



CASE STUDY

RISK-BASED ASSET INVESTMENT PLANNING & OPTIMIZATION AT HYDRO ONE

Hydro One is the largest electricity transmission and distribution company in Ontario, Canada, with \$24.33 billion in total assets as of 2015. It owns and operates substantially all of Ontario's electricity transmission system.

The company was looking to improve its planning and investment optimization processes in response to requirements from the provincial regulator, the Ontario Energy Board (OEB), for long-term, risk-based asset management plans, and data-driven decisions.

Hydro One responded to this challenge by implementing several process and technology innovations. One of these was to adopt the **Copperleaf Value Framework** to enable consistent risk assessment and investment decision making aligned to its corporate strategic objectives. This was followed by the implementation of the **Copperleaf C55** Asset Investment Planning and Management solution.

Risk-Based Planning & Investment Optimization

The investment evaluation and selection process is part of the overall asset management planning process at Hydro One. The company needed a more rigorous and consistent approach to align investment decisions with its corporate objectives and facilitate trade-offs between investments.

In 2013, Hydro One implemented the **Copperleaf C55** solution, which provides an enterprise-wide investment planning repository and a platform to:

- Consider the risk and financial impacts of investments
- Evaluate investments based on the value they contribute and their alignment to strategic objectives
- Coordinate competing investment plans to achieve an optimized long-term plan that meets all constraints

The **C55** optimization process uses a multi-criteria decision analysis, which helps decision-makers understand and quantify business risks and uncertainties, so that objective decisions can be made that respect all priorities. This approach allows Hydro One to obtain the best portfolio of investments that achieves the optimal balance of cost effectiveness, risk mitigation, customer expectations, asset and business needs, while respecting the imposed constraints and decision-making criteria. The process also considers resource, material and outage availability and minimizing customer rate impacts.



www.hydroone.com

HYDRO ONE

TOTAL ASSETS (2015)
\$24.33 Billion



CUSTOMERS
1.3 Million



DISTRIBUTION SYSTEM

123,000
 CIRCUIT KM

DISTRIBUTION &
 REGULATING STATIONS

1,000



TRANSMISSION SYSTEM

29,000
 CIRCUIT KM

TRANSMISSION STATIONS

292

FACILITIES

26 that interconnect with systems
 in neighbouring provinces and states,
 which can accommodate imports
 of up to 6,963 MW and exports
 of about 6,295 MW

Copperleaf C55 supports all of the steps in Hydro One's investment planning process:

1. Refine/validate business values in line with the corporate strategy
2. Develop multiple investment alternatives to incrementally mitigate risks
3. Determine and evaluate the cost, benefits and risks for each level of funding
4. Prioritize funding across all functional areas of the corporation
5. Assess the results and build the company's Investment Plan Proposal

Aligning investment decisions with corporate strategy

Hydro One's values and business objectives are shown in the table on the opposite page. These values and objectives are represented in the **Copperleaf Value Framework** and form the basis upon which investment decisions are made in C55.

Hydro One has defined a set of metrics to track performance and provide visibility into how the company is performing against each of its business objectives. For example, the average number of sustained interruptions per delivery point is a key metric used to measure system reliability and ensure the company is meeting its objectives in the area of operational effectiveness.

In C55, these metrics form the criteria against which: investments are developed, risks are managed, and trade-offs are facilitated between investments. They are used to prioritize investments by providing the dimensions for consideration when assessing the degrees of risk and the risk mitigation that each proposed investment level provides against each business value.

A probability and severity-of-outcome risk matrix is used to determine the impact ratings on each business metric. The Probability scale ranges from Unexpected to Very Likely, and the Severity of Outcome scale ranges from Minor to Catastrophic.

This approach ensures consistency in the assessment of risk, and that funding and resources are allocated to the projects that will mitigate the most severe risks.

Evaluating multiple investment options & funding levels

Customer, asset, and business needs guide the ongoing planning activities at Hydro One. Investment proposals are developed to address these needs, risks, and objectives, and are then incorporated into the optimization process.

For investment projects, multiple alternatives are considered (e.g. refurbishment vs replacement) and these are evaluated based on their respective costs and benefits (i.e. risk mitigated).

HYDRO ONE VALUES AND BUSINESS OBJECTIVES

CUSTOMER FOCUS	Customer Satisfaction	<ul style="list-style-type: none"> Improve current levels of customer satisfaction
	Customer Focus	<ul style="list-style-type: none"> Engage with our customers consistently and proactively Ensure our investment plan reflects our customers' needs and desired outcomes
OPERATIONAL EFFECTIVENESS	Cost Control	<ul style="list-style-type: none"> Actively control and lower costs through OM&A and capital efficiencies
	Safety	<ul style="list-style-type: none"> Drive towards achieving an injury-free workplace
	Employee Engagement	<ul style="list-style-type: none"> Achieve and maintain employee engagement
	System Reliability	<ul style="list-style-type: none"> Maintain top quartile reliability relative to transmission peers
PUBLIC POLICY RESPONSIVENESS	Public Policy Responsiveness	<ul style="list-style-type: none"> Ensure compliance with all codes, standards, and regulations Partner in the economic success of Ontario
	Environment	<ul style="list-style-type: none"> Sustainably manage our environmental footprint
FINANCIAL PERFORMANCE	Financial Performance	<ul style="list-style-type: none"> Achieve the ROE allowed by the OEB

This requires an assessment of the baseline risk (risk before investment) and residual risk (risk after investment). Since both baseline and residual risk are time dependent, C55 values investments differently depending on when they are carried out. Financial benefits and Key Performance Indicator (KPI) improvements are also included in the value calculation.

For investment programs (recurring instances of similar activities such as an annual transformer replacement program), incremental investment funding levels are established and evaluated for a period of five years. This is done within the context of a longer-term view of asset demographics to ensure the appropriate management of overall lifecycle requirements and resources. Short-term constraints, such as scheduling of skilled staff, availability of materials, availability of outages, and customer rate impacts are also considered when establishing the investment program funding alternatives.

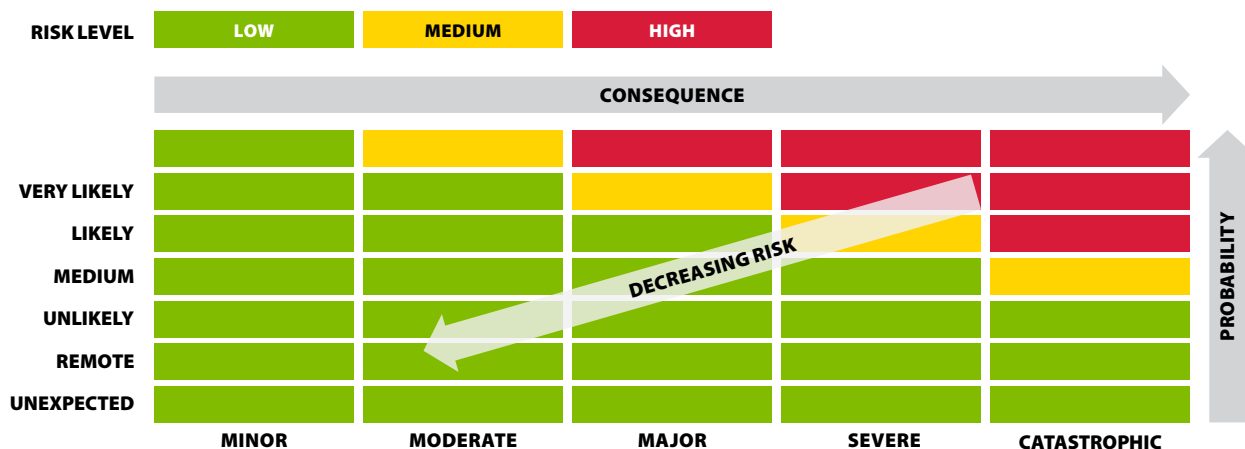
The value-based optimization process is used by Hydro One to quantify risks, and to identify the appropriate level of investments that will ensure the achievement of customer commitments and maintain safety and reliability, while minimizing customer bill increases.

Investment optimization

Hydro One documents the needs, objectives, accomplishments, costs, and risk assessment for each investment and level of accomplishment. This information is then reviewed by asset managers, business analysts and other stakeholders to ensure risk is evaluated consistently across all proposed transmission and distribution investments.

Each business case provides the necessary cost and risk mitigation data required to conduct the risk- and value-based optimization using C55.

HYDRO ONE RISK MATRIX



C55 determines the optimal set of investments, alternatives, and timing that deliver the greatest value for the given funding and resources. The optimization process selects one of several levels of investment for each investment program based on that level's ability to mitigate risk to an acceptable level to the business values. For individual projects, different alternatives are considered as well as the timing of the investment itself.

The output from C55 is reviewed by senior management taking into account the associated impacts on customer rates, the ability to accomplish the proposed work in light of known constraints (e.g. labour, material, engineering resources), the financial health of the company, as well as the residual risk to the business (i.e. the risk that remains after the investments are made).

The end result is an investment plan that represents an effective balance between these considerations.

Investment plan execution & re-optimization

While the investment plan is the product of extensive planning and analysis, implementation of the plan must be done in a manner that is dynamic and flexible. Approved investments may need to be redirected and the plan revised as new risks or opportunities emerge, including new customer requirements, changes in asset condition/risk, emerging regulations/legislations or a shift in corporate priorities. For example, transmission line emergency restoration work required to repair damage caused by storms or equipment failures can be significant in a given year and may necessitate the redirection of funds and field resources from other investment areas.

The changes from plan are identified on a monthly basis, and corrective action is recommended for approval to senior management. They in turn balance the emerging needs, financial impacts, resource impacts and the changing risk profile, when making a decision to approve the changes to plan.

Continuous planning & improvement

Hydro One continues to make improvements to the process with the experience gained during each planning cycle.

- The approach enables the consistent comparison of each investment's contribution towards the mitigation of risk and the achievement of corporate goals.
- The C55 optimization process identifies the best blend of investments to maximize benefit while minimizing risk to Hydro One and its customers.
- Various investment and risk levels for programs can easily be modeled to determine optimal funding.
- Alignment of Hydro One's values and business objectives with the Ontario Energy Board's Renewed Regulatory Framework for Electricity Distributors ("RRFE") results in a more efficient and effective regulatory rate filing process.



Designing an investment plan that enables Hydro One to balance the needs and preferences of our customers, our assets and our company, today and for the future, is extremely important to us. Copperleaf's C55 solution has enabled us to determine the optimal investment approach in the face of competing objectives, and make better investment decisions that support achieving our goals."

—Kevin Mancherjee, Manager, Investment Management
Hydro One

This case study has been adapted from its original publication in The Institute of Asset Management "Subject Specific Guidelines: Risk Assessment and Management", Version 1.0, June 2016.