant (Stewart Ramsay) met in person with PowerStream on May 19 to review the ACA and DSP materials that PowerStream provided and to address specific questions VAI had regarding the ACA process, methodology and its use in developing the capital investment plans. We noted that PowerStream transitioned away from external consultants to prepare the ACA. It currently prepares the ACA internally using its own staff, though it may rely on external expertise in support of components of the ACA.

For PowerStream, the meeting was attended by:

- Irv Klajman, Director, Asset Investment Planning
- Riaz Shaikh, Manager, System Planning
- Phil Dubeski, Manager, Asset Planning and Agreements
- Shelly Cunningham, SVP, Engineering Services

The meeting was productive and provided VAI with greater clarity around the process, the data elements used, the respective roles of different parts of the PowerStream organization in the development of the ACA, and most importantly an understanding of how the ACA results are used in the identification and development of capital investments.

Our observations and assessments are summarized, by topic, in the following paragraphs.

POWERSTREAM ACA ASSET CATEGORIES

Transformers • Distribution • TS • MS
Circuit Breaker
Distribution Switchgear
Switches • Mini-Rupter • Automated • 230 kV • MS Primary
Station • Capacitor • Reactor
Wood Poles
Underground Primary Cable
New Stations ACA programs have been added for: • Station Service Transformer • 230kV Primary Metering Unit • TS DC Systems • TS Protection and Control System

ACA

1. **Asset Categories**

   PowerStream uses internal personnel for the development of the ACA. Data is provided by a combination of internal resources and testing contractors.

   The determination of Asset Categories is based on the historical work done; and has been added to over the last few years to address the observed need to separate asset types into more distinct sub-groups based on the uniqueness of factors that affect end of life. PowerStream's ACA is focused on the Asset Categories identified in the table to the right.

   Assets are generally well subdivided for Health Indexing purposes; some multipliers are included (e.g. tap-changer, non-TR XLPE cable). Further stratification may be beneficial to zero in on the highest-risk sub-populations. For instance, currently PowerStream treats poles as a homogeneous asset group. They have also acknowledged that the risk/replacement cost trade off for a 100-ft pole is different than for a 40-ft pole. We would expect that over time

PowerStream would move to separate these two into sub-classes.

Our view is that PowerStream evaluates a large and growing number of assets. Presumed run to fail assets (e.g., single-phase, pole-mount transformers) are evaluated in order to justify the run-to-failure strategy.

Three-phase pole mount transformers are not treated as run to fail. PowerStream has observed that the predominant failure cause for these assets is overloading. As a result PowerStream is proactive in replacing these transformers when they are approaching their loading limits as they are expensive and can be used in other areas of the system. This type of proactive replacement, or relocation/redeployment is consistent with best practice Asset Management.

PowerStream has identified additional assets to be added to the ACA or to be further subdivided in the ACA. This decision appears to be based on both emergent failure issues and as part of a plan for proactive expansion of the ACA process. PowerStream acknowledges that there could be value in the continued expansion of the ACA to other asset types.

The level of rigour applied is consistent across all classes with the exception of underground cable, which uses a prioritization index rather than the economic life approach. PowerStream is working to expand the list of assets included in the economic life type ACA analysis. We see this as a positive step that will improve the results for PowerStream.

Protective relays and communication systems are not evaluated in PowerStream's ACA. This is inconsistent with better performing utilities as these assets are often high-value, high risk impact assets.

a. Impact on renewal investment plans

   For PowerStream, as is the case with most utilities, the somewhat limited detailed stratification to identify specific problem types or highly critical assets makes planning difficult. It tends to limit the ability to undertake more meaningful "bottoms-up" cost assessments which leads to a top-down spending cap approach to estimating spending need.

   PowerStream is conscious in undertaking a clear bottoms-up as well as a top-down approach to system investment analysis.

   Limited ability to do more detailed and predictable scenarios on asset failure related spending can become problematic. PowerStream has done good work in its ACA, advancing to more accurate approaches and is clearly leveraging the value of that work in the development and influence of its investment plans. We believe that further work in this area on both granularity of assets and asset HI data will enable PowerStream to increase the predictability and accuracy of its asset failures, as well as accurately predict impacts on system performance resulting from any given investment or renewal plan.

   PowerStream does undertake a review of ACA results against recent performance by asset category to validate the results of the ACA. This is consistent with best practice. PowerStream acknowledges that it is seeing evidence for the need for additional stratification within asset groups to allow it to refine its failure rate analysis. This is based on failures of sub-components within its existing asset groups. This is a normal progression and indicative of best practice approaches.

   There is the potential that the results of the ACA, to the extent they are not fully accurate, are pointing to somewhat less optimal renewal investment profiles. We recognize that this is also a common characteristic of utilities that have embarked on the HI and ACA path and are continuing to refine and improve their HI and ACA through better data and greater stratification. PowerStream's ACA results and the impact that they have on the investment plans are significantly better than the results it was able to produce in prior years and it

continues to improve the quality of the ACA and its ability to use the results to create well informed investment programs.

2. Condition Parameters

The condition parameters have been developed and evolved in a joint effort between consultant teams and PowerStream. This is a best practice approach which provides PowerStream with insights from consultants that may have a larger view of the industry and issues that others are facing. Moreover, it creates the opportunity for knowledge transfer from the consultants to the PowerStream team. The formulations appear to be complete and are consistent with what we would expect to see within leading utilities.

PowerStream's asset condition data for stations assets, switches, and switchgear are stored mainly in the Cascade tool. Data for the remainder of the assets are stored in GIS or Excel. PowerStream is investigating ways to automate the link between their databases and ACA which would enable regular and routine updates of asset Health Indices based on most recent inspection and test results. This, combined with running the ACA in house, is a best practice approach. In contrast to an annual ACA process, this approach enables PowerStream to see the impacts of sudden or significant changes in asset condition on its current investment plans and its current resources.

The condition parameters used by PowerStream and the data that it collects in support of those parameters are within normal range for best practice, especially for stations' assets such as transformers and breakers where testing and inspection data are available.

Health Indices are not calculated for assets with limited or no condition data (cable); this is appropriate.

We did not inquire with PowerStream regarding its standards for determining if it had a valid HI or if there are standards within PowerStream for determining required data availability or minimum data needed for valid HI calculation. We did observe that PowerStream does not do an HI calculation where it does not have available condition data.

Non-condition-related parameters such as age and obsolescence are generally excluded from the formulations. Obsolescence is handled as a factor in consequence of failure or cost of maintenance. Both of these are consistent with best practice approaches.

CAPITAL INVESTMENT PLANS

1. Assumptions and Approach

ACA is the primary driver for renewal investments, which PowerStream bases on assets at end of economic life.

Assets not evaluated in the ACA are replaced based on inspection criteria. PowerStream applies a standardized approach to ensure consistent recommendations across inspection contractors, including: definitions, pictures, etc. PowerStream audits a percentage of the inspection reports. PowerStream has also separated the inspection work from the execution of the work. As a result those doing inspections have no vested interest in the volume of replacement work identified by the inspections.

Justification is based on a business case process, which includes estimates of customer outage risk. Other parameters such as safety are considered qualitatively. This method is not applied comprehensively, presumably only in cases where the ACA model can provide risk values.

Planning and AM work closely together to coordinate projects so that system expansion and investments generated by other drivers (road widening, etc.) are leveraged to incorporate or optimize assets identified in the ACA as in need of replacement.

2. ACA Translation

"End of economic life" assets are the basis for spending renewal levels. The underground cable program is based on a prioritization method, assuming that all cables must be replaced or injected (a form of life extension or failure prevention that can be done only prior to a certain level of degradation) as they age. PowerStream uses the benefit/cost analysis from its ACA as an input into the cable replace/inject decisions.

Health Index is used to adjust effective age in cases where the health is lower than expected given the age of the asset.

End of life programs are reviewed by SMEs for reasonableness and smoothed to manage resources and spending. For instance, ACA identifies 700 pad mount switchgear at end of life, but the annual replacement program is much smaller. This is based on a combination of capital and resource constraints. The post-ACA adjustments are based on inspection results which provide PowerStream with further granularity and prioritization of end of life assets.

PowerStream is able to compare capital and corrective maintenance spending, modeled as part of the risk of failure, in their trade-off between replacing and not replacing (i.e. "Based on our current maintenance regime, when should the asset be replaced?"). PowerStream does not yet routinely evaluate the cost/benefit trade-off of increasing or decreasing their maintenance program (i.e. "If we increased maintenance, could we cost-effectively make the asset last longer?").

Proposed programs are scored for risk and value using a standardized approach. Staff were recently trained to ensure consistent scoring is applied across attributes and among the different proponents. PowerStream has a manager level person dedicated to ensuring consistency in the understanding and the application of the scoring criteria.

3. Constraint Analysis

Programs are smoothed to manage resource and spending impacts. As mentioned above PowerStream relies on inspection data and other fact based decision support in setting the priorities in smoothing. This is consistent with better performing utilities and has been received well by the OEB when presented by PowerStream and by other utilities in the province.

As with most utilities there is a category of spending that is "mandatory". These must-do projects are identified as such in the prioritization process. PowerStream appears to apply similar clear standards and rigour to defining and screening mandatory spending as to those used in scoring projects on value and risk. The lack of such standards is an issue for many utilities. Loose definitions result in large percentages of their overall spending being deemed mandatory. This is not the case with PowerStream and its mandatory spending levels are in keeping with what we would expect to see for Ontario. PowerStream's application of the mandatory filtering criteria is a best practice approach.

4. Reasonability Testing

We observed a significant amount of reasonability testing within the PowerStream processes. In addition to the quantitative analysis, there is a subjective review by AM team and SMEs. To the extent that the results of the quantitative analysis do not align with the SME's views or expectations, PowerStream undertakes additional analysis until there is a reconciliation. The results of that reconciliation are used to either improve the quantitative analysis or help expand the understanding of the AM and SME team.

Costs and benefits to determine end of life are explicitly evaluated from the customers' perspective. This step depends on assumed outage costs, which is an opportunity for future improvement for PowerStream. Given the nature of regulation and pricing in the province it may be an opportunity for PowerStream to work with other utilities to develop consistent values for all of the GTA in coordination with Toronto Hydro, which is currently undertaking a customer survey.

5. Optimal Investment Profile

PowerStream has been using multivariate optimization analysis for a number of years. It explicitly examines and scores the value of the investment across the range of corporate objectives. It also explicitly scores the investment with respect to the risk to the business (including personnel and public) if the investment is not undertaken. Our understanding is that PowerStream does the optimization for all capital investments within the organization.

The optimization methodology is consistent with best practice. However, best practice utilities apply the approach to both capital and OMA. Doing so ensures that, for example, capital for breaker replacement is being evaluated against maintenance for tree trimming. This helps to drive expenditures to the greatest value area for the business and the customers.

PowerStream is investigating new decision support tools that would enable it to integrate the ACA results into the optimization analysis. This would be a leading practice.

RESULTING EXPENDITURE LEVELS

The approach used by PowerStream may result in lower replacement rates for station assets compared with the other three utilities. For instance, PowerStream has a population of 71 station transformers, none of which is due for replacement in the next 20 years. By contrast, HOBNI's ACA recommends replacement of six station transformers in the next 20 years (three immediately) from a population of only 20. While these variations could be due to differences in actual condition of the assets, we believe that the refinements that PowerStream has made over the last several years, since it took over the ACA process, have helped it fine tune its spending needs.

PowerStream does have a large cable replacement/ remediation program based on assumptions regarding asset end of life age. PowerStream believes that its analysis supports a strong correlation between age and replacement timing.

Overall we believe that the expenditure levels resulting from the ACA and capital investment process are the result of a good process. PowerStream has applied many best practices in its processes and the expenditure levels appear to be consistent with what we would expect they need to be.

BEST PRACTICE ASSESSMENT

One of the requests made of VAI was to undertake an assessment of each of the LDCs against best practices in the areas of ACA (HI) and capital investment planning. The following table provides a summary of the assessments that we have made for PowerStream. In undertaking the assessment we have used a set of criteria that we believe represent best practice performance in the areas of ACA and investment optimization. The criterion and their definitions as well as our observations of PowerStream against each is included in the table below.

CRITERION DEFINITION	VAI ASSESSMENT: POWERSTREAM
Determining End of Life Assets at end of life are identified according to a systematic approach, balancing the cost of continued operation against the cost of replacement to minimize life-cycle cost of ownership. Other interventions (e.g. refurbishment) are considered.	End of life is determined using an economic life model as part of the ACA. Not all assets are modeled this way yet, so other means are used to fill in the gap, (e.g. prediction of failure rate health assessment). Run-to-fail strategies have supporting analysis.

CRITERION DEFINITION (CONT'D)	VAI ASSESSMENT: POWERSTREAM (CONT'D)
Business Case Spending recommendations have an accompanying business case that summarizes the problem statement, compares alternatives, and makes a recommendation. All costs and benefits are also quantified from the customers' perspective; alternatives including the do-nothing alternative are considered; assumptions are stated explicitly and quantitatively.	Cost/benefit analysis including customer costs performed for programs based on ACA economic models. For assets not modeled in detail, business case includes a narrative description of benefits. Prioritization scoring method used to compare projects. Benefits of projects are scored in this way, but are not explicitly compared with costs. Many business cases are narrative-based. Do-nothing is explicitly stated as an alternative. Other alternatives may be described and evaluated for comparison. Alternatives to replacement are considered by the SMEs on an asset-by-asset basis for modeled assets (station transformers, breakers, cables) and programmatically for dispersed assets. Benefits and risks are based on customer values (e.g. safety, reliability, environmental).
Long-Range Projections Aging asset populations include a projection of future spending needs based on expected future degradation and risk.	Long-range projections are provided in the ACA, based on the life-cycle cost analysis for each asset class. These are incorporated into the long-range spending plan.
Prioritization/Optimization Across Programs Spending on replacement, refurbishment, maintenance, and other options is directly compared in equal terms to optimize spending plans and to prioritize across programs. Capital and OMA expenditures are optimized in the same process using the same or comparable criteria.	Prioritization process compares spending across assets in equal terms based on the standard scoring scale. Renewal programs should be evaluated in ACA and prioritized in the value model based on the same assumptions for quantifying risk and value. For example, asset criticality should be quantified in terms of its effects on the prioritization parameters. (Alternatively, prioritization parameters could be adjusted to reflect the estimated customer costs in the ACA.) This will foster consistency, simplify scoring, and help ensure "apples-to-apples" comparisons.
Use of Subject Matter Experts (SME) Tacit knowledge of subject-matter experts is incorporated into the assessment process. Attention is focused on their areas of expertise (e.g. how best to assess condition) as opposed to complex questions outside it (e.g. how many transformers should we replace each year). SME input is documented explicitly for review and improvement over time.	Internal SMEs reviewed, modified, and approved the Health Index formulations and failure scenarios.

CRITERION DEFINITION (CONT'D)	VAI ASSESSMENT: POWERSTREAM (CONT'D)
Risk Assessment Asset risk is quantified in terms of actual failure probability and expected consequence cost of failure in terms that can be used in business cases and the budgeting process. Risk is included in business cases both as a benefit of spending (e.g., avoided risk) and as part of the cost of the work (e.g., risk of cost overrun).	Failure probability is an estimate of actual failure, which has been calibrated to even recent failure history or industry-standard data. Consequences of failure are quantified for the asset classes modeled. They are based on estimated actual customer costs but not yet calibrated with the prioritization model. Avoided risk is explicitly included in the business case where available. Not explicitly calculated for the cable program.
Condition Assessment Asset conditions are assessed relative to end-of-life failure criteria (i.e. Health Index). Health Index includes relevant parameters for predicting failure based on known degradation processes, and excludes other factors such as those related to criticality or obsolescence. Age is not included as a condition criterion.	Health Indices are based on major degradation processes and end of life criteria. The formulations are generally within the range of best practice, although recent improvements in the industry (e.g. multiplicative formulation) have not been applied. PowerStream has a strong testing and inspection program with good data availability. The multiplicative approach to health indexing is in contrast to the additive approach used by all four utilities in this review. It is a recent industry innovation wherein condition parameters are multiplied together rather than added. It avoids some of the common problems: "masking," where a bad test result is hidden amid several good ones, and validity, where there are not enough data available to calculate a valid health index. Age is excluded from most formulations. Factors related to obsolescence or consequences (e.g. oil circuit breakers, PCB transformers) are excluded from the formulations.
Failure Probability The meaning of failure is clearly defined and consistently applied (e.g. end-of-life failure events that require replacement). The likelihood of failure is determined based on condition, age, and historical data.	Definition of "failure" is clearly stated as failure scenarios. Failure probability is estimated based on correlations between age and failure rate, adjusted by Health Index.
Consequences of Failure (Asset Criticality) Failure consequences are monetized and related directly back to the customer as an outage cost or willingness-to-pay social cost. Consequence costs are intended to reflect the perceived cost to the customer. For example, how much would a ratepayer be willing to pay on a monthly basis to reduce or avoid power outage events? Where appropriate, multiple failure scenarios are considered and weighted according to their relative likelihoods.	Consequences of failure are monetized from customers' perspective and are expressed in terms that can be used in decision-making outside the ACA, e.g. prioritization and business cases. Multiple failure scenarios are explicitly considered.

CRITERION DEFINITION (CONT'D)	VAI ASSESSMENT: POWERSTREAM (CONT'D)
Processes Documentation Work flow processes are documented for significant tasks within the organization. The roles and responsibilities of each individual are documented and reviewed on a regular basis. The required flow of data to support asset management is documented. This includes data collection and storage, data requirements for program development, and data requirements for project justification and prioritization in the budgeting process.	ACA is performed in-house, therefore the ACA report and DSP summarize the process. Data requirements are documented in the ACA, e.g. test and inspection results for calculating health. Most needed criticality data is contained in Cascade. Project development using the outputs of the ACA is somewhat subjective and probably difficult to systematize. PowerStream is relying on sound engineering judgment to turn the raw results of the ACA into executable programs. A more rigorous cost/benefit approach, leveraging the economic life tools in the ACA, is possible and may strengthen the results.

OTHER OBSERVATIONS RELATIVE TO ASSET MANAGEMENT

In many instances we see that PowerStream is near the front of best practice, and it fully acknowledges that it is still working and still needs to improve other aspects of its processes.

PowerStream has a clear focus on renewal spending to provide value to customers, as opposed to a more technical approach focused on the assets. The result is that PowerStream is comfortable not replacing old station assets if they don't carry a lot of risk and if the cost of replacing those stations would take resources away from higher value, higher impact investments.

PowerStream does have areas that it should focus on improving. These include:

- Continuing to strengthen its approach used for the cable program, which is a large line item, by applying the economic life approach that it uses to assess other assets;
- Assumed values for customer outage cost could be improved through customer survey, independent study, coordination with local peers, or by using the same values used in the project prioritization method (so ACA projects are identified and justified in the same terms they are prioritized for budgeting). PowerStream participated in a CEATI study that may be a good source of information once it is published; and
- Expanding the number of asset categories and sub-categories that are explicitly studied in the ACA.

Horizon Utilities

VAI consultants (Stewart Ramsay and Darin Johnson) met in person with Horizon Utilities on May 20, 2015 to review the ACA and DSP materials that HU had provided, and to address specific questions VAI had regarding the ACA process, methodology and its use in developing the capital investment plans. We noted that Horizon uses an external consultant to prepare the ACA based on input from Horizon.

The meeting was attended by Jim Butler, Director, Engineering & Operating for Horizon.

The meeting was productive and provided VAI with greater clarity around the process, the data elements used, the respective roles of Horizon and its consultant in the development of the ACA, and most importantly an understanding of how the ACA results are used in the identification and development of capital investments.

Our observations and assessments are summarized by topic in the following paragraphs.

ACA

1. Asset Categories

Horizon uses an external consultant for the development of the ACA. Horizon provides the input data, but relies heavily on the external consultant for the calculations and the methodology.

The determination of Asset Categories is done in collaboration with the consultant based on the combined experience of Horizon and the consultant, as well as Horizon's knowledge of assets that have significant financial or reliability impact on the system. Horizon's ACA is focused on the Asset Categories identified in the table to the right.

HORIZON UTILITIES ACA ASSET CATEGORIES
Transformers • Substation • Pole Mounted • Pad Mounted • Vault
Substation Circuit Breakers
Substation Switchgear
Overhead Conductors
Switches • Overhead Line • Submersible Load Break
Poles • Wood • Concrete
Underground Cables
Utility Chambers
Vaults

Within the main asset categories in the Horizon ACA some assets are further subdivided, e.g. circuit breakers broken into air and oil for Health Index (HI) purposes; cable split into XLPE, PILC, and secondary. This is in recognition that the HI factors for these asset types differ sufficiently from one another that they require distinct analysis and review. This is a positive practice, consistent with better performing utilities. For Horizon this stratification is limited and has been based on its experience with specific sub-groups of assets that have been problematic, "a few bad-actors". Further stratification may be beneficial such as tap-changers, type-U bushings, etc.

When examining Horizon's ACA process, in industry terms, Horizon assesses a large number of assets. We do note that the level of rigour and detail drops off after the most critical assets. This is not unusual and is common among utilities that have recently begun using Health Indices and Condition Assessment. From our discussions with Horizon, it appears that Horizon expects to continue to increase the rigour and data collection for these sub-categories as well as add new categories to improve the granularity of its assessments. Our understanding is that Horizon does not have a plan for targeting specific assets but does expect to make these additions to the ACA based on seeing significant anomalies or variations in the ACA results. This is also a common practice, though leading utilities tend to have a more deliberate approach to looking for and assessing the next level of detail for the HI and ACA.

Protective relays and communication systems are not evaluated in Horizon's ACA. This is inconsistent with better performing utilities as these assets are often high-value, high-risk impact assets.

a. Impact on renewal investment plans

For most utilities, and in our view this holds for Horizon, the somewhat limited detailed stratification to identify specific problem types or highly critical assets, makes planning difficult. It tends to limit the ability to undertake more meaningful "bottoms-up" cost assessments which leads to a top-down spending cap approach to estimating spending need. The limited ability to do more detailed and predictable scenarios on asset failure related spending can become problematic. Horizon has done good work in its ACA and it is clearly leveraging the value of that work in the development and influence of its investment plans. We believe that further work in this area on both granularity of assets and asset HI data would enable Horizon to increase the predictability and accuracy of its asset failures, as well as accurately predict impacts on system performance resulting from any given investment or renewal plan. This would tend to improve the quality and transparency of the renewal and investment plans overall and increase credibility with the OEB and interveners in rate proceedings.

Horizon does not undertake a routine review of ACA results against recent performance by asset category to validate the results of the ACA. This is inconsistent with best practice. Horizon has recognized the need for this on certain asset types, particularly where data is limited. It has not, however instituted this as a standard check. There is the potential that the results of the ACA, to the extent they are not fully accurate, are pointing to somewhat less optimal renewal investment profiles. We recognize that this is also a common characteristic of utilities that have embarked on the HI and ACA path. That Horizon has not yet begun this check as a standard process is not a particular concern, provided that it has plans to continue in that direction. Horizon's ACA results and the impact that they have on the investment plans are significantly better than the results it was able to produce prior to 2012.

2. Condition Parameters

Based on our review of the ACA and our discussions with Horizon we understand that the condition parameters were proposed by the external consulting firm and reviewed and approved by SMEs within Horizon. We also note that Horizon moved to the HI based ACA in 2012 and changed external consultants at that time. Prior to 2012 Horizon was working with a consultant that used an age based approach to conducting ACAs.

The condition data is collected, reviewed and provided to the external consultant by Horizon. Some of the condition data appears to be collected by Horizon's testing contractors, which is fully consistent with best practice.

Condition parameters are generally within normal range for best practice, especially for stations' assets such as transformers and breakers where testing and inspection data are available.

Age continues to be included as a significant parameter in many of the HI formulations. In our view, this is a debatable practice. It is by no means a fatal flaw. We do see age as being a useful parameter:

- If no condition data are available then age is the proxy for condition, though generally a poor proxy;
- Age is a minor parameter when better data are available;
- HI methodology is focused on "effective age" (when properly done), so factoring in calendar age is necessary at some point; and
- Where test data show continued strong correlation between age and condition, many better performing utilities would reduce the costs of testing for that particular asset and rely more heavily on age.

Within the Horizon ACA, for some assets age is the only parameter, e.g. concrete poles. While we accept that this is the proxy for condition we do not believe that it is appropriate for it to be considered as

a Health Index. Doing so could mask findings in a way that would limit the interpretation of the results and potentially skew spending or investment decisions.

Horizon considers a Health Index "valid" as long as age data is available. In our view Horizon does not apply a best practice threshold for data availability in determining if it has a valid Health Index. This is not consistent with best practice. This is reasonable for the effective age calculation and as a proxy for condition, but not as a Health Index. Best practice utilities apply a level of rigour to determining the point at which they have a valid HI and differentiate between valid and incomplete HI and condition assessments. This supports their process in ensuring that the impacts of incomplete data are transparent and that making comparisons between assets with valid HI and those without valid HI are done with full understanding of the variation in accuracy. This ensures that assessments based on incomplete, not valid, HI are not biasing the investment decisions.

CAPITAL INVESTMENT PLANS

1. Assumptions and Approach

Life-cycle optimization of asset investments is the stated objective of Horizon's Capital Investment Plans. For Horizon, ACA is the primary driver for renewal investments. The ACA feeds the renewal plans via the "flagged for action" plan. Horizon is confident in the ACA approach in part due to a review of the ACA by third party (KPMG), who reviewed the plan and input parameters and identified adjustments and insights for Horizon based on its knowledge and experience with other utilities and with ACA.

Specific projects are identified through planning processes and scored for prioritization on a 1-5 according to drivers: safety, security, customer impact, regulatory/statutory and environmental. Horizon acknowledges that its prioritization process is limited and does not lend itself to the level of optimization that it has targeted. Horizon appears to have a sound understanding of the gaps between its current approach and where it believes it needs to be with respect to best practice optimization. Horizon is working to incorporate an updated value and risk model, and has begun investigating decision support tools such as Copperleaf, that it believes would enable it to improve the ability to test its inputs and assumptions. Horizon does not currently undertake routine scenario analysis or stress testing on its drivers. Nor does it appear to test the impact of HI parameters on the assets that would be flagged for action and thus be candidates for inclusion in the investment or renewal plans.

Horizon prepares business cases supporting projects and investments. These are used as a primary in the prioritization/ scoring and appear to be consistent with OEB requirements.

2. ACA Translation

In the development of the capital investment plans, it appears that "Flagged for action" assets are a significant driver of the renewal plans as well as the overall spending levels. We believe that Horizon is making renewal investment decisions based on both proactive and reactive spending expectations.

For those assets where the spending is proactive, the cumulative probability of failure (based on Health Index) times criticality index is the basis for identifying assets in need of replacement. For some proactive assets, the criticality is assumed to be the same for each asset, which is effectively a spending program based on health only.

For those assets where the spending is reactive, replacement rates are based on estimated probability of failure per ACA. We note that these failure rates are not calibrated to recent experience and thus may not be as accurate a predictor of spending needs as possible.

ACA results guide Horizon to areas of high risk. Horizon does not simply take the ACA results and convert them to investment plans. Horizon reviews the ACA results, particularly with respect to risk, and identifies assets that represent a risk and regions within their system with concentrations of mid-to-high probability of failure assets, or sub-classes of assets. This is a highly useful and best practice

approach to interpretation of the ACA and generates insight for incorporation into optimal investment plans.

We observed specific cases where Horizon has been taking the ACA results and applying insight and engineering judgment. For instance, the cable replacement *amount* contained in the investment plan is based on the ACA results. The *location* of the investment is based on system performance and other factors. Horizon has used the ACA results and its knowledge and insight to focus on Hamilton Mountain where outage consequences are highest.

In a similar vein:

- Horizon does not simply apply the ACA results to determine spending. Horizon takes the ACA results and explores alternative interventions, e.g. refurbishment. It uses the ACA results to guide this work at the planning stage.
- Proactive programs for specific assets (station transformers, breakers) are evaluated according to long-range plans for the stations. For instance, 4kV/8kV stations that are slated for retirement are not good candidates for large capital investment, regardless of the ACA results.

Spending programs, many of which have been underway for years, are attributed to ACA recommendations. For instance, refurbishment of 4kV/8kV overhead is considered part of the wood pole renewal program. This use of the ACA to help guide investment and find opportunities for economies of scale in matching short term and mid-term system needs result in lower overall spending for a given system performance level.

3. Constraint Analysis

Within Horizon we did not see much evidence that constraints were resulting in potential risks to system performance or the ability to undertake renewal programs. As with most utilities there is a category of spending that is "mandatory". These must-do projects are identified as such in the prioritization process. Horizon appears to have applied clear standards and solid rigour to defining and screening mandatory spending. This is an issue for many utilities. Loose definitions of mandatory result in large percentages of their overall spending being deemed mandatory. This is not the case with Horizon and its mandatory spending levels are in keeping with what we would expect to see for Ontario. Horizon's application of the mandatory filtering criteria is a best practice approach.

In our discussions with Horizon, and our review of the investment programs, it does not appear that renewal programs are compromised by lack of funding or resources except during the initial ramp-up, Horizon is fully aware of constraints on resource and capital in the near term, as well as the need to manage rate impacts to customers, which is the purpose of the ramp-up period.

Horizon does understand both the financial constraints that it has as a business as well as resource constraints though neither has been a factor that has compromised the decisions that it otherwise would have made.

4. Reasonability Testing

Horizon has used the ACA to validate its decisions regarding plans for renewal. Many of these plans were longer term plans that were developed prior to 2012. Horizon's SMEs review the ACA results and, as discussed previously, use their knowledge and expertise to interpret the results and develop plans that are informed by the ACA but not dictated by it. Horizon also engages in informal discussions with peer utilities to check and validate what it is seeing from its ACA as compared to the experience of other utilities.

Horizon has recognized that the current method of undertaking the ACA does not fully support an assessment of the ramp-up period to manage resources and rates: ACA does not directly support "smoothing" or prioritization when spending needs exceed resources, whereas some approaches to ACA, with more advanced cost/benefit assessment, support prioritization and smoothing directly. The SMEs are utilized to support this translation and apply reasonability. Future improvements in the

ACA should be geared toward supporting results that are more closely aligned with the SME knowledge and insights.

There are some areas where Horizon should look to improve its ACA process in the short term. Of higher importance is the need to test the sensitivity to changed assumptions in ACA, especially failure probability and criticality. This will help Horizon identify areas where better data is more critical and it will enable Horizon to better scenario test its ACA results as it finds changes in failure rates from those predicted. A second area for focus would be the reconciliation of the ACA predictions against recent historical results as well as future trends. A third area that does not appear to be considered in the ACA or the translation into the investment plan is the estimation or quantification of cost/benefit from the customers' perspective. Is this spending really worth it? To some degree this is handled in the assessment of the impact of the investment plans on rates but there is no method for assessing the impact of the individual investment other than its cost impact in the overall investment plan.

5. **Optimal Investment Profile**

   As discussed above, Horizon's ability to identify optimal investment profiles has been improving over the last several years. The process that it uses for ranking and prioritizing investments is common in the industry and is a natural step in the evolution towards true optimization based on value and risk.

RESULTING EXPENDITURE LEVELS

Review of the Horizon ACA reveals the need to spend nearly $700 million in renewal over 20 years. Planned investments will match this level after an initial ramp-up period. There is a large ramp up in cable remediation and replacement from about $1 million/year to about $10 million/year. There are large expenditures indicated for line transformers and wood poles. The assets are currently treated as largely run-to-failure (even if failure means identified as "failed" in an inspection). These programs should be calibrated to recent experience; this process is underway internally.

Horizon has estimated the cost premium for reactive work relative to planned, and is factoring it into decision making. This is consistent with best practice.

BEST PRACTICE ASSESSMENT

One of the requests made of VAI was to undertake an assessment of each of the LDCs against best practices in the areas of ACA (HI) and capital investment planning. The following table provides a summary of the assessments that we have made for Horizon. In undertaking the assessment we have used a set of criteria that we believe represent best practice performance in the areas of ACA and investment optimization. The criterion and their definitions as well as our observations of Horizon against each is included in the table below.

CRITERION DEFINITION	VAI ASSESSMENT: HORIZON UTILITIES
Determining End of Life Assets at end of life are identified according to a systematic approach, balancing the cost of continued operation against the cost of replacement to minimize life-cycle cost of ownership. Other interventions, e.g. refurbishment, are considered.	Proactive assets (stations): end of life is determined based on estimated failure probability and subjective (though consistent) measures of consequence. Cost of intervention is not considered. Proactive assets (lines): end of life is determined based on estimated failure probability and a single assumed criticality applied to each asset. Cost of intervention is not considered. Reactive assets: assumed run-to-failure due to perceived low criticality. No business cases back-up these strategies.

CRITERION DEFINITION (CONT'D)	VAI ASSESSMENT: HORIZON UTILITIES (CONT'D)
Business Case Spending recommendations have an accompanying business case that summarizes the problem statement, compares alternatives, and makes a recommendation. All costs and benefits are quantified from the customers' perspective; alternatives including the do-nothing alternative are considered; assumptions are stated explicitly and quantitatively.	Business cases are based on OEB filing requirements and the prioritization scoring method used by Horizon. Benefits of project are scored in this way, but are not explicitly compared with costs. Do-nothing is the unstated alternative. Other alternatives may be described but not evaluated for comparison Benefits and risks are based on customer values (e.g., safety, reliability, environmental).
Long-Range Projections Aging asset populations include a projection of future spending needs based on expected future degradation and risk.	Long-range projections are provided in the ACA, based on the assumed replacement strategies for each asset class. These are incorporated into the long-range spending plan.
Prioritization/Optimization Across Programs Spending on replacement, refurbishment, maintenance, and other options are directly compared in equal terms to optimize spending plans and to prioritize across programs. Capital and OMA expenditures are optimized in the same process using the same or comparable criteria.	Prioritization process compares spending across assets in equal terms based on the standard scoring scale. The ACA includes an estimate of risk for some "proactive" asset classes, where risk is probability of failure times expected consequence of failure. The prioritization model also includes an assessment of risk, but the assumptions do not appear to be consistent. Ideally, the way a spending option is scored in ACA should translate directly into the business case and the prioritization model. This will simplify scoring and help ensure "apples-to-apples" comparisons.
Use of Subject Matter Experts (SME) Tacit knowledge of subject-matter experts is incorporated into the assessment process. Attention is focused on their areas of expertise (e.g. how best to assess condition) as opposed to complex questions outside it (e.g. how many transformers should we replace each year). SME input is documented explicitly for review and improvement over time.	Internal SMEs review, modify, and approve the Health Index formulations. Their expertise is the basis for evaluating alternative interventions. Subject-matter expertise should be applied to failure probability estimates, consequence costs, and other technical input assumptions in the ACA.
Risk Assessment Asset risk is quantified in terms of actual failure probability and expected consequence cost of failure in terms that can be used in business cases and the budgeting process. Risk is included in business cases both as a benefit of spending (e.g., avoided risk) and as part of the cost of the work (e.g., risk of cost overrun).	Failure probability is an estimate of actual failure, but has not been calibrated to even recent failure history. Consequences of failure are quantified for a few asset classes. They are not based on actual customer costs or calibrated with the prioritization model. Avoided risk is implicitly included in the business case.

CRITERION DEFINITION (CONT'D)	VAI ASSESSMENT: HORIZON UTILITIES (CONT'D)
Condition Assessment Asset conditions are assessed relative to end-of-life failure criteria (i.e. Health Index). Health Index includes relevant parameters for predicting failure based on known degradation processes, and excludes other factors such as those related to criticality or obsolescence. Age is not included as a condition criterion.	Health Indices are based on major degradation processes and end of life criteria. The formulations are generally within the range of best practice, although recent improvements in the industry (e.g. multiplicative formulation) have not been applied. The multiplicative approach to health indexing is in contrast to the additive approach used by all four utilities in this review. It is a recent industry innovation wherein condition parameters are multiplied together rather than added. It avoids some of the common problems: "masking," where a bad test result is hidden amid several good ones, and validity, where there are not enough data available to calculate a valid health index. Relevant parameters are included except where data are known not to be available. Age is included in all formulations. This is mitigated by the focus on effective age rather than Health Index itself as the end output. Factors related to obsolescence (e.g. oil circuit breakers, PCB transformers) are included in some formulations.
Failure Probability The meaning of failure is clearly defined and consistently applied (e.g. end-of-life failure events that require replacement). The likelihood of failure is determined based on condition, age, and historical data.	Definition of "failure" is not clearly stated. It appears to be related to end of life, since it is driving reactive replacement programs. However, assets such as breakers and direct-buried cable can fail multiple times without being replaced. It is not clear whether this has been considered. Failure probability is estimated based on effective age, which incorporates calendar age and condition parameters.
Consequences of Failure (Asset Criticality) Failure consequences are monetized and related directly back to the customer as an outage cost or willingness-to-pay social cost. Consequence costs are intended to reflect the perceived cost to the customer. For example, how much would a ratepayer be willing to pay on a monthly basis to reduce or avoid power outage events? Where appropriate, multiple failure scenarios are considered and weighted according to their relative likelihoods.	Consequences of failure are not monetized or expressed in terms that can be used in decision-making outside the ACA, e.g., prioritization or business cases. Costs are customer focused, though implicitly. Multiple failure scenarios are not considered.

CRITERION DEFINITION (CONT'D)	VAI ASSESSMENT: HORIZON UTILITIES (CONT'D)
Processes Documentation Work flow processes are documented for significant tasks within the organization. The roles and responsibilities of each individual are documented and reviewed on a regular basis. The required flow of data to support asset management is documented. This includes data collection and storage, data requirements for program development, and data requirements for project justification and prioritization in the budgeting process.	Since the ACA is largely outsourced to a consultant, there is less need for detailed documentation of workflow. Horizon provides a review of assumptions and data needed to support the analysis. Data requirements are documented in the ACA, e.g. test and inspection results for calculating health. Matching of projects to the recommended/projected spending levels appears to require significant judgment, difficult to systematize.

OTHER OBSERVATIONS RELATED TO ASSET MANAGEMENT

In our review of the Horizon materials and through or discussions with Horizon personnel we were able to make additional observations relative to the Asset Management organization performance. Horizon exhibits many characteristics of best practice companies. While we would suggest that Horizon is not yet fully at best practice level it is well ahead of a large number of the utilities in the industry and above average in terms of its work in ACA and investment optimization. We note that there are numerous clear indicators that continual improvement is underway and well entrenched in the organization, another leading characteristic.

The areas that we observe would be of greatest value in supporting Horizon's move toward true best practice include:

- Incorporation of substantive business cases;
- Routine calibration/sensitivity analysis in ACA;
- Creating a rigourous process for computing asset criticality;
- Bringing the ACA work into the organization (relying on external consultants for support or audit as needed)
    - strengthens the skills and insight in the organization,
    - improves the ability to stress test and scenario test criteria; and
- Evolve from prioritization process for investments to a more robust multivariate optimization approach
    - for all capital spend,
    - for all OMA spend.

This should not be viewed as a criticism of Horizon or an implication that it is not performing well. In fact, its work over the last several years and the adoption of the ACA approach has been accepted by OEB to-date, with minor reductions required in the most recent rate case, even within a filing that included substantial increase in renewal request.

Hydro One Brampton - HOBNI

VAI consultants (Darin Johnson and Stewart Ramsay) met in person with Hydro One Brampton (HOBNI) on May 21 to review the ACA and DSP materials that HOBNI has provided, and to address specific questions VAI had regarding the ACA process, methodology and its use in developing the capital investment plans.

For HOBNI, the meeting was attended by:

- Tom Wasik, Director of Asset Management & Engineering
- Wolf Schaefer, Manager, Project & Asset Management
- Rolando Mena, Supervisor, Asset Management
- Jessica Davis, Restructuring Secretariat Observer

The meeting was productive and provided VAI with greater understanding of the process, the data elements used, the respective roles of different parts of the HOBNI organization in the development of the ACA, and a more complete understanding of how the ACA results are used in the identification and development of capital investments.

Our observations and assessments are summarized, by topic, in the following paragraphs.

ACA

2. Asset Categories

HOBNI contracts with an external consultant for the development of the ACA. HOBNI provides the input data, but relies on the external consultant for the calculations and the methodology.

The determination of Asset Categories was done in collaboration with the consultant based on the combined experience of HOBNI and the consultant, and its experience regarding assets that have significant financial or reliability impact on the system. HOBNI's ACA is focused on the Asset Categories identified in the table to the right.

HOBNI ACA ASSET CATEGORIES

Transformers
• MS
• Pole Mounted
  ○ 1 Phase
  ○ 3 Phase
• Pad Mounted
  ○ Mini
  ○ 3 Phase
• Vault

Breakers
Load Interrupting Switches
Pad Mounted Switchgear
Wood Poles
Primary XLPE Cable • Feeder • Distribution
SCADA Batteries

Some assets are subdivided based on significant variation in the end of life drivers, e.g. circuit breakers are divided into air and oil for HI purposes; cable is split into XLPE, PILC, secondary. However, this stratification is limited.

In industry terms, HOBNI assesses a large number of assets in its ACA. The level of rigour and detail tends to drop off after the most critical assets. This is common among utilities who are starting the ACA process. We expect that HOBNI will continue to add to the rigour and data collection. HOBNI appears to see additional value in further separation based on the performance of subsets of assets in some of the large asset categories.

Protective relays and communication systems are not evaluated in HOBNI's ACA. This is inconsistent with better performing utilities as these assets are often high-value, high risk impact assets.

a. Impact on renewal investment plans

For HOBNI, as is the case with most utilities, the somewhat limited detailed stratification to identify specific problem types or highly critical assets, makes planning difficult. It tends to limit the ability to undertake more meaningful "bottoms-up" cost assessments which leads to a top-down spending cap approach to estimating spending need. The limited ability to do

more detailed and predictable scenarios on asset failure related spending can become problematic. HOBNI has done good work in its ACA and is clearly leveraging the value of that work in the development and influence of its investment plans. We believe that further work in this area on both granularity of assets and asset HI data will enable HOBNI to increase the predictability and accuracy of its asset failures as well as accurately predict impacts on system performance resulting from any given investment or renewal plan.

HOBNI does not undertake a routine review of ACA results against recent performance by asset category to validate the results of the ACA. This is inconsistent with best practice. HOBNI has acknowledged the value of this on certain asset types, particularly where data is limited.

There is the potential that the results of the ACA, to the extent they are not fully accurate are pointing to somewhat less optimal renewal investment profiles. We recognize that this is also a common characteristic of utilities that have embarked on the HI and ACA path. HOBNI's ACA results and the impact that they have on the investment plans are significantly better than the results it was able to produce in prior years and it continues to improve the quality of the ACA and its ability to use the results to create well informed investment programs.

3. Condition Parameters

The condition parameters have been proposed by the external consultant and are reviewed and approved by SMEs inside HOBNI. The condition data is collected by HOBNI by its personnel and by its testing contractors. HOBNI screens and cleans up the data and provides it to the external contractor for use in the ACA.

The condition parameters employed by HOBNI are sparse relative to the range for best practice. This is especially true for station assets such as transformers and breakers where testing and inspection data are usually readily available.

The breaker formulation is not consistent with best practice. HOBNI's contractor is using contact resistance as the only factor besides age. We understand the argument that contact resistance is a proxy for the number and type of operations, and we acknowledge that in the absence of historical data on operations that it is a valuable measure. We do believe that HOBNI should explore other measures (such as timing tests) in addition to contact resistance that would help avoid the potential for end of life purely based on contact resistance.

HOBNI employs several aggressive de-rating factors that might be worth reviewing, e.g. 0.4 multiplier on HI for obsolete transformers, and for PCB for line transformers. The low numbers tend to move this type of equipment out of the system ahead of its true end of life. This is often a practice in utilities that have determined that the risks of failure of obsolete equipment or of modest concentration PCB transformers are higher than the cost of a premature replacement. We do not see the business cases or analysis that supports these decisions. We are not implying that these decisions are wrong. Many utilities have undertaken the analysis to justify such decisions. In the time available for our review we did not see that analysis.

Age continues to be included as a significant parameter in several of the HOBNI HI formulations. In our view, this is a debatable practice. It is by no means a fatal flaw. We do see age as being a useful parameter:

- If no condition data are available, then age is the proxy for condition, though generally a poor proxy;
- age is a minor parameter when better data are available;
- HI methodology is focused on "effective age" (when properly done), so factoring in calendar age is necessary at some point; and

- Where test data shows continued strong correlation between age and condition, many better performing utilities would reduce the costs of testing for that particular asset and rely more heavily on age.

Based on the methodology used by the external consultant, in the HOBNI ACA, a Health Index is considered "valid" as long as age data are available. In our view HOBNI and its consultant are not applying a best practice threshold for data availability in determining if it has a valid Health Index. It is reasonable for the effective age calculation and as a proxy for condition, but not as a Health Index. Best Practice utilities apply a level of rigour to determining the point at which they have a valid HI and differentiate between valid and incomplete HI and condition assessments. This supports their process in ensuring that the impacts of incomplete data are transparent, that making comparisons between assets with valid HI and those without valid HI are done with full understanding of the variation in accuracy. This ensures that assessments based on incomplete, not valid, HI are not tilting the investment decisions in an inappropriate direction either towards or away from the true need.

Using age is reasonable for the effective age calculation, but questionable as a Health Index.

CAPITAL INVESTMENT PLANS

1. Assumptions and Approach

Life-cycle optimization is the stated objective for HOBNI investment plans. HOBNI has a documented process for identifying and evaluating spending needs, optimizing, and budgeting. ACA is one input for defining needs rather than identifying investment levels. Using ACA as a driver of defining needs is consistent with best practice.

ACA generated "needs" (i.e. "flagged for action") are evaluated for technical alternatives, including refurbishment, reconfiguration and replacement.

The output of the ACA is subject to a business case process, applying the same scoring of risk and benefits used in the corporate prioritization/budgeting process. Again this is consistent with best practice.

2. ACA Translation

"Flagged for action" assets are the main source of spending for asset replacement.

For those assets where the spending is proactive, the cumulative probability of failure (based on Health Index) times criticality index is the basis for identifying assets in need of replacement. For some proactive assets, the criticality is assumed to be the same for each asset, which is effectively a spending program based on health only.

For those assets where the spending is reactive, replacement rates are based on estimated probability of failure per ACA; we note that the failure rates are not calibrated to recent experience and thus may not be as accurate a predictor of spending needs as possible.

HOBNI's planning and other engineering functions are responsible for identifying possible projects for evaluation based on the spending levels projected in the ACA. These spending recommendations are smoothed over time and adjusted based on known programs, e.g. voltage conversion. This results in an overall lower cost for level of system performance.

Alternative interventions, e.g. refurbishment, are considered at the technical alternatives stage. Some alternatives have been accepted generally, such as cable injection.

Major projects such as station transformer, wood pole, and cable replacement are budgeted as programs in the DSP.

3. Constraint Analysis

Must-do projects are identified at the "needs" stage. HOBNI applies a clear set of standards to define mandatory work, to eliminate the potential for non-mandatory work being misclassified. Reasonable judgment is applied, e.g. safety projects that address a known problem are must-do. Whereas safety related projects based on normal risk of failure are evaluated through the business case/prioritization process. This is consistent with best practice utilities.

Renewal programs are not compromised by lack of funding or resources except in smoothing the initial spikes, so constraints have not apparently played a significant role in planning. HOBNI's smoothing appears to be an implicit understanding of the need to manage within an expected ceiling based on ensuring stable rates to customers.

HOBNI has not found itself constrained by its board or by the OEB in obtaining capital to undertake the projects and programs that it believes are essential to the business.

4. Reasonability Testing

As an integral part of the development of the ACA and capital investment profile, HOBNI undertakes several reasonability tests. HOBNI goes through a subjective review by AM team and SMEs in the organization. This happens at various stages in the overall process. This ensures that the results of each of the steps in the process are matched with the knowledge and experience of the people that understand the system the best.

HOBNI engages in informal discussions with peer utilities to gain insights as well as test their findings against those of other utilities in similar circumstances.

HOBNI prepares its plans such that it understands the resource requirements and ramp up times.

HOBNI also examines proposed programs to identify how they can be improved based on experience of the programs already underway. This provides further clarity around actual cost and schedule that can be used to validate the value of the proposed plans.

We did note that HOBNI does not undertake sensitivity analysis to changed assumptions in ACA, especially failure probability and criticality. We attribute this largely to the fact that the ACA is conducted outside of HOBNI and thus running such analysis is potentially costly and cumbersome. We believe that this is an area that would be valuable for HOBNI to explore. It already has several best practices firmly embedded in its processes, this type of analysis would tend to strengthen the knowledge and insights of the organization.

We did not see much evidence that HOBNI has worked to quantify cost/ benefit from the customers' perspective, i.e. is this spending really worth it? HOBNI's business cases are detailed and so we recognize that the business cases could serve a reasonable approximation, if HOBNI ensures that customer cost is a valid parameter.

5. Optimal Investment Profile

HOBNI does an optimization of its capital investment program. HOBNI explicitly examines and scores the value of the investment across the range of corporate objectives. It also explicitly scores the investment with respect to the risk to the business (including personnel and public) if the investment is not undertaken. Our understanding is that HOBNI includes all capital expenditures, across all business units in the organization. The inclusion of all capital (e.g. facilities, fleet, furnishings, IT, line assets, station assets, etc.) is a leading practice and ensures that all capital is directed towards addressing the highest value or highest risk needs.

HOBNI has not yet applied the optimization process to its OMA expenditures. We believe that the process and standards already in place would support such an OMA optimization.

HOBNI is investigating new decision support tools that would enable it to integrate the ACA results into the optimization analysis. This would be a leading practice.

RESULTING EXPENDITURE LEVELS

In our review of HOBNI's materials we did not see a clear comparison of renewal spending projection to the totals from ACA. We did note that renewal spending has increased since about 2009, which is when AM processes were introduced. The spending levels have risen from $4 million in 2009 to nearly $9 million in the 2016 test year.

The wood poles replacement program tops out at 280 per year. This represents a replacement rate of about three percent of the population.

In our discussions with HOBNI we pointed out a concern we have with the methodology used by the ACA consultant with respect to cables. The assumed failure curve for XLPE primary cable has a very steep elbow: more than half of all failures are expected to occur in a five-year window. This effectively results in an age-based program with a large backlog (as shown in the ACA Figure 11-1). We believe that the backlog may be exaggerated by the de-rating factor for recent failures: a single fault in a 100m cable segment would translate to over 1000 faults/100 km and a de-rate factor of 0.6. If this is applied as described, it would push any segment with a fault into the "flagged for action" category. Essentially a fault on a short segment is a death sentence for that segment, which is not consistent with industry best practice, nor with HOBNI's intent. We understand that HOBNI is moving from faults per 100km to faults per segment for its next ACA. We believe that this will result in a significant shift in the assumed failure curve for this type of cable.

BEST PRACTICE ASSESSMENT

One of the requests made of VAI was to undertake an assessment of each of the LDCs against best practices in the areas of ACA (HI) and capital investment planning. The following table provides a summary of the assessments that we have made for HOBNI. In undertaking the assessment we have used a set of criteria that we believe represent best practice performance in the areas of ACA and investment optimization. The criterion and their definitions as well as our observations of HOBNI against each is included in the table below.

CRITERION DEFINITION	VAI ASSESSMENT: HYDRO ONE BRAMPTON
Determining End of Life Assets at end of life are identified according to a systematic approach, balancing the cost of continued operation against the cost of replacement to minimize life-cycle cost of ownership. Other interventions, e.g. refurbishment, are considered.	Proactive assets (station transformers and breakers): end of life is determined based on estimated failure probability and subjective (though consistent) measures of consequence. Cost of intervention is not considered. Proactive assets (some lines assets): end of life is determined based on estimated failure probability and a single assumed criticality applied to each asset. Cost of intervention is not considered. Reactive assets: assumed run-to-failure due to perceived low criticality. No business case back-up for these strategies.

CRITERION DEFINITION (CONT'D)	VAI ASSESSMENT: HYDRO ONE BRAMPTON (CONT'D)
Business Case Spending recommendations have an accompanying business case that summarizes the problem statement, compares alternatives, and makes a recommendation. All costs and benefits are quantified from the customers' perspective; alternatives including the do-nothing alternative are considered; assumptions are stated explicitly and quantitatively.	Have a business case process for scoring benefits and risks of proposed projects. Large-scale projects such as cable replacement are evaluated as a single line-item Do-nothing is the unstated alternative. Other alternatives are considered in the technical alternatives step, but are not assessed quantitatively. Benefits and risks are based on customer values (e.g., safety, reliability, environmental).
Long-Range Projections Aging asset populations include a projection of future spending needs based on expected future degradation and risk.	Long-range projections are provided in the ACA, based on the assumed replacement strategies for each asset class. These are treated as "needs" for evaluation in the asset management process.
Prioritization/ Optimization Across Programs Spending on replacement, refurbishment, maintenance, and other options are directly compared in equal terms to optimize spending plans and to prioritize across programs. Capital and OMA expenditures are optimized in the same process using the same or comparable criteria.	Optimization process compares spending across assets in equal terms based on the standard scoring scale. All capital of all types (asset and non-asset) is included in the optimization. The ACA includes an estimate of risk for some "proactive" asset classes, where risk is probability of failure times expected consequence of failure. The prioritization model also includes an assessment of risk, but the assumptions do not appear to be consistent. Ideally, the way a spending option is scored in ACA should translate directly into the business case and the prioritization model. This will simplify scoring and help ensure "apples-to-apples" comparisons.
Use of Subject Matter Experts (SMEs) Tacit knowledge of subject-matter experts is incorporated into the assessment process. Attention is focused on their areas of expertise (e.g. how best to assess condition) as opposed to complex questions outside it (e.g. how many transformers should we replace each year). SME input is documented explicitly for review and improvement over time.	Internal SMEs review, modify, and approve the Health Index formulations. They review and select intervention alternatives and create rational programs from the assessed needs. Subject-matter expertise should be applied to failure probability estimates, consequence costs, and other technical input assumptions in the ACA.
Risk Assessment Asset risk is quantified in terms of actual failure probability and expected consequence cost of failure in terms that can be used in business cases and the budgeting process. Risk is included in business cases both as a benefit of spending (e.g. avoided risk) and as part of the cost of the work (e.g. risk of cost overrun).	Failure probability is an estimate of actual failure, but has not been calibrated to even recent failure history. Consequences of failure are quantified for a few asset classes. They are not based on actual customer costs or calibrated with the prioritization model. Avoided risk is implicitly included in the business case.

CRITERION DEFINITION (CONT'D)	VAI ASSESSMENT: HYDRO ONE BRAMPTON (CONT'D)
Condition Assessment Asset conditions are assessed relative to end-of-life failure criteria (i.e. Health Index). Health Index includes relevant parameters for predicting failure based on known degradation processes, and excludes other factors such as those related to criticality or obsolescence. Age is not included as a condition criterion.	Health Indices are based on major degradation processes and end of life criteria. The formulations are generally within the range of best practice, although recent improvements in the industry (e.g. multiplicative formulation) have not been applied. The multiplicative approach to health indexing is in contrast to the additive approach used by all four utilities in this review. It is a recent industry innovation wherein condition parameters are multiplied together rather than added. It avoids some of the common problems: "masking," where a bad test result is hidden amid several good ones, and validity, where there are not enough data available to calculate a valid health index. Relevant parameters are included except where data are known not to be available. Age is included in all formulations. This is mitigated by the focus on effective age rather than Health Index itself as the end output. Factors related to obsolescence or consequences are generally excluded from the formulations.
Failure Probability The meaning of failure is clearly defined and consistently applied (e.g. end-of-life failure events that require replacement). The likelihood of failure is determined based on condition, age, and historical data.	Definition of "failure" is not clearly stated, although HOBNI experts are clear that they mean "end of life" as opposed to minor, repairable failures. Failure probability is estimated based on effective age, which incorporates calendar age and condition parameters.
Consequences of Failure (Asset Criticality) Failure consequences are monetized and related directly back to the customer as an outage cost or willingness-to-pay social cost. Consequence costs are intended to reflect the perceived cost to the customer. For example, how much would a ratepayer be willing to pay on a monthly basis to reduce or avoid power outage events? Where appropriate, multiple failure scenarios are considered and weighted according to their relative likelihoods.	Consequences of failure are not monetized or expressed in terms that can be used in decision-making outside the ACA, e.g., prioritization or business cases. Costs are customer focused, though implicitly. Effect of obsolescence is factored into criticality assessments, as it should be. Multiple failure scenarios are not considered.
Processes Documentation Work flow processes are documented for significant tasks within the organization. The roles and responsibilities of each individual are documented and reviewed on a regular basis. The required flow of data to support asset management is documented. This includes data collection and storage, data requirements for program development, and data requirements for project justification and prioritization in the budgeting process.	HOBNI has an Asset Management process document that they use to guide the entire decision-making process. ACA is an input for identifying needs. Data requirements are documented in the ACA, e.g. test and inspection results for calculating health. Matching of projects to the recommended/projected spending levels appears to require significant judgment and is difficult to systematize.

OTHER OBSERVATIONS RELATIVE TO ASSET MANAGEMENT

In many instances we see that HOBNI is near the front of best practice, and the AM team views that it is still working and still needs to improve other aspects of its processes.

HOBNI has a clear focus on optimizing the overall capital to ensure value to customers, as opposed to a more technical approach focused on the assets. Continuous improvement of process and methodologies is clearly underway and a standard for HOBNI's AM organization.

HOBNI expects to be able to begin predicting reliability impacts from its renewal projects.

HOBNI is also expecting to introduce the use of business cases for maintenance programs. HOBNI has already performed an effectiveness evaluation of maintenance practices which resulted in expanded IR inspection. This is advanced and a reinforcement of the commitment to reaching and maintaining best performance.

HOBNI's current approach has been accepted by OEB to-date, and spending requests for renewal based on ACA have been approved.

HOBNI does have areas that it should focus on improving. These include:

- Improvements in its business case methodology;
- Calibration and sensitivity analysis of ACA results with recent actual system performance; and
- Development of a more rigorous process for computing asset criticality.

Enersource

VAI consultants (Darin Johnson and Stewart Ramsay) met in person with Enersource on May 21 to review the ACA and DSP materials that Enersource has provided, and to address specific questions VAI had regarding the ACA process, methodology and its use in developing the capital investment plans.

For Enersource, the meeting was attended by:

- Alykhan Premji, Reliability Engineer
- Chris Master, Capital Manager
- Chris Hudson, VP Asset Operations
- Branko Boras, Manager, Asset Planning & Analysis

The meeting was productive and provided VAI with greater clarity around the process, the data elements used, the respective roles of different parts of the Enersource organization in the development of the ACA, and most importantly an understanding of how the ACA results are used in the identification and development of capital investments.

Our observations and assessments are summarized by topic in the following paragraphs.

ACA

1. Asset Categories

Enersource uses an external consultant for the development of the ACA. Enersource provides the input data, but relies heavily on the external consultant for the calculations and the methodology.

The determination of Asset Categories was done in collaboration with the consultant based on the combined experience of Enersource and the consultant, and its experience regarding assets that have significant financial or reliability impact on the system. Enersource's ACA is focused on the Asset Categories identified in the table to the right.

ENERSOURCE HYDRO ACA ASSET CATEGORIES

- Transformers
  - Substation
    - In Service
    - Spares
  - Pole Mounted
  - Pad Mounted
    - 1 Phase
    - 3 Phase
  - Vault
- Substation Circuit Breakers
- Pad Mounted Switchgears
- Overhead Line Switches
  - 44kV
  - 27.6 kV
  - Inline
  - Motorized
- Underground Cables
  - Main Feeder
  - Distribution
- Poles
  - Wood
  - Concrete

Assets are generally well subdivided for Health Indexing purposes; some "bad actors" have been identified by manufacturer, e.g. certain types of breakers and line transformers. These specific types of equipment have been validated with specific failure modes and risks that warrant specific treatment in the ACA and risk prioritization.

Further breakdown may be beneficial to Enersource in enabling better identification of opportunities to manage cost and risk. These include: tap-changers, type-U bushings, etc. These breakdowns should be based on actual data wherever possible.

In industry terms, a large number of assets were assessed in Enersource's ACA, although the level of rigour and detail drops off after the most critical assets. This is common among utilities who are starting the ACA process. We expect that Enersource will continue to add to the rigour and data collection. It is clear that there is funding in their plans to accomplish that objective and the plans for specific data capture and analysis appear to be well defined.

Protective relays and communication systems are not evaluated in Enersource's ACA. This is inconsistent with better performing utilities as these assets are often high-value, high risk impact assets.

a. Impact on renewal investment plans

For most utilities, and in our view this holds for Enersource, the somewhat limited detailed stratification to identify specific problem types or highly critical assets, makes planning difficult. It tends to limit the ability to undertake more meaningful "bottoms up" cost assessments which leads to a top-down spending cap approach to estimating spending need. The limited ability to do more detailed and predictable scenarios on asset failure related spending can become problematic. Enersource has done good work in its ACA and it is clearly leveraging the value of that work in the development and influence of its investment plans. It is deliberate in its efforts to improve the level and quality of the data that it collects and uses in the ACA. We believe that further work in this area on both granularity of assets and asset HI data will enable Enersource to increase the predictability and accuracy of its asset failures as well as accurately predict impacts on system performance resulting from any given investment or renewal plan. This would tend to improve the quality and transparency of the renewal and investment plans overall and increase credibility with the OEB and interveners in rate proceedings.

Enersource does not undertake a routine review of ACA results against recent performance by asset category to validate the results of the ACA. This is inconsistent with best practice. We recognize that it is relatively new to this process and so is continuing to work to improve the process.

Enersource has recognized the need for this on certain asset types, particularly where data is limited. It has moved deliberately to increase its efforts in these areas. Enersource has also taken a best practice step of working to identify the specific data needs and the potential value of the data before it is collected. It has also moved to handheld data collection tools that automatically apply standards for data capture, another best practice.

There is the potential that the results of the ACA, to the extent they are not fully accurate are pointing to somewhat less optimal renewal investment profiles. We recognize that this is also a common characteristic of utilities that have embarked on the HI and ACA path. Enersource's ACA results and the impact that they have on the investment plans are significantly better than the results it was able to produce prior to 2012.

2. Condition Parameters

The condition parameters used in the ACA have been proposed by the external consultant and reviewed and approved by senior level SMEs inside Enersource. It may be beneficial to extend involvement in these reviews to field personnel. This would provide greater insights for the ACA and for the field personnel and foster even greater buy-in for data collection and strategy.

The condition data is collected and provided by Enersource to the consultant as described above.

The condition parameters are generally within normal range for best practice, especially for stations' assets such as transformers and breakers where testing and inspection data are available. Enersource is expanding the formulations. We expect that, over time, as their data collection, testing and inspection processes continue to mature, Enersource will see continued improvement in the accuracy and insight of the ACA results.

Enersource's consultant applies a data availability indicator (DAI) in its reporting. This DAI can be misleading. If the data for an asset type is only age (which provides only minimal value in HI and ACA) then having all of the age data results in a 100% DAI. On the other hand, for assets where Enersource has identified 10 parameters that materially impact condition and end of life, having only

80% of the data results in a DAI of 80%. In our view the 80% data would produce far more meaningful results than 100% of the age data. If Enersource desires to retain a DAI, we believe that weighting the data elements by their relative value in producing an HI would be prudent. As it stands the DAI is merely a measure of completion.

Age continues to be included as a significant parameter in many of the Enersource HI formulations. In our view, this is a debatable practice. It is by no means a fatal flaw. We do see age as being a useful parameter:

- If no condition data are available, then age is the proxy for condition, though generally a poor proxy;
- Age is a minor parameter when better data are available;
- HI methodology is focused on "effective age" (when properly done), so factoring in calendar age is necessary at some point; and
- Where test data shows continued strong correlation between age and condition, many better performing utilities would reduce the cost of testing for that particular asset and rely more heavily on age.

Within the Enersource ACA, for some assets age is the only parameter, e.g. poles. While we accept that this is the proxy for condition we do not believe that it is appropriate for it to be considered as a Health Index. Doing so could mask findings in a way that would limit the interpretation of the results and potentially skew spending or investment decisions. Enersource is beginning a pole testing program (hammer test only); industry normal practice is more extensive testing to determine remaining strength. Enersource may wish to work with other utilities in the province to gain insights into the cost/benefit of more extensive pole testing.

For Enersource, based on the methodology used by the external consultant, a Health Index is considered "valid" as long as age data are available. In our view Enersource is not applying a best practice threshold for data availability in determining if it has a valid Health Index. It is reasonable for the effective age calculation and as a proxy for condition, but not as a Health Index. Best practice utilities apply a level of rigour to determining the point at which they have a valid HI and differentiate between valid and incomplete HI and condition assessments. This supports their process in ensuring that the impacts of incomplete data are transparent, that making comparisons between assets with valid HI and those without valid HI are done with full understanding of the variation in accuracy. This ensures that assessments based on incomplete, not valid, HI are not tilting the investment decisions in an inappropriate direction either towards or away from the true need.

CAPITAL INVESTMENT PLANS

1. Assumptions and Approach

ACA is the primary driver for renewal investments, which Enersource bases on the "flagged for action" plan within the ACA. Assets not evaluated in the ACA are replaced based on inspection criteria. Enersource had begun the process of moving towards an updated value model but deferred that due to the announcement of the merger.

While Enersource does not yet apply a quantitative method, we did review with Enersource the tools they are leveraging to move towards a quantitative method. The capabilities that they have assembled are very strong and it is clear that Enersource is close to moving toward a best practice capability in assessing the impact on reliability of the ACA results. Enersource currently uses those tools outside of the ACA process as part of the smoothing or identification of how best to optimize the replacement levels identified by the ACA.

This method is not applied comprehensively as yet, presumably only in cases where the ACA model can provide risk values and the asset types lend themselves to assessments of reliability impact.

Planning and AM work closely together to coordinate projects so that system expansion and investments generated by other drivers (road widening, etc.) are leveraged to incorporate or optimize assets identified in the ACA as in need of replacement.

2. ACA Translation

In the development of the capital investment plans, it appears that "Flagged for action" assets are a significant driver of the renewal plans as well as the overall spending levels. We believe that Enersource is making renewal investment decisions based on both proactive and reactive spending expectations.

For those assets where the spending is proactive, the cumulative probability of failure (based on Health Index) times criticality index is the basis for identifying assets in need of replacement. For some proactive assets, the criticality is assumed to be the same for each asset, which is effectively a spending program based on health only.

For those assets where the spending is reactive, replacement rates are based on estimated probability of failure per ACA, we note that the failure rates are not calibrated to recent experience and thus may not be as accurate a predictor of spending needs as possible. However Enersource is aware of this gap and is working to address it by comparing industry data with its own history, perhaps through CEATI.

ACA recommendations are an input, supplemented with review based on condition, remaining value of the asset, customer effect, reliability, etc. At present this is mainly a subjective task, creating programs out of the overall recommendations. As an example the Enersource ACA identifies the need to replace 100 pad mount switchgear, but Enersource will undertake a greater number of replacements because of PCB concerns. Another example that highlights the efforts that Enersource has taken to bring greater insight into the process is the use of GIS tools to map risk factors attributed to transformers (reliability, PCB, condition, etc.) to support the planning of the cable replacement program which includes other UG assets and the transformers. This results in Enersource getting scale economies while addressing the aggregate highest priorities.

3. Constraint Analysis

Proactive replacement budgets that are driven from the ACA are converted to accepted budgets and are then smoothed and compared with system plans to seek out economies of scale and resource.

Investments and investment programs are prioritized based on effect of delay using prioritization tools. The results are then vetted by SMEs and adjustments made based on that input.

Enersource has recognized that there are both capital constraints and resource constraints. The capital constraints are the result of the need to moderate the impact on rates. The resource constraints are driven largely by the availability of contractors to undertake the field work. There is a finite level of resource in the province. Going outside of the province changes the cost of the work. Enersource appears to do a good job in working with the contracting partners to understand the availability of construction resources based on the province wide workloads.

It does not appear that constraints in either capital or workload are causing Enersource to defer work that it believes must be done immediately.

Enersource has well defined standards for mandatory work. It appears that these standards and definitions eliminate the potential for non-mandatory work to masquerade as mandatory work thereby bypassing the prioritization and screening processes.

Enersource has not yet tested its improved methodologies and their recent improvements in Asset Management processes for capital in front of OEB. Its most recent rate case was before the current AM team was formed.

4. **Reasonability Testing**

   During the course of the development of the ACA and capital investment profile, Enersource takes several steps that provide sensible reasonability tests. The first that Enersource leverages multiple times throughout the process is a subjective review by AM team and senior SMEs in the organization. This ensures that the results of the tools are matched with the knowledge and experience of the people that understand the system the best.

   Enersource is also very active in seeking informal discussions with peer utilities to gain insights as well as test their findings against those of other utilities in similar circumstances.

   Enersource does extensive work to understand the resource requirements as well as the resource availability and ramp up times to ensure that the work that it proposes is actually achievable within the projected time frames. This ensures not only that the schedule is achieved, but also that the cost rates for the workforce are consistent with the projections.

   Enersource has not been in the practice of conducting sensitivity analysis around changed assumptions in ACA, especially failure probability and criticality. We believe that adding this capability, which may require bringing the ACA work in-house, would enable Enersource to better stress test its assumptions and its plans.

   Likewise, Enersource has not yet attempted to quantify cost/benefit from the customers' perspective, which could enable Enersource to adjust its spending plans to better address the areas of customer concern.

5. **Optimal Investment Profile**

   Specific projects are identified by taking ACA results and incorporating as much of the replacement work as possible into overall system plans. Projects are identified and scored for prioritization and risk according to corporate drivers. Enersource acknowledges that its prioritization process is limited and does not lend itself to the level of optimization that it has targeted. Enersource appears to be working to improve its understanding of the gaps between its current approach and where it believes it needs to be with respect to best practice optimization. Enersource is working to incorporate an updated value and risk model, and has begun investigating decision support tools such as Copperleaf, that it believes would enable it to improve the ability to test its inputs and assumptions. Enersource does not currently undertake routine scenario analysis or stress testing on its drivers.

   The process that it uses for ranking and prioritizing investments is common in the industry and is a natural step in the evolution towards true optimization based on value and risk.

RESULTING EXPENDITURE LEVELS

The resulting expenditures appear to track well against areas of risk and system performance need. As mentioned above, Enersource does high caliber work leveraging its tools and data to maximize the amount of value and risk that can be addressed in its expenditures.

Enersource's ACA indicates plans for large expenditures on line transformers and wood poles. These assets are largely run-to-failure (even if failure means identified as "failed" in an inspection). These programs should be calibrated to recent experience, a process we understand is underway internally.

BEST PRACTICE ASSESSMENT

One of the requests made of VAI was to undertake an assessment of each of the LDCs against best practices in the areas of ACA (HI) and capital investment planning. The following table provides a summary of the assessments that we have made for Enersource. In undertaking the assessment we have used a set of criteria that we believe represent best practice performance in the areas of ACA and investment optimization. The criterion and their definitions as well as our observations of Enersource against each is included in the table below.

CRITERION DEFINITION	VAI ASSESSMENT: ENERSOURCE
Determining End of Life Assets at end of life are identified according to a systematic approach, balancing the cost of continued operation against the cost of replacement to minimize life-cycle cost of ownership. Other interventions, e.g. refurbishment, are considered.	Proactive assets (stations): end of life is determined based on estimated failure probability and subjective (though consistent) measures of consequence. Cost of intervention is not considered. Proactive assets (lines): end of life is determined based on estimated failure probability and a single assumed criticality applied to each asset. Cost of intervention is not considered. Reactive assets: assumed run-to-failure due to perceived low criticality. No business case back-up for these strategies.
Business Case Spending recommendations have an accompanying business case that summarizes the problem statement, compares alternatives, and makes a recommendation. All costs and benefits are also quantified from the customers' perspective; alternatives including the do-nothing alternative are considered; assumptions are stated explicitly and quantitatively.	Prioritization scoring method used to compare projects. Benefits of project are scored in this way, but are not explicitly compared with costs. Overall, a narrative-based business case. Do-nothing is the unstated alternative. Other alternatives may be described but not evaluated for comparison. Alternatives to replacement are considered by the SMEs on an asset-by-asset basis for large assets (station transformers, breakers) and programmatically for dispersed assets (cable, poles). Benefits and risks are based on customer values (e.g. safety, reliability, environmental).
Long-Range Projections Aging asset populations include a projection of future spending needs based on expected future degradation and risk.	Long-range projections are provided in the ACA, based on the assumed replacement strategies for each asset class. These are incorporated into the long-range spending plan.
Prioritization Across Programs Spending on replacement, refurbishment, maintenance, and other options are directly compared in equal terms to optimize spending plans and to prioritize across programs.	Prioritization process compares spending across assets in equal terms based on the standard scoring scale. The ACA includes an estimate of risk for some "proactive" asset classes, where risk is probability of failure times expected consequence of failure. The prioritization model also includes an assessment of risk, but the assumptions do not appear to be consistent. Ideally, the way a spending option is scored in ACA should translate directly into the business case and the prioritization model. This will simplify scoring and help ensure "apples-to-apples" comparisons.

CRITERION DEFINITION (CONT'D)	VAI ASSESSMENT: ENERSOURCE (CONT'D)
Use of Subject Matter Experts (SME) Tacit knowledge of subject-matter experts is incorporated into the assessment process. Attention is focused on their areas of expertise (e.g. how best to assess condition) as opposed to complex questions outside it (e.g. how many transformers should we replace each year). SME input is documented explicitly for review and improvement over time.	Internal SMEs review, modify, and approve the Health Index formulations. Their expertise is the basis for evaluating alternative interventions. Subject-matter expertise should be applied to failure probability estimates, consequence costs, and other technical input assumptions in the ACA.
Risk Assessment Asset risk is quantified in terms of actual failure probability and expected consequence cost of failure in terms that can be used in business cases and the budgeting process. Risk is included in business cases both as a benefit of spending (e.g. avoided risk) and as part of the cost of the work (e.g. risk of cost overrun).	Failure probability is an estimate of actual failure, but has not been calibrated to even recent failure history for every asset class. Consequences of failure are quantified for a few asset classes. They are not based on actual customer costs or calibrated with the prioritization model. Avoided risk is implicitly included in the business case.
Condition Assessment Asset conditions are assessed relative to end-of-life failure criteria (i.e. Health Index). Health Index includes relevant parameters for predicting failure based on known degradation processes, and excludes other factors such as those related to criticality or obsolescence. Age is not included as a condition criterion.	Health Indices are based on major degradation processes and end of life criteria. The formulations are generally within the range of best practice, although recent improvements in the industry (e.g. multiplicative formulation) have not been applied. Ongoing improvement in data collected. The multiplicative approach to health indexing is in contrast to the additive approach used by all four utilities in this review. It is a recent industry innovation wherein condition parameters are multiplied together rather than added. It avoids some of the common problems: "masking," where a bad test result is hidden amid several good ones, and validity, where there are not enough data available to calculate a valid health index. Relevant parameters are included except where data are known not to be available. Age is included in all formulations. This is mitigated by the focus on effective age rather than Health Index itself as the end output. Factors related to obsolescence or consequence (e.g. oil circuit breakers, PCB transformers) are included in some formulations.

CRITERION DEFINITION (CONT'D)	VAI ASSESSMENT: ENERSOURCE (CONT'D)
Failure Probability The meaning of failure is clearly defined and consistently applied (e.g. end of life failure events that require replacement). The likelihood of failure is determined based on condition, age, and historical data.	Definition of "failure" is not clearly stated, however the AM team takes it to mean any failure to perform. In the ACA, it appears to relate to end of life, since it is driving reactive replacement programs. However, assets such as breakers and direct-bury cable can fail multiple times without being replaced. It is not clear whether this has been considered. Failure probability is estimated based on effective age, which incorporates calendar age and condition parameters.
Consequences of Failure (Asset Criticality) Failure consequences are monetized and related directly back to the customer as an outage cost or willingness-to-pay social cost. Consequence costs are intended to reflect the perceived cost to the customer. For example, how much would a ratepayer be willing to pay on a monthly basis to reduce or avoid power outage events? Where appropriate, multiple failure scenarios are considered and weighted according to their relative likelihoods.	Consequences of failure are not monetized or expressed in terms that can be used in decision-making outside the ACA, e.g., prioritization or business cases. Costs are customer focused, though implicitly. Multiple failure scenarios are not considered.
Processes Documentation Work flow processes are documented for significant tasks within the organization. The roles and responsibilities of each individual are documented and reviewed on a regular basis. The required flow of data to support asset management is documented. This includes data collection and storage, data requirements for program development, and data requirements for project justification and prioritization in the budgeting process.	Since the ACA is largely outsourced to a consultant, there is less need for detailed documentation of workflow. Enersource provides review of assumptions and data needed to support the analysis. The plan is to bring the ACA (or other methodology) in-house eventually. Data requirements are documented in the ACA, e.g. test and inspection results for calculating health. Matching of projects to the recommended/projected spending levels appears to require significant judgment, difficult to systematize.

OTHER OBSERVATIONS RELATIVE TO ASSET MANAGEMENT

In our review of the Enersource materials and through our discussions with Enersource personnel we were able to make additional observations relative to the Asset Management organization performance. While we would suggest that Enersource is not yet at best practice level it is well ahead of a large number of the utilities in the industry and above average in terms of its work in ACA results with system performance for maximizing portfolio value. We note that there are numerous clear indicators that continual improvement is underway and well entrenched in the organization, another leading characteristic.

Enersource exhibits several practices that are within range of best practice and others that are already at best practice. Chief among these is the integration of their GIS tools and asset performance data with their investment planning. The work done to migrate data collection to tablets and simplify the process is a leading practice.

Enersource has placed significant emphasis on improvement: expanding HI, and reviewing and improving data collection processes to update GIS data. Enersource is sophisticated in its targeting of asset and component failures and the potential for impact on the ACA. As an example there was significant discussion of porcelain insulators in the context of pole inspection and replacement planning. The AM group is approaching this issue in a manner consistent with best practice: define problem first, decision-making strategy next, then think about solutions.

The areas that we observe would be of greatest value in supporting Enersource's move toward true best practice include:

- Improving the content and rigour of the business cases;
- Instituting a process for calibration and sensitivity analysis in ACA;
- Developing a rigorous process for computing asset criticality,
    - We note that Enersource's current methods for integrating the ACA results into the overall system plan, in effect delivers an assessment of criticality, it is just not used in the ACA; and
- Conforming the value and risk criteria used in the ACA to those used in the business cases and prioritization.

These have already been identified by the AM team and appear to be tasks that the AM team is planning to undertake.

CONCLUSIONS

Based upon the review of the materials provided by each of the LDCs, the interviews conducted with the LDC personnel and our analysis of the findings, we have identified a number of conclusions that we believe are germane to the potential merger of the four LDCs. In our conclusions we have focused on the potential impacts of the merging of processes, practices and methodologies on the merged entity and resulting capital investment programs.

We have also provided a summary of our assessments of each of the LDCs relative to best practice for the areas related to ACA and capital investment planning.

Alignment of Methodologies

GENERAL

The ACA practices at Horizon, HOBNI, and Enersource are generally aligned. The approach at PowerStream is somewhat different, but consistent in the sense that it is a more advanced version of the same concept in use at the other three. There is no reason to believe that a merger would result in any major philosophical change of any of the ongoing renewal approaches. It is possible that applying the economic life methodology used at PowerStream to the assets at the other three utilities (and to PowerStream's cable program) would result in somewhat lower renewal spending, although this is hard to predict with certainty.

All four utilities are aligned in terms of pursuing minimum life-cycle cost as the basis for renewal spending. All are committed to a customer-focused business case approach to making spending decisions. This is important because it means that changes that come about from a possible merger of the asset management practices will tend to be improvement opportunities at the margin due to minor variations in expertise.

DETERMINING END OF LIFE

All four utilities use a risk-based approach to determine end of life. Horizon, HOBNI, and Enersource do so only for their proactive programs, and even then they are not as sophisticated as PowerStream, who make explicit estimates of the cost/benefit trade-off between replacement and continued operation.

BUSINESS CASE

All four utilities produce business cases to justify projects, per OEB requirements. The link between ACA, the business case, and the prioritization methods is not as strong for any of the four as it might be. None of the utilities is yet able to make an estimate of reliability improvements (i.e., SAIDI, SAIFI) for a given renewal project, as an example. Best practice utilities are able to predict changes in performance across the corporate objectives with a moderate to high degree of accuracy and consistency.

LONG RANGE PROJECTIONS

All four produce long-range spending projections for capital renewal. None yet evaluate maintenance programs on the same terms.

PRIORITIZATION ACROSS PROGRAMS

All the utilities score projects in terms of risk and value for prioritization. PowerStream is already moving towards adopting the Copperleaf value model to support this; Horizon and EnerSource are considering it and HOBNI has a similar approach already in place. HOBNI and Enersource apply prioritization/optimization to all capital spend, including non-asset spending.

A single model for all four, with consistent drivers and scoring assumptions that are filtered down to the ACA process will be an important step in normalizing renewal spending across the utilities.

USE OF SUBJECT MATTER EXPERS (SMEs)

Subject-matter experts have been involved in Health Index formulations at all four utilities. For all of them, expanding this role to include field personnel would improve the formulations and failure scenarios, and would help create buy-in for data collection as well as renewal and maintenance strategies.

CONDITION ASSESSMENT

The approach to condition assessment is the same at all four utilities, although the specifics of what tests and inspections are used and how they are weighted varies. It will be important to standardize this to ensure comparability of equipment health. This could be a challenge in cases where one utility collects some data that another does not. Use of multiplicative Health Indices would help ensure that Health Indices are still valid during the transition period. They are also useful in ensuring that an important bad test is not masked by several good ones, which is sometimes a problem at utilities with lots of test and inspection data available.

All four utilities use health to modify effective age, which is appropriate. The specific conversions vary, but there is not much industry data to support this correlation, so settling on a standard will be a matter of judgment.

FAILURE PROBABILITY

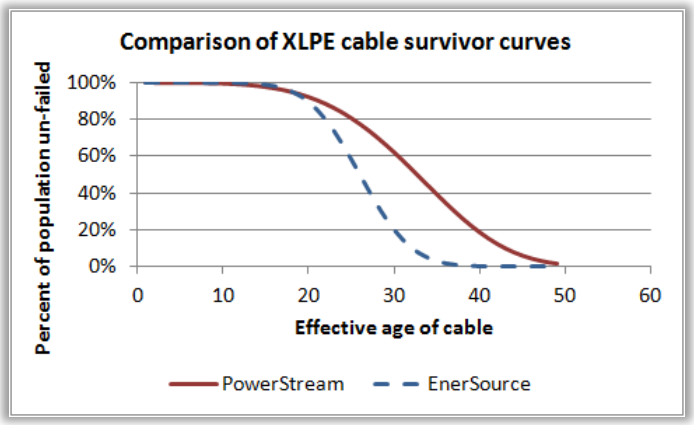
Only PowerStream has calibrated its failure probability estimates to actual failure rates, although the other three LDCs are aware of the need for this and have begun the process. We would expect failure rates versus effective age for a given asset type to be the same at every utility, unless there is some reason to believe otherwise (e.g. different specification, loading policy, etc.). Table 3 below compares the failure probability estimates for select asset classes.

COMPARISON OF ASSUMED FAILURE PROBABILITIES

		ENERSOURCE		HOBNI		HORIZON		POWERSTREAM	
ASSET	SUB-CATEGORY	20%	50%	20%	50%	20%	50%	20%	50%
Transformers	Substation	54	47	56	48	59	53	88	66
	Pad Mounted	42	39	42	44	54	50		
Breakers	OCB	56	53	60	51	59	53	70	53
Poles	Wood	58	53	68	58	66	59	54	40
Underground Cables	XLPE, non-TR, DB	30	26	34	31	40	31	40	33

Values shown are measured in years as recorded in the respective ACA reports.

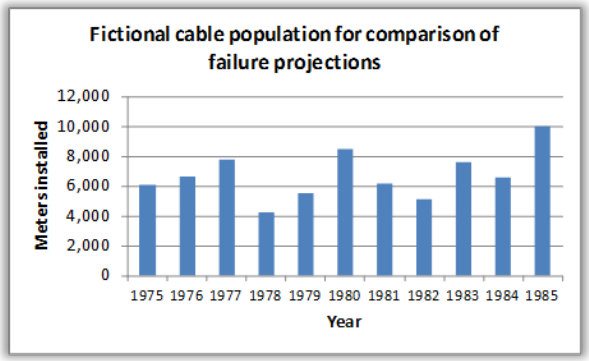
This is a significant issue for comparing spending programs, especially for reactive programs or proactive programs where criticality is assumed to be the same for every asset (e.g. breakers at Horizon, HOBNI, and Enersource), because the failure probability curve defines the spending projection. To see this effect, let's compare the failure curve for XLPE cable used by Enersource to that used by PowerStream. Both of these relate to pre-1990s, direct-buried, non-tree-retardant cable. Although there may be different assumptions about the exact range of years for this cable population, we would expect the curves and failure projections to be similar. The figure below shows the survivor curves. You can see that the PowerStream curve projects a substantially lower failure rate as cables age.



Comparison of survival curves for non-tree-retardant, direct buried XLPE cable used by PowerStream and Enersource.

Even though the differences in the parameters may seem small, the projected failure rates differ by a factor of nearly 4:1 by age 35.

What are the implications of this difference in estimated failure probability? If we apply these failure rates to a hypothetical population of cables, we can see the dramatic difference in number of failures projected. The figure to the right shows a fictional population of cables by installation date along with the total number of failures projected.



FAILURE PROBABILITY CURVE	ANNUAL PROJECTED FAILURES (fictional population above)
Enersource	35
PowerStream	9

The projected failures from the fictional sample population from the Enersource curve are nearly four times higher. Since projected failure rate is the basis for the replacement or injection program at all four utilities, these differences in failure assumptions could create significant differences in the projected long-range spending need for renewal. Similar outcomes can be shown for other asset classes, but this example is enough to highlight the point. The point is not that one of these curves is wrong and the other right, but rather that there may be substantial differences in planned replacement spending among the utilities, which we expect would begin to converge as they acquire more data and analytical capability.

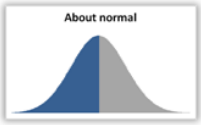
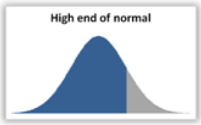
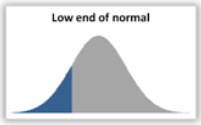
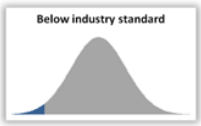
The solution, which is already underway at both Enersource and PowerStream, is to calibrate the failure probability curves to match actual failure rates. This can be done fairly easily using each utility's own data, but sharing data or working through a group such as CEATI to have larger amounts of data to work with is recommended where possible.

CONSEQUENCES OF FAILURE (ASSET CRITICALITY)

PowerStream takes the most rigorous view of consequence cost of failure, actually counting customers by type and evaluating both major and minor scenarios. However the other utilities are aware of the need for criticality assessment and plan to move in that direction. All of them have the ability to count customers affected by failure of an asset (including cable) through connectivity models.

Best Practice Assessment

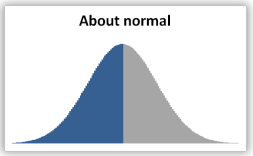
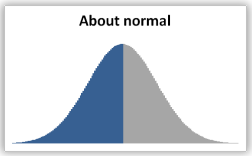
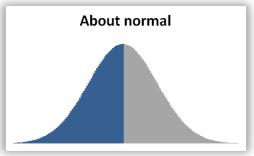
The table below summarizes the overall performance of the asset management functions at the four utilities relative to industry best practice (legend to the right). It should be noted that many, perhaps most, electric utilities are not practicing asset management in any meaningful sense. Our assessments and comparisons to Best Practice includes only those utilities that have made a significant effort to implement a program and apply it. If we were to apply these assessments and compare across the industry as a whole, each of the utilities would move to the right on these charts.

	About normal – typical for utilities implementing asset management.
	High end of normal – better than the majority of asset management utilities; highly developed.
	Best practice
	Low end of normal – still within the range of best practice, but below most utilities implementing asset management.
	Below industry standard – outside the range to be considered best practice; improvement needed.

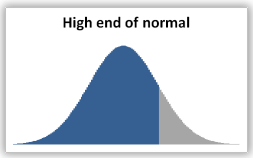
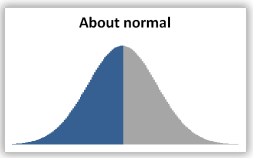
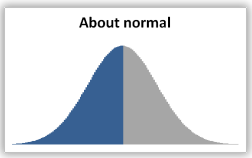
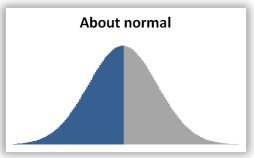
The bell curves below are intended to show where each utility stands relative to the population of utilities actually practicing asset management. Bell-shaped curves are used to reflect the fact that the large majority of utilities lie somewhere in the middle relative to best practice. These rankings represent our overall assessment; for more detail refer to the sections of this report specific to each utility.

We recognize that not all four asset management groups have been in place for very long. We have tried to make allowance in our ratings for plans for future improvements that appear to be already underway.

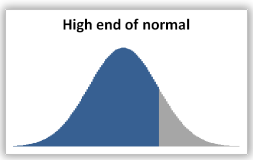
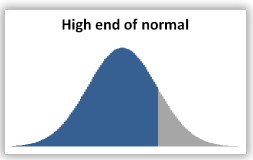
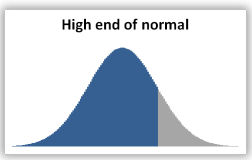
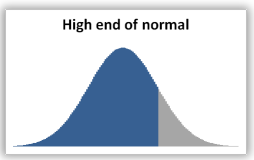
Determining End of Life

PowerStream	Horizon	HOBNI	Enersource
			

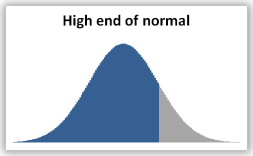
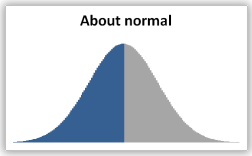
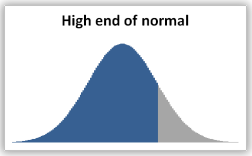
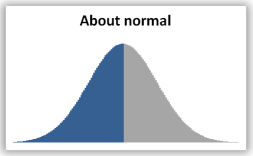
Business Case

PowerStream	Horizon	HOBNI	Enersource
			

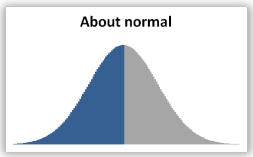
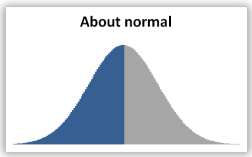
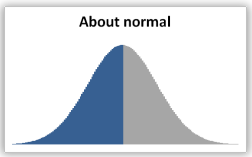
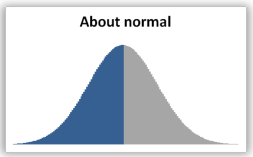
Long-Range Projections

PowerStream	Horizon	HOBNI	Enersource
			

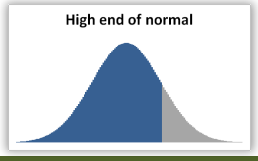
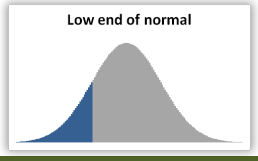
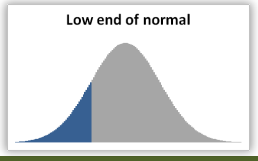
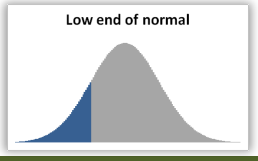
Prioritization Across Programs

PowerStream	Horizon	HOBNI	Enersource
			

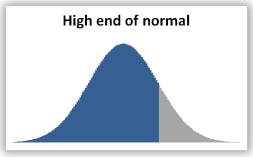
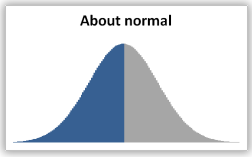
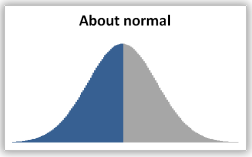
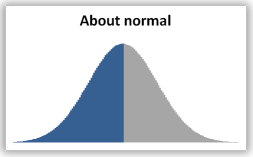
Use of Subject Matter Experts (SMEs)

PowerStream	Horizon	HOBNI	Enersource
			

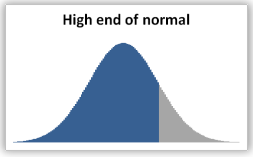
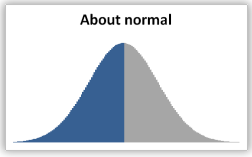
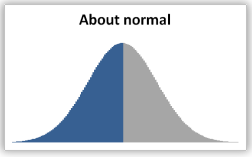
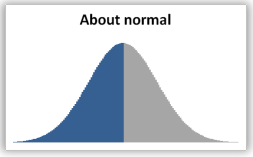
Risk Assessment

PowerStream	Horizon	HOBNI	Enersource
			

Condition Assessment

PowerStream	Horizon	HOBNI	Enersource
			

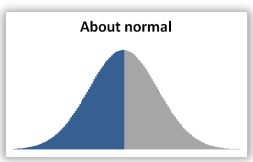
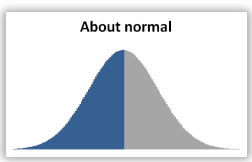
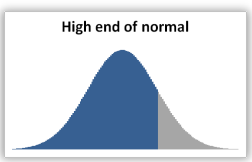
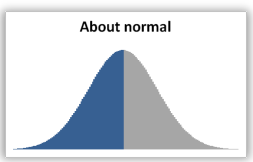
Failure Probability

PowerStream	Horizon	HOBNI	Enersource
			

Consequences of Failure (Asset Criticality)

PowerStream	Horizon	HOBNI	Enersource
			

Processes Documentation

PowerStream	Horizon	HOBNI	Enersource
			

CREDITS

Interviews conducted by Stewart Ramsay and Darin Johnson

Observations and Assessments prepared by
Neil Reid, Darin Johnson and Stewart Ramsay

Report written by Darin Johnson and Stewart Ramsay
Edited by Darin Johnson, Tracey Lawrence and Yvette Smith

THANK YOU.