ONTARIO ENERGY BOARD
File No. EB-2018-0165
Exhibit No. K5.3
Date July 5, 2019 jfs

EB-2018-0165

ONTARIO ENERGY BOARD

IN THE MATTER OF the *Ontario Energy Board Act, 1998*, Schedule B to the *Energy Competition Act, 1998*, S.O. 1998, c.15;

AND IN THE MATTER OF an Application by Toronto Hydro-Electric System Limited ("Toronto Hydro") for an Order or Orders approving or fixing just and reasonable distribution rates and other charges, effective January 1, 2020 to December 31, 2024.

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COMPENDIUM OF THE SCHOOL ENERGY COALITION
(Panel 2 – General Plant, Operations, and Administration)

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RESPONSES TO CONSUMERS COUNCIL OF CANADA INTERROGATORIES

INTERROGATORY 14:

Reference(s): Exhibit 1B, Tab 1, Schedule 1, p. 21

The evidence states that THESL has proposed a ratemaking framework for this Application that provides incentives for the utility to seek out further productivity and efficiency improvements over the 2020-2024 period. Please explain how the rate framework incents productivity. Please set out for each year 2015-2019 the productivity gains achieved for both OM&A and Capital. What are the specific productivity initiatives expected for the period for 2020-2024 both with respect to capital and OM&A? Please provide a detailed list.

RESPONSE:

As described in Exhibit 1B, Tab 2, Schedule 1, Toronto Hydro is proposing an incentive-based rate framework that encourages the utility to continuously seek efficiencies. This incentive is created by including the OEB's productivity factor and a custom stretch factor in the custom Price Cap Index ("PCI"). In doing so, Toronto Hydro is committing to share with its customers the benefits of these efficiencies before they are realized, by directly reducing rates funding. This approach provides customers with a guaranteed, up-front share in productivity generated by the utility.

The evidence in Exhibit 1B, Tab 2, Schedule 1 provides an overview of Toronto Hydro's historical productivity and performance, including specific examples of productivity and process improvements at Exhibit 1B, Tab 2, Schedule 1, at pages 8 through 20. For additional examples over the 2015-2019 period, please refer to the OM&A program evidence at Exhibit 4A, Tab 2 (Cost Management and Productivity sections of each OM&A

program and segment), and the Capital program evidence at Exhibit 2B, Sections E5 through E8. Specific interrogatory responses also provide additional details: see for example, Toronto Hydro's response to 2B-BOMA-77.

The references to the OM&A and Capital programs above also detail examples of the investments and initiatives that will support the utility's efforts to control costs and increase productivity over the 2020-2024 period. For example, Exhibit 2B, Section A4.4 highlights some of these activities including: grid modernization, capacity improvements, standardization, area rebuilds, conservation first, safety and environmental costs, enhanced work coordination, and facilities asset management system and procurement.

At this time, Toronto Hydro is unable to quantify the estimates of cost savings of the planned initiatives. As part of continuous improvements throughout the plan period, Toronto Hydro intends to evaluate the operational efficiencies gained, as well as the reduced and avoided costs. The cost savings realized will help Toronto Hydro to realize the savings required by the incentive-based rate framework that encourages the utility to continuously seek efficiencies by including the OEB's productivity factor and a custom stretch factor in the custom PCI, and to deliver on the planned outcomes for customers.

RESPONSES TO CONSUMERS COUNCIL OF CANADA INTERROGATORIES

INTERROGATORY 38:

Reference(s): Exhibit 4A, Tab 2, Schedule 13, p. 6

With respect to Supply Chain Services the intent is to transition the majority of the operational responsibilities to the Third-Party procurement provider. When is this expected to happen? Will it result in significant cost reductions? What are the expected savings?

RESPONSE:

Toronto Hydro expects that by the end of 2019, the third-party procurement provider ("3PP") will manage the majority of the operational responsibilities in the Demand and Acquisition Services area within the Supply Chain department. This transition is expected to result in the following benefits, as described in Exhibit 4A, Tab 2, Schedule 13, page 6:

- Reduce the overhead cost per purchase order;
- Provide better operational cost certainty; and
- Provide more operational flexibility to meet Toronto Hydro's varying operational requirements consisting of managing 10,340 active inventory codes linked to individual assets, issuing 14,700 purchase orders, and executing 133 solicitations annually.

At this time, Toronto Hydro is unable to comment on the specific amount or timing of when the expected savings can be realized.

project of unprecedented scale for Toronto Hydro, experienced slower progress and less spending than planned in 2015 and 2016 due to several unforeseen events and factors. The project is now scheduled for completion in 2018. Overall, Toronto Hydro is forecasting that Stations Expansion expenditures will be approximately 6 percent lower than forecast for the 2015-2019 period. Section E7.4 provides additional information on Copeland TS and other cost and timing variances for Stations Expansion work, including variances related to Toronto Hydro's capital contributions to Hydro One for transformer station upgrades.

E4.1.3 2015-2019 Variances: General Plant

As shown in Table 1, General Plant expenditures were lower than forecast in 2015 and higher than forecast in 2016 and 2017. Toronto Hydro expects expenditures to be greater than forecast in 2018 and 2019. Overall, 2015-2019 General Plant expenditures are projected to be 32 percent higher than forecast. Variances related to two major projects – the Operating Center Consolidation Program ("OCCP") and the Enterprise Resource Planning ("ERP") system – accounted for the majority of the variance between actual and planned spending:

- The OCCP was a real estate initiative from 2014 to 2018, intended to: (i) ensure security of tenure at major crew-supporting operating centers; (ii) ensure the uninterrupted continuation of critical functions; and (iii) achieve permanent significant cost savings for ratepayers. The OCCP program exceeded planned costs by $46.5 million due to higher than forecast capital improvement costs at 715 Milner Rd., 71 Rexdale Blvd., and 500 Commissioners St. These improvements were necessary to support consolidation. Changes in capital improvement costs were largely driven by changes in project costs between the initial and final estimates, including increases associated with the Ontario Building Code, environmental considerations, and design considerations.

Despite these variances, the program has generated more value in returns to rate payers than originally planned. Table 2 shows the variances on cost and net gains of sale related to the original OCCP scope of work. Net proceeds from the sale of 5800 Yonge Street will be returned to rate payers in the form of a rider over the 2020-2024 period.[6]

[6] Refer to Exhibit 9, Tab 1, Schedule 1 for more information on the OCCP deferral and variance account.

Table 2: Costs and Gains Associated with the OCCP Program ($ Millions)

	Planned	Actual	Variance
Capital Cost	160.0	206.6	**46.6**
Net gain from Sale	72.5	133.9	**61.4**

Beyond the original planned scope of consolidation, the program's space utilization efforts allowed Toronto Hydro to dispose of an additional property, at 60 Eglinton Ave., the proceeds of which will also be returned to ratepayers in the form of a rider over the 2020-2024 period. The employees from 60 Eglinton Ave. were transferred to other Toronto Hydro owned properties in June 2017, allowing for a reduction in maintenance costs related to that property. Overall, the program has achieved an increase of $69.8 million in amounts to be returned to rate payers compared to the original plan.

- IT/OT program investments are expected to exceed planned investments over the 2015-2019 period. Actuals in 2017 and forecasts in 2018 and 2019 are offset by lower than planned expenditures in 2015 and 2016, resulting in an expected variance over the 2015-2019 period of $18.3 million, or 9 percent.

  The majority of this variance is attributed to increased investment in Toronto Hydro's new ERP system, which the utility plans to complete in 2018. Approximately half of the ERP variance is attributed to higher infrastructure costs compared to the original high-level estimates developed in 2013. Drivers of cost changes included changes in the Canadian to American dollar exchange rate, a change in hardware requirements necessitated by standards changes during the period between the initial project estimate and the commencement of the project, additional requirements for components not identified in the 2013 estimate, and scope changes to include additional subscriptions and licenses for capabilities that would deliver greater benefits and better align with business requirements. The remaining variance is the result of a greater allocation of internal employee time in support of the project.

E4.1.4 2015-2019 Variances: Other Capital

Expenditures in the "Other Capital" investment category are projected to be 40 percent less than forecast over the 2015-2019 period. The Other Capital budget had included approximately $20.6 million in road cut repair costs. Toronto Hydro revised its approach during the period to begin

RESPONSES TO SCHOOL ENERGY COALITION INTERROGATORIES

INTERROGATORY 71:

Reference(s): Exhibit 2B, Section E8.4, p.18
EB-2014-0116, Exhibit 2B, Section E8.6, p.3

With respect to the ERP project undertaken between 2015 and 2019:

a) Please explain in detail why the project actuals were $62.8M when they were forecast to cost $51.3M.

b) Please provide copies of any post-competition/lesson-learned or similar report that was completed. If one was not completed, please explain why not.

c) Please explain what lessons Toronto Hydro has learned regarding the ERP project that it is using for the purposes of work to be undertaken between 2020 and 2024.

RESPONSE:

a) As described in Exhibit 2B, Section E4, page 6, the variance in the ERP program over the 2015-2019 period is attributable to the following factors:

- an additional $8.4 million resulting from additional resources that were required for the project, changes in infrastructure costs following a more detailed technical assessment, and exchange rate fluctuations;
- an additional $1.8 million resulting from a three month schedule extension to allow the alignment of various activities and streamline project related tasks; and

- an additional $1.3 million in subscription fees for SuccessFactors modules. These modules bring additional functionalities such as Compensation, Recruiting, Onboarding, Performance & Goals, Workforce Analytics & Planning and Employee Central;

b) Toronto Hydro intends to complete the lesson-learned process after the post-implementation phase of the project concludes in April 2019.

c) Toronto Hydro has learned the following lessons, which it intends to apply over the 2020-2024 period:

1. Toronto Hydro adopted leading practices which included selecting an internal team staffed with driven individuals and system implementation partner who brought industry experience and allowed the utility to identify industry best practices to adopt into the utility's configuration.
2. Toronto Hydro minimized customization through aligning the utility's business processes to the pre-established standard functionality embedded in the product.
3. Toronto Hydro followed strong project management practices which established effective project governance discipline within the execution of the project, including a detailed project plan, short interval controls (regular status checks, leadership and executive touch points), and risk management.
4. Toronto Hydro ensured that the configured solution supports the business processes as designed by performing thorough testing of the configuration.
5. For future initiatives, Toronto Hydro should explore sustainability options in detail to assess the transition from the project mode to ongoing operations and plan out the support requirements ahead of time, including data governance, business process management, system support, etc.

6. Toronto Hydro adopted strong internal governance processes to manage project costs utilizing short interval controls and formal change request processes to manage agreed scope.

TABLE 2: EXPECTED COSTS AND BENEFITS OF OPTION 3 – ERP IMPLEMENTATION

	Expected Spending ($M)										
Year	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**
CAPEX	**54.0**	**-**	**-**	**-**	**-**	**5.5**	**-**	**-**	**-**	**-**	**-**
Hardware	3.4	-	**-**	-	-	1.5	-	-	-	-	-
Software & Implementation	50.5	-	**-**	-	-	4.0	-	-	-	-	-
OPEX	**0.2**	**2.8**	**2.4**	**2.4**	**2.4**	**2.4**	**2.4**	**2.4**	**2.2**	**2.2**	**2.2**
TOTAL EXPENDITURE	**54.1**	**2.8**	**2.4**	**2.4**	**2.4**	**7.9**	**2.4**	**2.4**	**2.2**	**2.2**	**2.2**
	Expected Benefits ($M)										
Year	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**
Monetary	**-**	**17.9**	**4.2**	**4.2**	**4.2**	**13.2**	**4.2**	**4.2**	**4.2**	**4.2**	**13.2**
Cost Savings	-	3.5	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
Cost Avoidance	-	14.5	0.1	0.1	0.1	9.1	0.1	0.1	0.1	0.1	9.1
Process Improvements	**-**	**1.9**	**2.4**	**2.9**	**2.9**	**2.9**	**2.9**	**2.9**	**2.9**	**2.9**	**2.9**
TOTAL BENEFIT	**-**	**19.8**	**6.6**	**7.0**	**7.0**	**16.1**	**7.0**	**7.0**	**7.0**	**7.0**	**16.0**
	Net Present Value (NPV)										
10-yr: Monetary only	**-15.3**										
10-yr: Monetary and Process	**4.9**										

ORAL HEARING UNDERTAKING RESPONSE TO SCHOOL ENERGY COALITION

UNDERTAKING NO. J6.5:

Reference(s):

To explain which savings outlined in 2B-SEC-39, Appendix A are OM&A savings and which are capital savings.

RESPONSE:

ORAL HEARING UNDERTAKING RESPONSE TO SCHOOL ENERGY COALITION

Section 7.7 Metrics to Measure Benefits Attainment

Response to Interrogatory J6.5	Year 1 Annual Benefit		Year 2 Annual Benefit		Year 3+ Annual Benefit	
ID Metric Name	**Capex**	**Opex**	**Capex**	**Opex**	**Capex**	**Opex**
Goal: Cost Savings						
3.1 Planning Cycle Integration	-	17	-	23	-	23
3.2 Budget Transfer Automation	-	6	-	8	-	8
3.3 Elimination of External Consulting Support	-	113	-	150	-	150
4.1 Month-End Processing Time	-	16	-	21	-	21
4.2 Automatic production of shell documents	-	49	-	65	-	65
4.3 Asset Capitalization	71	18	94	24	94	24
4.4 Funding Type Automation	11	3	14	4	14	4
4.5 Automated Financial Reporting	8	2	10	3	10	3
4.6 Automated Trial Balance	-	0	-	1	-	1
5.1 Payroll Journal Entry Automation	-	32	-	42	-	42
6.1 Timesheet Data Entry Automation	-	75	-	100	-	100
6.2 Planned Overtime Reduction	1,125	-	1,500	-	1,500	-
7.1 Automated Business Reporting	-	19	-	25	-	25
7.2 Field Resource Optimization	6	13	7	18	7	18
7.3 Timesheet Data Entry Automation	-	38	-	50	-	50
8.1 Warranty Cost Recovery	-	60	-	80	-	80
8.2 Inventory Reduction	80	-	107	-	107	-
9.1 Ellipse & Legacy System Operations	-	1,632	-	1,632	-	1,632
9.2 IT Incident Mgmt Savings	-	65	-	86	-	86
	1,300	**2,155**	**1,733**	**2,330**	**1,733**	**2,330**
		3,455		**4,063**		**4,063**
Goal: Increased Productivity						
1.1 Journal Entry And Reconciliation Savings	-	77	-	100	-	118
2.1 Improved Business Reporting	-	33	-	43	-	50
2.2 Designer System Rationalization	195	-	255	-	300	-
3.1 Improved Business Reporting	-	56	-	74	-	87
3.2 Increased Unit Completions	49	119	65	155	76	183
4.1 Procurement Time Savings	-	34	-	44	-	52
4.2 Work Order Entry Efficiency	-	9	-	12	-	14
4.3 One-Time Vendor Efficiencies	-	8	-	10	-	12
4.4 Data Reconciliation Efficiencies	77	-	101	-	118	-
5.1 Designer System Rationalization	65	-	85	-	100	-
6.1 Improved IT System Reliability	-	1,137	-	1,487	-	1,749
	386	**1,472**	**505**	**1,924**	**594**	**2,264**
		1,858		**2,430**		**2,858**

TECHNICAL CONFERENCE UNDERTAKING RESPONSES TO SCHOOL ENERGY COALITION

UNDERTAKING NO. JTC3.4:

Reference(s): 2B-SEC-71

To provide an updated version of exhibit no. KTC3.1, and explain any changes, to the extent possible.

RESPONSE:

Please see Appendix A to this response for a copy of Exhibit KTC3.1 and an updated version of this exhibit.[1] The variances between the documents are explained below.

Capital Expenditures

Toronto Hydro's response to interrogatory 2B-SEC-71 provides a variance explanation for the difference between the plan and actual ERP costs over the 2015 to 2019 period.[2] The current version of the ERP system[3] will not be supported by the vendor beyond 2025.[4] In order to maintain business continuity and protect the utility from cybersecurity risks, Toronto Hydro must upgrade the ERP system in the 2020 to 2024 rate period.[5] Toronto Hydro plans to implement the HANA database upgrade in 2023 and the S/4 HANA application upgrade in 2024. The expected total cost of this investment is

[1] EB-2014-0116, Exhibit 2B, Section E8.6, page 47.
[2] The table of ERP costs and benefits reproduced in Exhibit KTC3.1 states that the ERP project was expected to cost $54 million over the 2015-2019 period. Note that this amount includes $2.7 million from a historical period.
[3] ERP system refers to both the ERP application (ECC 6.0 and EHP 8.0) and the ERP database (Oracle 9.0).
[4] See Exhibit 2B, Section E8.4, page 18.
[5] For more details on Toronto Hydro's HANA implementation plans, please see Exhibit 2B, Section E.8.4.3 and Appendix A of response to IR 2B-SEC-70.

$19.6 million. The cost is higher than what Toronto Hydro forecasted in 2013 when it prepared the information in Exhibit KTC3.1 because of: inflationary cost pressures, changes in the technology platform offered by the ERP vendor, increased testing requirements, and additional business resources to support the execution of the project.

Operational Expenditures

Over the 2015-2019 rate period, Toronto Hydro expects to incur $7.0 million in operational expenditures for ERP project implementation support, adoption of the new ERP system, and operating and maintaining the ERP system post go-live. This compares to a forecast of $7.8 million in the original ERP business case over the 2015-2019 period.

The 2020 Test Year costs are expected to be $2.3 million higher than the original forecast due to additional subscription fees for Ariba and SuccessFactors, higher than expected Application Managed Services related to ERP, and anticipated notes/patches updates. The operational expenditures beyond the 2020 Test Year have not been determined.

Benefits

The expected ERP benefits included in the Appendix A represent a combination of projected: 1) cost savings (i.e. cash benefits); 2) cost avoidance benefits associated with not having to invest capital to replace the legacy systems that have been decommissioned as a result of the new ERP system; and 3) non-monetary process improvement benefits that Toronto Hydro expects to realize.

For the 2015-2019 period, the benefits in the updated table are based on the cost savings projections that have been reflected in the utility's operational budget forecasts, and the general assumption that the cost avoidance benefits and non-monetary process improvement benefits will be realized as envisioned in the original business case.

There is a variance of $5.2 million between the original and the revised table with respect to benefits attainment in the first two years following implementation of the new system (i.e. 2017-18 vs. 2019-20). This variance is attributable to the cost savings (i.e. cash benefits) category. In this category Toronto Hydro included the estimated net cost savings in the Finance and Information Technology OM&A budgets, which were directly attributable to the ERP program. Other cost savings forecasted in the original business case, such as capital overtime costs reductions in the order of $1.5 million, cannot be directly and fully attributed to the ERP, and therefore have not been included in the table.[6]

For the 2020-2024 period, the benefits have not been provided as Toronto Hydro has not completed the benefit attainment analysis. Toronto Hydro expects to undertake this analysis after the post-implementation phase of the project concludes in April 2019.

[6] As the result of various initiatives that Toronto Hydro has undertaken over the 2015-2019 period to manage its cost pressures and drive productivity, Toronto Hydro's overtime costs are trending downwards from 2015 to 2020. Please see the response to interrogatory 4A-Staff-128(b).

Appendix A- Expected Costs and Benefits of ERP Implementation

Table 1: Original Table of ERP Costs and Benefits- filed in EB-2014-0116, Exhibit 2B, Section E8.6, page 47

TABLE 2: EXPECTED COSTS AND BENEFITS OF OPTION 3 - ERP IMPLEMENTATION

		Expected Spending ($M)										
Year		2016 (Yr 0)	2017 (Yr 1)	2018 (Yr 2)	2019 (Yr 3)	2020 (Yr 4)	2021 (Yr 5)	2022 (Yr 6)	2023 (Yr 7)	2024 (Yr 8)	2025 (Yr 9)	2026 (Yr 10)
CAPEX		54.0					5.5					
Hardware		3.4					1.5					
Software & Implementation		50.5					4.0					
OPEX		0.2	2.8	2.4	2.4	2.4	2.4	2.4	2.4	2.2	2.2	2.2
TOTAL EXPENDITURE		54.2	2.8	2.4	2.4	2.4	7.9	2.4	2.4	2.2	2.2	2.2
		Expected Benefits ($M)										
Year		2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Monetary		0.0	17.9	4.2	4.2	4.2	13.2	4.2	4.2	4.2	4.2	13.2
Cost Savings		0.0	3.5	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
Cost Avoidance		0.0	14.5	0.1	0.1	0.1	9.1	0.1	0.1	0.1	0.1	9.1
Process Improvements		0.0	1.9	2.4	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
TOTAL BENEFIT		0.0	19.8	6.6	7.0	7.0	16.1	7.0	7.0	7.0	7.0	16.0

Table 2: Updated Table of ERP Costs and Benefits

Filed Undertaking JTC 3.4 (2018 filing)

TABLE 2: EXPECTED COSTS AND BENEFITS OF OPTION 3 - ERP IMPLEMENTATION

		Expected Spending ($M)										
Year	2015 Actual	2016 Actual	2017 Actual	2018 Actual	2019 Forecast	2020 Plan	2021 Plan	2022 Plan	2023 Plan	2024 Plan	2025 Plan	2026 Plan
CAPEX	1.0	5.8	25.1	25.7	5.3	0.0	0.0	0.0	8.6	11.0	tbd	tbd
Hardware (equip only)	0.0	1.1	0.0	0.0	0.0	tbd	tbd	tbd	tbd	tbd	tbd	tbd
Software & Implementation	1.0	4.7	25.1	25.7	5.3	tbd	tbd	tbd	tbd	tbd	tbd	tbd
OPEX (Note 2)	0.0	0.1	0.1	1.8	5.0	4.7	tbd	tbd	tbd	tbd	tbd	tbd
TOTAL EXPENDITURE	1.0	5.9	25.2	27.4	10.3	4.7	tbd	tbd	tbd	tbd	tbd	tbd
		Expected Benefits ($M)										
Year	2015 Actual	2016 Actual	2017 Actual	2018 Actual	2019 Forecast	2020 Plan	2021 Plan	2022 Plan	2023 Plan	2024 Plan	2025 Plan	2026 Plan
Monetary	0.0	0.0	0.0	0.0	15.3	1.7	n/a	n/a	n/a	n/a	n/a	n/a
Cost Savings	0.0	0.0	0.0	0.0	0.8	1.6	n/a	n/a	n/a	n/a	n/a	n/a
Cost Avoidance	0.0	0.0	0.0	0.0	14.5	0.1	n/a	n/a	n/a	n/a	n/a	n/a
Process Improvements	0.0	0.0	0.0	0.0	1.9	2.4	n/a	n/a	n/a	n/a	n/a	n/a
TOTAL BENEFIT	0.0	0.0	0.0	0.0	17.1	4.1	n/a	n/a	n/a	n/a	n/a	n/a

Notes
1) ERP project Go-live was on Oct 1, 2018. HyperCare from Oct 1, 2018 to Apr 30, 2019.
2) Amounts 2015-2019 are Project Opex, while amounts 2019-2020 are On-going Opex.

Project Synergy Business Case

7.4 Execution Risks and Critical Success Factors

Critical Success Factor	Description and Associated Execution Risks	High-Level Risk Mitigation Measures
Solution Fit to Business Requirements	Future State Processes and the new ERP system must ensure Toronto Hydro can perform its core operational tasks and comply with its legislative and regulatory obligations. "Consultant Led" ERP implementations that design process and system solutions within functional silos and without deep business context often fail to fulfill this objective.	• Project approach emphasizes paper-based "thinking" about the Future State and consensus from all areas of the business before any configuring or coding takes place. • Future State process and system requirements must be defined and documented by the Toronto Hydro Project Team and agreed before System Selection and System Integrator on-boarding. • Solution Acceptance Criteria to include business sign-off of end-to-end Business Process based testing scenarios.
Adherence to Budget	To achieve the NPV and benefits committed to in the Business Case, the ERP Program must not exceed its budget. ERP Programs often exceed their allotted budget, regardless of the system selected and System Integrator.	• Experienced ERP Program Manager, ERP Project Manager and ERP Solution Architect employed by Toronto Hydro from Initiation Phase, providing expertise with budget preparation. • All key Business Process and Functional Requirements to be defined and agreed by Toronto Hydro and validated that they can be accomplished within the selected ERP system before the on-boarding of System Integrators. By limiting their role to the "Design, Realize and Deploy" and "Support and Optimize" Phases of the Program, spend velocity is controlled and likelihood of budget adherence is improved. • Implementation of industry standard Project Management methodologies and tools to ensure early identification of cost over-runs and to initiate corrective actions.
Adherence to Timeline	To achieve the NPV and benefits committed to in the Business Case, the ERP Program must be implemented on time. ERP Programs often exceed their estimated timeline, regardless of the	• Experienced ERP Program Manager, ERP Project Manager and ERP Solution Architect employed by Toronto Hydro from Initiation Phase, providing expertise with timeline preparation. • Inclusion of Phase Timelines in System Integrator Services

	system selected and System Integrator.	Contract (Subject to Agreement). • Commitment to not start the "Design, Realize and Deploy" Phase until preparation is complete.
Solution Adoption Post Go-Live	To achieve the benefits committed to in the Business Case, Future State Processes and the new ERP System must be used consistently and as intended by all of Toronto Hydro business units. Post Go-Live System Adoption is often compromised by resistance to change, non-compliance and malicious compliance by users who prefer the status quo or users who do not understand the new processes and system and / or their role.	• Significant Change Management and Training effort is included throughout the Program Plan to ensure that resistance to change is identified and mitigated. • User Training will be provided to ensure that users understand their role(s) in the Future State Business Processes and that they can confidently execute the required system operations to perform them. • Solution Adoption Monitoring during the Support and Optimize Phase will identify issues and deploy appropriate Change Management and Training remedies.

7.7 Metrics to Measure Benefits Attainment

Cash Benefits

ID	Metric Name	Formula	**Target (per Year)**	Realization Timing	Beneficiary Department
Goal: Revenue Loss Avoidance					
1.1	Late Payment Penalties Recovery	Interest paid on Unpaid non-electricity invoices	$125,000	• 0% in Yr. 0 • 75% in Yr. 1 • 100% Yr. 2+	Customer Care
Goal: Cost Avoidance					
2.1	Information Technology Asset Efficiency (Software)	Ellipse and Legacy System Upgrades not performed	$2,773,600*	See Note.	Information Technology
2.2	Information Technology Asset Efficiency (Hardware)	Ellipse and Legacy System Hardware Upgrade not performed	$464,700*	See Note.	Information Technology
Goal: Cost Savings					
3.1	Planning Cycle Integration	Elimination of time spent cleaning coding errors from Hyperion-SAP interfaces for each planning cycle.	$23,000	• 0% in Yr. 0 • 75% in Yr. 1 • 100% Yr. 2+	Finance
3.2	Budget Transfer Automation	Automation of employee budget transfers through the integration of planning activities to the ERP.	$7,500	• 0% in Yr. 0 • 75% in Yr. 1 • 100% Yr. 2+	Finance
3.3	Elimination of External Consulting Support	Elimination of Hyperion Consultant	$150,000	• 0% in Yr. 0 • 75% in Yr. 1 • 100% Yr. 2+	Finance
4.1	Month-End Processing Time	Reduction in number of working days to close financial period.	$21,316	• 0% in Yr. 0 • 75% in Yr. 1 • 100% Yr. 2+	Finance
4.2	Automatic production of shell documents	Automatic production of shell documents	$65,070	• 0% in Yr. 0 • 75% in Yr. 1 • 100% Yr. 2+	Finance

4.3	Asset Capitalization	Reduction in number of working days related to the capitalization of assets.	$117,644	• 0% in Yr. 0 • 75% in Yr. 1 • 100% Yr. 2+	Finance
4.4	Funding Type Automation	Eliminate Resources requird to identify funding type.	$18,108	• 0% in Yr. 0 • 75% in Yr. 1 • 100% Yr. 2+	Finance
4.5	Automated Financial Reporting	Reduce Resources required for Capital Reporting by Portfolio and Headcount Reporting.	$12,600	• 0% in Yr. 0 • 75% in Yr. 1 • 100% Yr. 2+	Finance
4.6	Automated Trial Balance	Automation of Regulatory Trial Balance	$621	• 0% in Yr. 0 • 75% in Yr. 1 • 100% Yr. 2+	Finance
5.1	Payroll Journal Entry Automation	Automation of Payroll Journal Entries	$42,000	• 0% in Yr. 0 • 75% in Yr. 1 • 100% Yr. 2+	Human Capital Management
6.1	Timesheet Data Entry Automation	Eliminate 2 FTE required for timesheet data entry.	$100,000	• 0% in Yr. 0 • 75% in Yr. 1 • 100% Yr. 2+	Distribution Services
6.2	Planned Overtime Reduction	30% reduction in current overtime spend.	$1,500,000	• 0% in Yr. 0 • 75% in Yr. 1 • 100% Yr. 2+	Distribution Services
7.1	Automated Business Reporting	Reduce Reporting Resources	$25,000	• 0% in Yr. 0 • 75% in Yr. 1 100% Yr. 2+	Distribution Grid Management
7.2	Field Resource Optimization	Skillsets matched to Events	$25,000	• 0% in Yr. 0 • 75% in Yr. 1 • 100% Yr. 2+	Distribution Grid Management
7.3	Timesheet Data Entry Automation	Eliminate FTE required for timesheet data entry.	$50,000	• 0% in Yr. 0 • 75% in Yr. 1 • 100% Yr. 2+	Distribution Grid Management
8.1	Warranty Cost Recovery	Better collection of warranties, supplier cost savings	$80,000	• 0% in Yr. 0 • 75% in Yr. 1 • 100% Yr. 2+	Supply Chain

8.2	Inventory Reduction	Implement Consignment Inventory for select categories	$107,000	• 0% in Yr. 0 • 75% in Yr. 1 • 100% Yr. 2+	Supply Chain
9.1	Ellipse & Legacy System Operations		$1,632,000	• 0% in Yr. 0 • 100% Yr. 1+	Information Technology
9.2	IT Incident Mgmt Savings		$86,100	• 0% in Yr. 0 • 75% in Yr. 1 • 100% Yr. 2+	Information Technology

Note: Figures marked with an asterisk are "lumpy" and the per year value is calculated by dividing the total by 10 (the expected life of the new ERP system and, hence, the duration of the avoided cost). More detailed information on the actual year the cost will be avoided is included in the Financial Model.

Productivity Benefits

ID	Metric Name	Formula	**Target (per Year)**	Realization Timing	Beneficiary Department
Goal: Increased Productivity					
1.1	Journal Entry And Reconciliation Savings	Time saving in reconciliation between 3 systems and elimination of time spent to input Journal Entries.	$118,000	• 0% in Yr. 0 • 65% in Yr. 1 • 85% in Yr. 2 • 100% Yr. 3+	Human Capital Management
2.1	Improved Business Reporting	Reduction in hours spent to produce Business Reports.	$50,000	• 0% in Yr. 0 • 65% in Yr. 1 • 85% in Yr. 2 • 100% Yr. 3+	Distribution Services
2.2	Designer System Rationalization	Designers will work from one system, saving time spent between applications.	$300,000	• 0% in Yr. 0 • 65% in Yr. 1 • 85% in Yr. 2 • 100% Yr. 3+	Distribution Services
3.1	Improved Business Reporting	Reduction in hours spent to produce Business Reports.	$86,500	• 0% in Yr. 0 • 65% in Yr. 1 • 85% in Yr. 2 • 100% Yr. 3+	Distribution Grid Management
3.2	Increased Unit Completions	Raised work visibility to enable better management of crews.	$259,000	• 0% in Yr. 0 • 65% in Yr. 1 • 85% in Yr. 2 • 100% Yr. 3+	Distribution Grid Management

4.1	Procurement Time Savings	Reduction in effort due to enabling of Self Service Procurement.	$52,000	• 0% in Yr. 0 • 65% in Yr. 1 • 85% in Yr. 2 • 100% Yr. 3+	Supply Chain
4.2	Work Order Entry Efficiency	Time savings from Fleet Planing Maintenance Work Orders	$13,910	• 0% in Yr. 0 • 65% in Yr. 1 • 85% in Yr. 2 • 100% Yr. 3+	Supply Chain
4.3	One-Time Vendor Efficiencies	Faster Processing Times for One-Time Vendor Payments	$11,661	• 0% in Yr. 0 • 65% in Yr. 1 • 85% in Yr. 2 • 100% Yr. 3+	Supply Chain
4.4	Data Reconciliation Efficiencies	Time savings -- Red Prairie to ERP Interface Reconciliation	$118,300	• 0% in Yr. 0 • 65% in Yr. 1 • 85% in Yr. 2 • 100% Yr. 3+	Supply Chain
5.1	Designer System Rationalization	Designers will work from one system, saving time spent between applications.	$100,000	• 0% in Yr. 0 • 65% in Yr. 1 • 85% in Yr. 2 • 100% Yr. 3+	Distribution Services
6.1	Improved IT System Reliability	System Downtime Reduction	$1,749,000	• 0% in Yr. 0 • 65% in Yr. 1 • 85% in Yr. 2 • 100% Yr. 3+	Information Technology

Other Benefits (Intangible)

ID	Metric Name	Formula	**Target (per Year)**	Realization Timing	Beneficiary Department
Goal: Improved Data Quality and Security					
1.0	Improved Data Security & Quality	System Rationalization to 1 ERP System.	N/A	From Go-Live	Toronto Hydro

E8.4.4.2 IT Software

1. Software Upgrades

Over the 2020 to 2024 period, Toronto Hydro plans to spend $208.5 million on IT software upgrades, enhancements and regulatory compliance initiatives.

As discussed in the driver's section, Toronto Hydro plans to upgrade its Tier 1 software applications. Table 7, below, outlines the historical and forecast spending for the Tier 1 software applications.

Table 7: Tier 1 IT Systems Upgrades Costs ($ Millions)

IT Systems	2015 - 2019 Actual & Bridge	2020 - 2024 Plan
ERP	62.8	46.3
CIS	10.0	38.5
Tier 1 Systems excluding CIS & ERP	**36.7**	**40.2**
Tier 1 Systems Total	**109.5**	**125.0**

a. Enterprise Resource Planning

Compared to the 2015 to 2019 period, Toronto Hydro is proposing to decrease its spend in relation to the ERP system. As discussed in the 2015-2019 DSP (Exhibit 2B, E8.6), the utility detailed its need to replace the legacy system, Ellipse, in favour of a modern application to address significant reliability and cybersecurity risks. Through a competitive process, Toronto Hydro procured an independent System Integrator services provider for SAP implementation. In addition, the approved ERP program entailed the consolidation of 30 other legacy systems into the new ERP to streamline the effort required to administer and support those functions over the long run and minimize business risks.

In the 2020 to 2024 period, the scope of Toronto Hydro's planned investment in its ERP is reduced and paced more consistently across the five years. Toronto Hydro plans to upgrade its ERP database and application, referred to as ECC, to the current version of SAP's system, referred to as HANA. This upgrade is required because SAP will no longer provide vendor support to the ECC version by 2025. Without the proposed upgrade, this core IT system would be exposed to unacceptable reliability and cybersecurity risks, as detailed in Section E8.4.3. In addition to this upgrade, Toronto Hydro expects to implement ongoing security patches while vendor support is still available and incur data archiving and decommissioning costs from previous legacy programs.

RESPONSES TO SCHOOL ENERGY COALITION INTERROGATORIES

INTERROGATORY 70:

Reference(s): Exhibit 2B, Section E8.4, p. 18

Please provide any internal business case that was created for the ERP and CIS upgrades.

RESPONSE:

Internal business cases setting out the preliminary general scoping of the Enterprise Resource Planning and Customer Information System upgrades are attached as Appendices A and B, respectively, to this response.

Please also refer to the evidence in Exhibit 2B, Section E8.4, which provides the main elements of Toronto Hydro's business case for these upgrades, including the following: the drivers of the investment, the costs, the options analysis, and the proposed approach.

Preliminary Scoping Business Case – Enterprise Resource Planning ("ERP")

Table of Contents

Confidentiality Notice

Document Objectives

The purpose of this document is to provide a common template that will be used for projects within the Toronto Hydro organization, initiated to remain in compliance with Toronto Hydro IT standards.

1 EXECUTIVE SUMMARY

Project Name	Costs	
ERP 2020-2014 Rate Period	$	46.3M

SAP, SuccessFactors and Ariba systems (collectively ERP system) implemented as part of the Enterprise Resource Planning 2015-2019 program (ERP 2015-2019 Rate Period program) is a foundational platform that has significant capabilities with respect to adding new functional capabilities, new reporting features and integrating with major existing non-ERP systems. Through the ERP 2020-2024 Rate Period program, Toronto Hydro seeks to enhance the existing ERP system which support core business processes and operations. This program will also look at and migrate to ERP any systems that have reached their end of life or identify and migrate those services and functionalities that can be better provided through an upgraded ERP system.

Finally, the ERP 2020-2024 Rate Period program's objective is to maintain, operate and develop the ERP system in line with Toronto Hydro's Asset Management Life Cycle Methodology, Run-Grow-Transform[1] strategy and adhere to Toronto Hydro's IT Architectural Standards.

The intended benefits of this program are to:

- increase efficiency through a modern, secure, robust, well-supported and consolidated ERP system;
- integrate with other non-ERP systems to increased system reliability, eliminate duplication and reduce manual efforts;
- improve data governance and data management through the integrated ERP system;
- improve quality of management reporting and strengthen the decision making process;
- customer service employees will be able to better serve the customer through integrated access to customer information/work orders; and
- field workers will be able to have increased access to the systems and get information and data in the field and thereby improve business operations and efficiency

2 PROBLEM / OPPORTUNITY STATEMENT

2.1 Problem / Opportunity Statement

2.1.1 Critical Information Technology Infrastructure Assets

As Toronto Hydro evolves, regular and planned capital investment would be required to its IT systems to keep it current, reliable and secure. Similar to how physical assets age, IT technology matures overtime, business needs change and new cyber security threats emerge.

The ERP system is a Tier 1 application[2]. It is critical to maintain currency for Tier 1 applications. Toronto Hydro has been following the prudent practice of maintaining currency, not necessarily at the

[1] Based on Gartner's Run-Grow-Transform Framework

[2] IT Software Standards classify software applications in two categories – Tier 1 and Tier 2 – based on the consideration of the operational criticality of the application, level of complexity, integration with other applications, maintenance costs and number of

leading edge of technology, but rather a version which is well tested and adopted by the industry. This practice ensures the best value for money as well as a product/version that has been tested in the market, is widely accepted as well as free from bugs and faults. This is the version where the vendor has responded to and tackled most customer issues. Hence, installing a version at least one version behind the latest version generally has the highest level of quality in terms of RASM[3].

SAP BW is the business information warehouse that ERP at Toronto Hydro uses. The current equivalent technology is SAP HANA that includes a database and which has been in the market since 2011. Similarly, SAP ECC 6.0 EHP 8.0 is the ERP application at Toronto Hydro. The current equivalent technology is SAP S/4 HANA which has been in the market since 2015.

The figure below illustrates the market timing of SAP products. Now, as part of the 2020-2024 rate period, is the appropriate time to upgrade both the database and application.

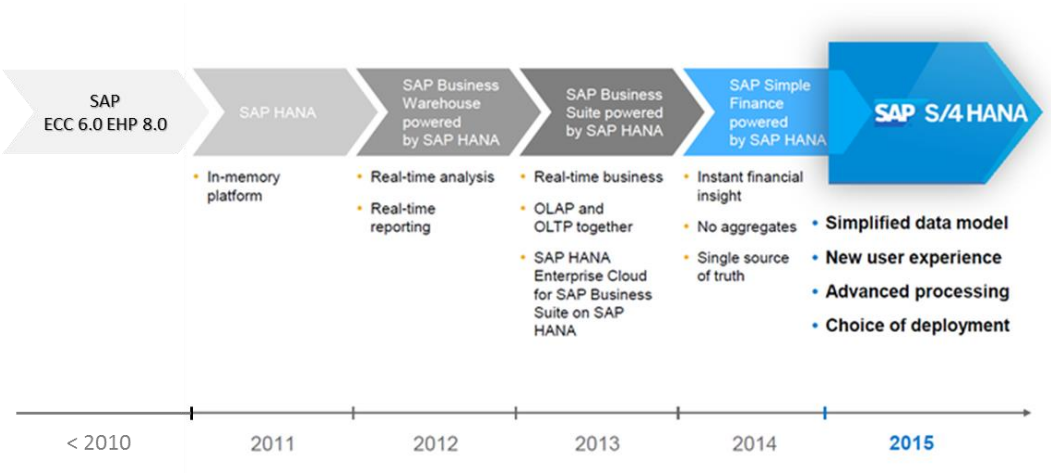

Figure 1: MARKET TIMING OF SAP PRODUCTS

Source: Illustration adapted from erpinnews.com

2.1.2 Product Life Cycle of ERP Software

Our current vendor, SAP, is a global giant in enterprise resource planning software and has strong history of continuous development of new products through innovation. SAP, realizing the criticality of the ERP applications, follows an Innovative Maturity Model for the development of its product (product life cycle). In this model before a product reaches the end of its life it is significantly enhanced through innovative features and technology to be able to continue on another wave of sales and/or implementation. This approach is further promoted by acquisition of other companies' products and integrating it with their core product. This continually expands the functional coverage of an ERP system across the company's operations and business. This model of product development is illustrated in figure below.

users. Tier 1 applications enable Toronto Hydro's business operations and support company-wide business processes. They are functionally integrated with other applications, and are supported by complex underlying infrastructure such as databases, middleware, storage and network. As a result, Tier 1 applications generally have higher maintenance costs and a large user base. In a disaster scenario, the recovery point objective is less than four hours. Examples of Tier 1 applications include the ERP system, Inventory Management System, Geographical Information System.

[3] RASM – Reliability, Availability, Security and Manageability. An industry term for when a software has reached stability in use, adoption and realization of benefits from the product.

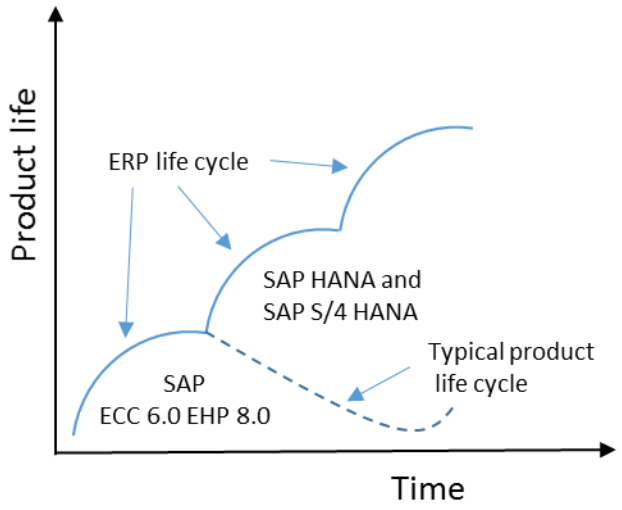

Figure 2: TYPICAL ERP PRODUCT LIFE CYCLE – INNOVATIVE MATURITY MODEL

2.1.3 Strategy To Stay Current With Tier 1 Applications

Toronto Hydro's strategy is continuous upkeep by carrying out technical and functional upgrades. The figure below highlights the benefits of this strategy to keep Tier 1 applications, like the ERP system, current. The investment amount in any particular year and the initiatives depend on the product strategy of the vendor and the vendor's support to its clients. It also depends on new tools and business solutions that the vendor may develop in the future as well as the cost and benefits of such solutions to Toronto Hydro.

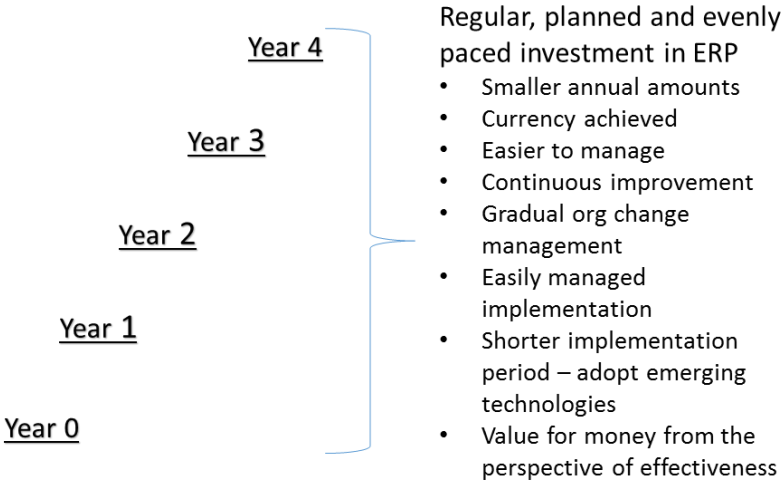

FIGURE 3: IT STRATEGY TO STAY CURRENT WITH CRITICAL TIER 1 APPLICATIONS

Based on the above and anticipated business and IT needs of Toronto Hydro the initiatives in the ERP 2020-2024 Rate Period program are divided as Sustainment stream initiatives and Enhancement stream initiatives.

Sustainment stream initiatives – SAP releases notes/patches on predetermined schedule for various SAP components. These updates to underlying infrastructure need to be performed to maintain stability and patch linkages.

The Enhancement stream initiatives are further grouped into five categories as Integration, Reporting Capability, Advanced Functionality, Ariba and SuccessFactors initiatives. The figure below illustrates at a high level the program and how it relates to the existing ERP system.

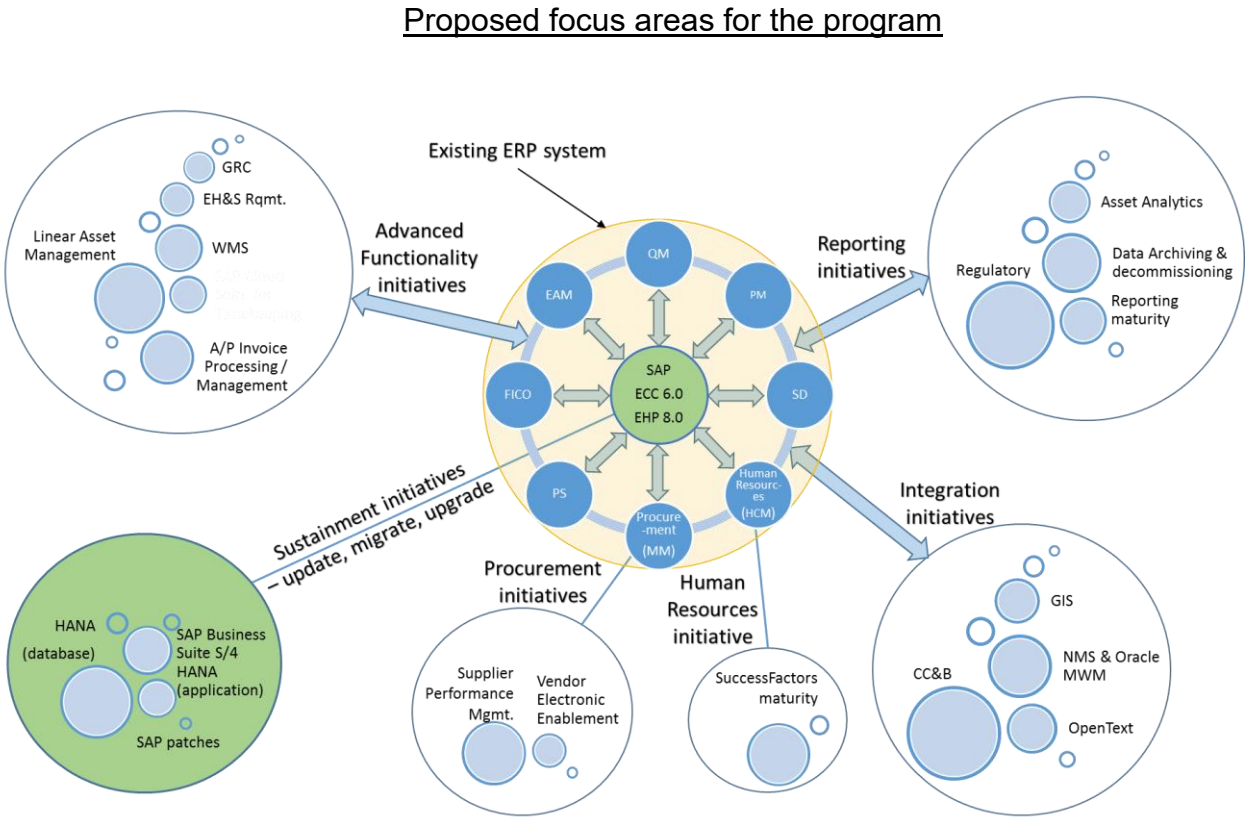

Figure 3: Preliminary Illustration Of ERP 2020-2024 Rate Period program focus areas

The initiatives planned for ERP 2020-2024 Rate Period contains the following focus areas:

- Sustainment – notes/patches, updates, migrations, upgrades; SAP HANA database; and SAP Business Suite 4 SAP HANA (or SAP S/4HANA)[4] application.
- Integration with non-ERP legacy systems – initiatives that integrate ERP with other major (non-SAP) IT systems such as OpenText Document Management System (DMS); Customer Care & Billing (CC&B); Network Management System (NMS); Mobile Workforce Management (MWM); and Geographical Information System (GIS).
- Reporting Capability – initiatives that enable reporting and analytics capabilities through initiatives such as SAP Business Warehouse (BW); and SAP Business Objects (BOBJ).
- Advanced Functionality – initiatives that enable new functionality in SAP such as Linear Asset Management (LAM); Warehouse Management System (WMS); Vendor Electronic Enablement; Environment, Health & Safety (EH&S); Governance Risk & Compliance (GRC); and Vendor Invoice Management (VIM).
- Ariba – Supplier Performance Management; and Vendor Electronic Enablement.
- SuccessFactors – SuccessFactors maturity and further integration of the modules to the SAP ECC system.

2.2 Business Requirements

[4] HANA – High-Performance Analytic Appliance, an SAP product

An implied objective of any ERP optimization and consolidation is the further alignment of business processes to day-to-day activities. Nonetheless, the directly related objectives of this program are to:

- Enhance the foundational platform that the current ERP created through integration with corporate non-ERP systems for more seamless processes and associated improved productivity (increase employee efficiency, eliminate duplication and reduce manual efforts)
- Achieve new functionality in ERP through a modern, secure, robust and well-supported centralized system
- Improve quality of financial reporting and strengthen the decision making process
  Allow secure, reliable and sustained use of the ERP system for the entire duration of its life.

The key, high-level business requirements[5] to ensure sustainability, reliability and deliver business objectives are outlined as sustainability requirements and functional requirements in the following two tables:

2.2.1 High-Level Sustainability Requirements

Requirement	Description
Vendor Supported Solution(s)	Maintaining vendor provided General Support for each application, database or development technology is key to sustainable information technology solutions, for it enables Toronto Hydro's Information Technology Division to provide its users with secure, functionally rich and reliable applications without employing the staff that would be required to design, test, implement and maintain each solution.
Vendor Stability	Given that Toronto Hydro is relying upon its application, database and development technology vendor to enable it to provide its users with up-to-date, secure and reliable applications, the stability and strength of its vendor is an important sustainability factor. A financially strong vendor with an established industry presence and a clear application roadmap will, over time, build functionally rich solution offerings which, in turn, will reduce the need for Toronto Hydro to implement new applications to fulfill new business solution requirements.
Ease of Technical Administration and Support	To help ensure that its Information Technology Division remains as modest in size as possible while, at the same time, continuing to enable necessary business functions**,** the degree to which the solution facilitates technical administration is important. In addition, the availability of application support, from both vendor and system integrator – where required, is an important factor to consider, as it lowers implementation costs and speeds time to result.

2.2.2 High-Level Functional Requirements

To address the business and operations requirements, the new solution will maintain the functionality currently provided by the existing ERP system as well as deliver the following incremental capabilities:

[5] Note that these are high-level requirements only and are intended to be used as a guide to the future option selection process. While directionally correct, they will be augmented and expanded upon in Sustainability and Functional Requirement Specifications should the project receive funding and proceed to the next stage.

Categories	Incremental Solution Requirements[6]
Sustainment Stream	• Typically every year, based on predefined schedule (schedule outlook is typically 6 months), SAP releases OSS notes / patches to various SAP components. The updates to underlying infrastructure need to be performed in conjunction to maintain stability and patch linkages. Scope - Perform a technical upgrade only. • Upgrade to SAP HANA - We have implemented SAP ECC 6.0 EHP 8.0; SAP will release the roadmap for SAP ECC – third party databases in Jan 2019. Depending on the future roadmap upgrading our SAP ECC to run on HANA may have to be eventually considered. Scope - Upgrade BI and ECC to SAP HANA. • Data Archiving / Decommissioning Program - Initiative to ensure that we decommission 35 applications and enable an archiving solution. Scope - Maintain high frequency legacy for read only to account for as needed data retrieval and retire low frequency legacy (store cleansed low frequency data in BI).
Enhancement Stream – Integration	• Integration with Open Text to bring in cross functional process based workflows, notifications and meta-data to flow back and forth between the two systems. E.g., Integration of GCF, RCF, WCF process and process for storage and integration of picture storage for construction and inspection work. Scope - Legal and financial attachment types supported only. • Integration with CC&B to bring in metering orders and tie them to work orders, this will also include CAF process. Scope - One to one mapping between MO and WO supported with 2 way integration. • The extent of Integration with NMS and Oracle MWM will depend on the scope of Oracle MWM project and details of work being performed in NMS vs. Oracle MWM. Scope - One to one mapping between NMS/Oracle MWP and SAP supported with 2 way integration. • Integration with GIS to sync equipment and asset registries between two systems. The complexity depends on the choice of the solution. Scope - One to one mapping between GIS and SAP supported with 2 way integration.
Enhancement Stream – Reporting	• Enablement of Netezza and SAP BW has been enabled through the foundational program however extending Netezza to satisfy all business esp. future regulatory requirements will happen over longer period of time. Scope - Carry over historical data up to two years back for regulatory related reporting only and maintain legacy for older data retrieval. • Regulatory - Models and reports for regulatory team to support OEB Application; includes SAP BW and self-serve reporting. Scope - Export structured data into BW and train staff on self-serve reporting using "variants" (Requires BW/BI in house skills in both IT and the business). • Enabling asset analytics interface with SAP BW and calculations in Business Objects (BOBJ) space. Scope - Extract SAP EAM data into structured BW/BI cubes to be used as data feeds into a 3rd party Asset Analytics application.
Enhancement Stream – Advanced Functionality	• Enabling scope of linear asset management in SAP ECC will depend on creation of nomenclature in GIS and DMS to manage linear assets. This may also include updates to SAP accounting ledgers to accommodate the changes to accounting treatment of assets. Scope - Implement LAM and incorporate all linear assets through data conversion. • Bring Red Prairie (Warehouse Management System) within SAP. Scope - Perform a technical and functional upgrade and perform limited functional enhancements. • Enable EDI interface through Ariba / Value Added Network (VAN) to ensure all the TH vendors are EDI enabled. Scope - Account for vendor collaboration via Ariba and VAN (hybrid).

[6] Only *incremental requirements* are detailed here. A full list of functional requirements will emerge from the SIPOCs and will be included in any RFI / RFP.

	• Enabling EH&S requirements such as Hazard rate, hazard information, MSDS and ISN information. Making it available to crews and other parties as needed. Scope - Extract data and make it available as reports and downloadable spreadsheet format. • Enabling Governance, Risk and Compliance (GRC) capabilities for SAP suite. Scope- Implement SAP Audit Management and Risk Management. • A/P Invoice Processing/ Management Solution - Implement invoice processing and management solution (SAP/OpenText VIM). Scope - Emulate the data entry process.
Enhancement Stream – Ariba	• Configuration of other modules within Strategic Sourcing Ariba Suite - Supplier performance management; adding digital signatures for approvals and documentation. Scope - Configure other modules limited to SAP data feeds and vendor collaboration enablement.
Enhancement Stream – SuccessFactors	• Enabling and maturing more seamless data flow across different SuccessFactors modules and between SF and ECC. Enabling fully integrated end to end solution and business processes through enhanced integration between SuccessFactors and SAP ECC.

2.3 Assumptions & Dependencies

The following assumptions have been made related to the overall scope of this project:

- Successful Go-live of ERP 2015-2019 Rate Period program on October 1, 2018.

3 PROPOSAL DESCRIPTION

3.1 Proposed Solution Description

As described earlier, this program is composed of the following streams:

- Sustainment stream initiatives – these are initiatives that are typically required to update, maintain and upgrade the core ERP system with no or minimal new functionality or capability.

Typically every year, based on a predefined schedule (schedule outlook is usually 6 months), SAP releases OSS[7] notes / patches to various SAP components. The updates to underlying infrastructure need to be performed to maintain stability and patch linkages and this will be ongoing throughout the 2020-2024 rate period. Also part of these initiatives would be the upgrading of the existing ERP database and application software to a more current version. The upgraded version of ERP has been in the market for more than three years and Toronto Hydro believes it is now time to install this version. While support for the current version of SAP (ECC 6.0 EHP 8.0)[8] will likely be available till 2025 (as covered through SAP roadmap released in January 2018 and is subject to change in subsequent SAP releases), development of new functionality and features for this version of SAP has effectively stopped as a newer version of the software has already been rolled out by the vendor. This newer version is HANA for the database and SAP Business Suite 4 SAP HANA[9] (or SAP S/4 HANA) for the application.

One of the initiatives is to enable an archiving solution for the approximately 35 legacy systems that would need to be decommissioned following the ERP 2015-2019 Rate Period program. The data

[7] OSS – Operational Support System
[8] ECC – ERP Central Core; EHP – Enhancement Packages
[9] SAP S/4 HANA is SAP's next generation business suite (application). It's meant to replace SAP ECC/ERP with a simplified tool designed specifically to work with HANA database.

archiving and decommissioning program would maintain high frequency legacy as-needed data retrieval and retire low frequency legacy data.

- Enhancement stream initiatives – These are initiatives that bring additional benefits of productivity, efficiency, ease of doing business and improved customer service.

Integration with other non-ERP systems – Integrate with other non-ERP systems to increase employee efficiency, eliminate duplication and reduce manual efforts. These initiatives integrate ERP with systems such as OpenText; Customer Care & Billing (CC&B); Network Management System (NMS); Mobile Workforce Management (MWM); Geographical Information System (GIS) and Time Sheet application. This integration will allow for faster transfer of information and data as well as reduced manual intervention which decrease the risk of errors and omissions.

Reporting capability – These initiatives improve quality of management reporting and strengthen the decision making process related to plant investment. These initiatives enable reporting, data archiving and analytics capabilities through initiatives such as SAP Business Warehouse[10] and SAP Business Objects[11]. For example, SAP HANA, the database underlying the application SAP S/4 HANA, is an in-memory[12] technology that lets users explore and analyze all transactional and analytical data in real time from virtually any data source. This improves faster task completion which improves the currency of information and helps better decision making.

Advanced Functionality – These initiatives enable advanced functionality in SAP such as Linear Asset Management (LAM); Contracts/Supplier Management; Warehouse Management System (WMS); Vendor Electronic Enablement; Governance Risk & Compliance (GRC); and Vendor Invoice Management (VIM). For example, LAM is an enhancement within SAP Enterprise Asset Management. LAM provides management functionality for linear assets extending over long distances – like overhead electrical wires or underground cables – rather than point assets. LAM allows linear modelling and asset identification by spatial attributes for condition monitoring, order management and analytics. This functionality increases asset capability and availability – as low performance in any linear section could have negative impact on overall throughput.

The figure below illustrates how the initiatives of the ERP 2020-2024 Rate Period builds upon the foundational ERP system.

[10] SAP BW – SAP Business Warehouse – also known as SAP NetWeaver – stands for business information warehouse and is an important technical module of SAP. SAP BW is a software which groups together and formats huge amounts of business data in the data warehouse. A data warehouse is software that integrates, manages and stores all the data within a company from all sources. SAP BW provides critical decision making information and also allows for multidimensional analysis.
[11] SAP BusinessObjects BI (also known as BO or BOBJ) is a suite of front-end applications that allow business users to view, sort and analyze business intelligence data.
[12] In-memory database technology is a database management system that primarily relies on main memory for computer data storage. Main memory is called RAM or Random Access Memory. It is contrasted with traditional database management system that employs a disk storage mechanism. RAM reduces hardware required to store the same amount of data as before. This would lead to reduced costs through simplifications in hardware, maintenance and testing in future years.

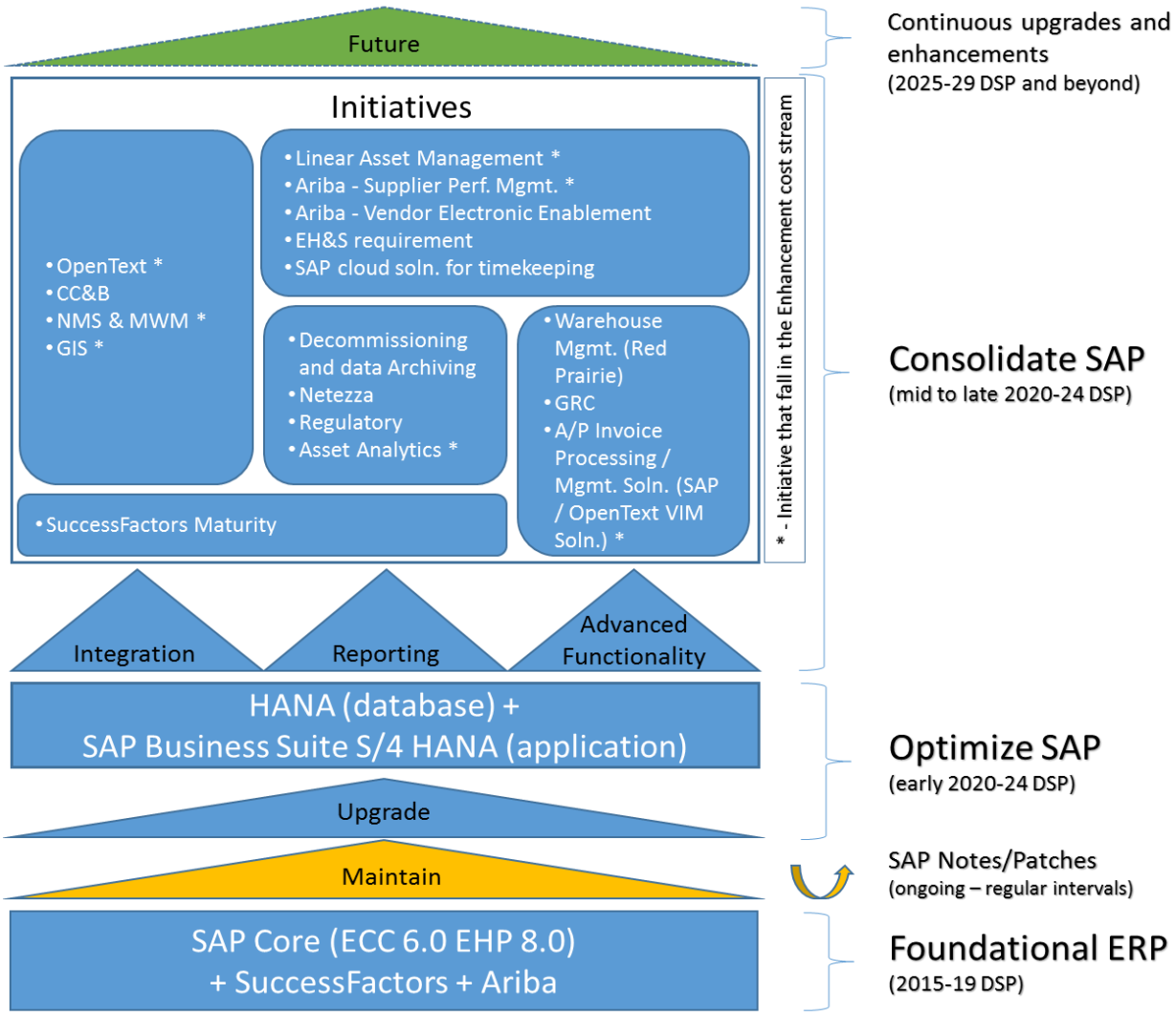

Figure 5: Illustration Of How ERP 2020-2024 Rate Period Initiatives Builds Upon The Foundational ERP

Collectively these streams comprise initiatives preliminarily identified within the program that will achieve the desired business outcomes. The selection of the initiatives; the level of scope solution; and timing will be chosen after the approval of this plan and evolving business needs. As technology, products and business needs change constantly the solution to achieve these outcomes will be refined closer to the time of implementation (start of the rate period). However, the initiatives will be prioritized and rationalized in such a manner as to limit the spending in this program to the amount approved in the 2020-2024 CIR filing. Toronto Hydro will work internally with the various business units and implement those initiatives that return the best value to the company. Also, the selection and implementation of these initiatives will be planned to avoid conflict with any other projects and ensure the initiatives meet pre-requisite dependencies.

3.2 Solution Scope

Please refer to table below for preliminary solution scope.

Segment	Initiative	Description and scope
Integration	Integration with Open Text	Integration with Open Text to bring in cross functional process based workflows, notifications and meta data to flow back and forth between the two systems. Eg. Integration of GCF, RCF, WCF process and process for storage and integration of picture storage for construction and inspection work. Scope - Legal and financial attachment types supported only
Integration	Integration with CC&B	Integration with CC&B to bring in metering orders and tie them to work orders, this will also include CAF process. Scope - One to one mapping between MO and WO supported with 2 way integration.
Integration	Integration with NMS & Oracle MWM	The extent of Integration with NMS and Oracle MWM will depend on the scope of Oracle MWM project and details of work being performed in NMS vs. Oracle MWM. Scope - One to one mapping between NMS/Oracle MWP and SAP supported with 2 way integration.
Integration	Integration with GIS	Integration with GIS to sync equipment and asset registries between two systems. The complexity depends on the choice of the solution. Scope - One to one mapping between GIS and SAP supported with 2 way integration.
Reporting	Reporting Maturity	Enablement of Netezza and SAP BW will happen through the project however extending Netezza to satisfy all business esp. future regulatory requirements will happen over longer period of time. Scope - Carry over historical data up to two years back for regulatory related reporting only and maintain legacy for older data retrieval.
Reporting	Upgrade to SAP HANA	We are planning to deliver SAP ECC 6.0 EHP 8.0; SAP will release the roadmap for SAP ECC – third party databases in Jan 2018. Depending on the future roadmap upgrading our SAP ECC to run on HANA may have to be eventually considered. Scope - Upgrade BI and ECC to SAP HANA.
New Functionality	Linear Asset Management	Enabling scope of linear asset management in SAP ECC will depend on creation of nomenclature in GIS and DMS to manage linear assets. This may also include updates to SAP accounting ledgers to accommodate the changes to accounting treatment of assets. Scope - Implement LAM and incorporate All linear assets through data conversion.
Sustainability	SAP Patches	Typically every year, based on predefined schedule (schedule outlook is typically 6 months), SAP releases OSS notes / patches to various SAP components. The updates to underlying infrastructure need to be performed in conjunction to maintain stability and patch linkages. Scope - Perform a Technical upgrade only.
Reporting	Data Archiving / Decommissioning Program	Initiative to ensure that we decommission 35 applications and enable an archiving solution. Scope - Maintain high frequency legacy for read only to account for as needed data retrieval and retire low frequency legacy (store cleansed low frequency data in BI).
New Functionality	Ariba	Configuration of other modules within Strategic Sourcing Ariba Suite - Supplier performance management; adding digital signatures for approvals and doumentation. Scope - Configure other modules limited to SAP data feeds and vendor collaboration enablement.
Reporting	Regulatory	Models and reports for regulatory team to support OEB Application; includes SAP BW and self serve reporting. Scope - Export structured data into BW and train staff on self serve reporting using "variants" (Requires BW/BI in house skills in both IT and the business).
New Functionality	Red Prairie	Bring Red Prairie (Warehouse Management System) within SAP. Scope - Perform a technical and functional upgrade and perform limited functional enhancements.
New Functionality	Vendor Electronic Enablement	Enable EDI interface through Ariba / Value Added Network (VAN) to ensure all the TH vendors are EDI enabled. Scope - Account for vendor collaboration via Ariba and VAN (hybrid).
Reporting	Asset Analytics	Enabling asset analytics interface with SAP BW and calculations in BOBJ space. Scope - Extract SAP EAM data into structured BW/BI cubes to be used as data feeds into a 3rd party Asset Analytics application.
New Functionality	EH&S Requirements	Enabling EH&S requirements such as Hazard rate, hazard information, MSDS and ISN information. Making it available to crews and other parties as needed. Scope - Extract data and make it available as reports and downloadable xls.
New Functionality	GRC	Enabling GRC capabilities for SAP suite. Scope- Implement SAP Audit Management and Risk Management
New Functionality	Successfactors Maturity	Enabling and maturing more seemless data flow across different successfactors modules and between SF and ECC. Enabling more self serve options for employees and managers. Scope - Interfaces external to successfactors.
New Functionality	A/P Invoice Processing / Management Solution (SAP / OpenText VIM Solution)	Implement invoice processing and management solution (SAP/OpenText VIM). Scope - Emulate the data entry process.

3.3 Options Analysis

The following options have been considered:

1. Status quo / do nothing
2. Implement a simple scope solution with minimal benefits
3. Implement a moderate scope solution with benefits that are commensurate to the costs
4. Implement a complex scope solution with benefits that do not justify the higher level of costs

Each option was evaluated for the proposed focus areas for the 2020-2024 Rate Period and is summarized at a high-level in the table below:

Options Analysis - ERP 2020-2024 Rate Period				
Criteria	**Status quo / do nothing**	**Simple Scope Solution**	**Moderate Scope Solution**	**Complex Scope Solution**
Integration with Open Text				
Integration with CC&B				
Integration with NMS & Oracle MWM				
Integration with GIS				
Reporting Maturity				
Upgrade to SAP HANA				
Linear Asset Management				
SAP Patches				
Data Archiving / Decommissioning Program				
Ariba				
Regulatory				
Red Prairie				
Vendor Electronic Enablement				
Asset Analytics				
EH&S Requirements				
GRC				
SuccessFactors Maturity				
A/P Invoice Processing / Management Solution (SAP / OpenText VIM Solution)				
Total estimated cost of program				
Intended benefits from program				
Overall recommendation			✓	

Legend
Does not meet criteria
Partially meets criteria
Meets Criteria
Exceeds Criteria

3.4 Cost

Some of the resources from within Toronto Hydro who were involved in the ERP 2015-2019 Rate Period program may also be involved in the ERP 2020-2024 Rate Period program. To efficiently utilize these resources and to keep resources evenly distributed throughout the implementation period it is recommended to start the ERP – O & C initiatives in early 2020. Generally, most of the initiatives are relatively small in scope and scale and as such will be staggered over the five year period. Toronto Hydro intends to follow a "rolling" model of few initiatives under implementation at any given point in the rate period as opposed to a "big-bang" approach where all initiatives Go-live at the same time.

Toronto Hydro requires flexibility over the five year period to execute its ERP 2020-2024 Rate Period program. This includes flexibility to manage externally-driven risks, such as the risk that the vendor may increase software/ hardware costs over the 2020 to 2024 period or change the release dates for ERP application updates and patches. Both of these events could affect the cost, timing and pacing of a program in a given year. However, based on the strategy to keep current with Tier 1 applications the amount of spending has been gradually paced to increase with later years in the rate period. The below table breaks down the historical and forecast program costs for ERP.

Program	**Forecast**					
	2020	**2021**	**2022**	**2023**	**2024**	**Total**
ERP 2020 - 2024 Rate Period	6.4	9.0	9.2	10.7	11.0	**46.3**

Prior to investing in new IT systems, Toronto Hydro follows an evaluation methodology to help ensure that the utility makes well-informed decisions relating to new IT investments[13]. The cost estimate of initiatives in the Sustainment stream is the combination of regular updates of notes and patches, migration to HANA database and upgrade to the SAP S/4 HANA application, and data migration and decommissioning. The cost estimate of the Enhancement stream are the total of those initiatives that the business units have preliminarily put forward as valuable to the company to achieve its goals for the 2020-2024 rate period.

[13] Details of this standard methodology is available in Exhibit2B Section D5 paragraph D.4.2.2

Preliminary Scoping Business Case – Customer Information System (CIS)

1 EXECUTIVE SUMMARY

Project Name	Costs	
Customer Information System Upgrade	$	38.5 M

The purpose of this program is to upgrade the Customer Information System ("CIS") to a version consistent with the risk mitigation objectives of Toronto Hydro's Information Technology Asset Management Strategy. Furthermore, if the CIS is upgraded to a current version which is closely aligned to other Ontario Local Distribution Companies ("LDCs"), this will better position the utility to respond to future public policy initiatives with lower costs or shorter delivery timeframes.

The CIS stores customer account information, produces bills, applies payments to customer accounts, and optimizes activities to collect outstanding amounts. The current version of Toronto Hydro's CIS has only been eligible for minimal vendor support since April 2016. This level of support only covers pre-existing patches and the vendor no longer addresses emerging threats to Toronto Hydro's customer information or the accuracy of their bills. Without full vendor support, any disruption caused by a system failure will take longer to resolve as it is challenging to obtain the suitable skilled resources to resolve the issue. Toronto Hydro will incur additional costs in correcting any errors in coding or any open security vulnerabilities

Toronto Hydro issues approximately 43,000 bills per day and any delays or inaccuracies in those bills have major customer impacts. This is in addition to any impact on revenue capture and financial reporting that would also result. Currently, Toronto Hydro minimizes these risks via additional Information Technology operating costs and additional testing of every modification to the system, no matter how small. However, the risks cannot be entirely eliminated through this approach. This tactic is only suitable in the short-term as the costs become exponentially higher the further Toronto Hydro's CIS differs from the vendor and industry norms.

It is important to note that Toronto Hydro's system will be at least four years out-of-support and will have been in service for 10 years before this program completes the initial upgrade. This results in the program being a substantial undertaking as it must assess the changes across five major versions of the system, interfaces with 33 other technology systems, 460 reports, 400 business processes, and 1000 configurations, and customizations. The CIS is used by 270 individuals, each of which must be retrained and whose work must remain consistent with regulatory and customer expectations.

Benefits will be attained consistent with the objectives of Toronto Hydro's Information Technology Asset Management Strategy, such as:

- improved data security and quality including improved protection against cyber-security threats and unauthorized access to customers' confidential information; and
- mitigation of reliability risks of CIS with an upgraded and vendor supported system.

2 PROBLEM STATEMENT

2.1 Problem Statement

Toronto Hydro is using the CIS to control and operate the meter-to-cash process responsible for the billing, payment application and collections activities for $4 billion in annual revenue or approximately $18 million per day. The CIS also manages account and personal information for approximately 764,000 customers.

As media coverage and bill accuracy perception have shown, the reliable operation of a company's CIS is a critical part of brand and reputation, both inside and outside the electricity industry. This is in addition to the critical role the CIS plays in ensuring accurate and timely revenue capture and financial reporting.

Toronto Hydro's CIS is five major versions behind the current version which exposes customers and the utility to increasing levels of risk as described in the bullet points below. Toronto Hydro intends to bring the CIS back into the regular Tier 1 lifecycle. However, Toronto Hydro has also had to perform long-awaited upgrades on other key systems (for example NMS and ERP) prior to doing this. Although the optimal strategy from a corporate perspective, this increases the scope, time required and cost of the initial upgrade described in this document.

Toronto Hydro implemented its current CIS in 2011. In the time since implementation, Toronto Hydro has ensured that the system remained cost effective, secure, and reliable through ongoing minor software upgrades and incremental custom development. This was done to meet evolving public policy, regulatory and business requirements. As the CIS continues to age, the risks associated with the system become more difficult to mitigate. These risks include:

- **Limited vendor support** – the system is not supported against defects or security flaws discovered after April 2016. All system changes required to meet financial, legislative or public policy requirements must be purchased or developed internally at an additional cost. Additionally, collaboration to deliver new functions or features and/or reduce costs with other LDCs is becoming increasingly difficult since the companies are operating on increasing divergent versions. For example, for recent policy changes the vendor has supplied one solution for three LDCs and a separate one for Toronto Hydro despite identical requirements.
- **Personal data security deficiencies** – Toronto Hydro's CIS version no longer receives fixes to security gaps from the vendor. The CIS operates on aged infrastructure which in turn will have issues related to vendor support. Customer personal data and consumption information are more vulnerable to cyber security attacks such as "exploit" and "denial of service" types of attacks. "Exploit" type attacks seek to gain unauthorized access to confidential information such as customers' personal information and bank account details. A successful "denial of service" attack would mean Toronto Hydro could not issue electricity bills, apply payments to accounts or service customer accounts.
- **Resource availability** – Toronto Hydro's CIS includes substantial portions built with the COBOL programming language, which was first used in 1959, and is criticized for being not easily comprehensible. Due in part to this, the vendor over recent versions has replaced all COBOL programs with JAVA programs. This is a common occurrence across the computer industry and as such, COBOL programmers are both difficult to find and expensive to retain. Should a major issue occur with the CIS, it is likely that it will be sustained while suitable and sufficient resources are located.
- **Technology Enhancements –** The replacement of COBOL with JAVA and other similar changes in underlying technology and supported infrastructure will also significantly lower the effort required to implement future changes, maintain and support the system. The transition to common technologies also allows Toronto Hydro to use its internal resources more effectively as specialist skills would no longer required.
- **Integration Architecture** – Where possible, Toronto Hydro has included industry best practices in the CIS and supporting business processes. However, because of limitations in the current CIS, Toronto Hydro has invested in customizations to support the required regulatory, legislative or other Ontario market functions and features. These customizations, some of which can be delivered by standard functionality in the latest version, increase the complexity of the system, make it more expensive to support and more prone to errors unique to Toronto Hydro and its customers. Errors unique to the utility typically take a much longer to resolve since the same error is not in the current, vendor delivered code that the entire user community uses.

  In the current business environment, significant opportunities exist when systems are integrated with one another. The current CIS version is difficult and expensive to integrate with other systems often to the point that potential customer service improvements are not cost effective.

Given the criticality of the CIS to Toronto Hydro's business operations, an upgrade to the system likely provides an opportunity to improve operational efficiency through optimization of processes, simplification

or removal of modifications to the system and processes, and the implementation of new functionality. To implement any such changes, Toronto Hydro's policies require the demonstration of benefits which are greater than the costs. Furthermore, this analysis competes against other initiatives based on net benefit for the utility.

Generally speaking, with this type of initiative, Toronto Hydro considers the following in the early stages of the project:

- **Optimization** – Toronto Hydro periodically reviews business operations and looks for optimization opportunities. By optimizing processes, Toronto Hydro is able to reduce rework and increase the quality and timing of staff outputs. Optimization also allows Toronto Hydro to create predictive mechanisms to manage outcomes and monitor efficiency and effectiveness of critical processes.

  Early consideration of opportunities for optimization, typically through automation, have flagged the following for further investigation:

  - Customer experience processes including customer move processing, bill and payment analytics, and customer issue management,
  - Processes related to bill presentment, electronic payments, equal payment plans processing, billing adjustments, and meter data verification,
  - Collections and severance processes, including a more segmented arrears management strategy, and
  - Exception management and audit functionality
- **Simplification** - With the evolution of public policy, growth of customer service offerings and increasingly complex billing scenarios, there may be a need to simplify the CIS architecture. The simplification process aims to evaluate the existing configuration and system setup and compare it against the flexibility that will be required in the future. Toronto Hydro has identified simplification opportunities related to system configuration and data processing between systems for further analysis. This in turn will reduce the implementation time for public policy initiatives. They may also lower the costs of related process automation and may allow for improved process controls which manage and monitor efficiency and effectiveness of customer services.
- **New functionality -** Toronto Hydro plans to further assess new functionality available in the latest version of the CIS. Initial high-level work indicates that some of Toronto Hydro's customizations are now base CIS features. Customizations increase costs of future upgrades since they frequently require expensive vendor services and potentially proprietary code. By adopting base CIS features in place of customizations, Toronto Hydro aims to reduce future upgrade time requirements and subsequent costs.

2.2 Business Requirements

This section lists the key interested parties (internal/external) impacted by this solution. It identifies who is involved directly (as a recipient of the solution outcome) or indirectly (through integration/alignment with other programs and/or work processes), and their high-level requirements for the solution to meet their expectations. This early list of requirements identifies a combination of key requirements, capabilities for investigation and areas of known differences between the current CIS and the current in-market version.

Department	Division	Requirements
Call Center	Customer Care	• Ability to process moves including setting up landlord agreements • Ability to link incoming and outgoing documents to customer accounts as a part of document & record management process • Ability to manage information relays between different Customer Care departments through consistent processes • Ability to update landlord information on multiple premises • Ability to produce landlord move notification letters • Ability to inform internal staff of marketing initiatives in a timely and consistent manner

Department	Division	Requirements
		• Ability to maintain and access accurate customer data in CIS by optimizing and creating appropriate process controls (e.g. Standardize structured format to eliminate inaccurate service address, email address or phone numbers) • Ability to manage customer cases accurately and timely manner for customer escalations, account management and follow ups • Reduce manual effort to analyze/create billing history for analysis • Reports to control the process efficiency and effectiveness
Collections	Customer Care	• Optimize collections and severance process steps and controls to manage bad debt • Ability to accurately and consistently perform transfer of balance between service agreements without system automatically resetting the aging so that collections activities can be initiated as per business rules • Ability to assess/capture partial payment cases to improve severance process effectiveness • Ability to have segmented arrears management process and controls to maintain bad debt at acceptable levels • Enhanced controls to proactively assess and monitor accounts or customers at high risk for continued non-payment • Ability to evaluate the collection process effectiveness to create a feedback loop to CIS from auto-dialer event • Ability to segment account base based on quantitative factors to make decisions related to collections activities • Ability to view past due arrears in a single holistic view and take appropriate actions to improve average call handling time • Ability to calculate amount of deposit based on customer risk profile • Ability to process field activities • Ability to apply direct deposit and deposit interest linked to customer account based on business rules • Ability to interact effectively with customer when initiating remote reconnect process • Ability to send a copy of any disconnection notice issued to the customer for non-payment to a third party designated by the customer for that purpose provided that the request is made no later than the last day of the applicable minimum notice period • Ability to send notices/letters through customer preferred channels • Ability to optimize the process where a disconnect field activity (FA) is outstanding (waiting for a read to be returned), a payment plan should not cancel the FA • Reports to control the process efficiency and effectiveness • Ability to record write-offs and write-backs
Remittance	Customer Care	• Automate EFT process in CIS • Ability to perform real time tender balancing • Ability to mass update system (e.g. different types of payments) • Ability to reverse payments for multiple accounts • Ability to evaluate the charge back reason when a payment is reversed • Improve PAP, NBB and payment reversal letters and review processes • Ability to identify and take corrective action for duplicate refunds • Ability to refund customer credit in automated and consistent manner • Ability to provide equal payments plan (evaluate budget billing) in consistent manner • Optimize security deposits that needs to be refunded within 10 days of the final bill • Improve debit adjustment process • Reports to control the process efficiency and effectiveness

Department	Division	Requirements
Billing	Customer Care	• Ability to disable autopay when a billing adjustment is performed until customer provides direction for repayment for billed amount • Workflow approval control over manual bill cancellations • Ability to control high and low bill cases consistently and accurately • Ability for customer review bill segment based on different pricing terms • Ability to optimize process with extensive manual and repetitive steps (e.g. declaration form, rate reclassification etc.) • Ability to identify and take actions for cases having zero consumption • Ability to cancel multiple bills linked to customer account • Ability to provide credits for net metering customers accurately and consistently • Ability for clearing un-actionable flag from the CIS • Automation of manually produced customer letters • Optimize adjustment approval process (e.g. CIS allows to change the amount of the adjustment after it's already submitted for approval. This does not modify the approval threshold amounts) • Ability to bill new segment of customer accurately and consistently (e.g. new SA for FIT customers) • Ability to do a segmented bill insert for select customers on an ad-hoc basis • Ability to issue consolidated billing for customers having multiple accounts • Ability to process online payments • Ability to automatically waive account setup fee based on special cases • Ability to automatically identify if a customer is doubled billed for the period • Reduce billing segment errors for timely, & accurately issuance of bill • Ability to link weather information with bill information (e.g. case of high bill) • Ability to consolidate the bill for customer having multiple accounts • Ability to evaluate significant variance in consumption through automated reminder (e.g., To Do TD-INT (Interval Profile Peak Validation) logic needs to be reviewed and updated to ensure that to dos are only generated on accounts with significant variances in consumption) • Ability to evaluate significant variance in month over month dollar amount billed • Ability to flag bill segments that have issued bills for more than one billing period (e.g. bills going out for multiple periods cause incorrect calculations on distribution and transmission rates due to bill is calculated on highest demand for whole period) • Ability to flag and review the first bill segment of a new accounts where consumption or demands are outside the rate class of the customer • Reports to control the process efficiency and effectiveness
Billing and Meter Data Management	Customer Care	• Ability to monitor the life cycle of FA so that billing knows when a meter is energized • Proactive exception management, for e.g. ability to evaluate all the prior and immediate issues while solving an error to get a holistic view of the scenario • Automatic cycle validation, exception read from Operation Data Store (ODS) • Ability to automatically validate prime read meter reads • Enhance RIMS meter pending To Do's so that correct action can be taken in timely manner • Ability to accurately and consistently perform RIMS billing by having automated process control

Department	Division	Requirements
		• Ability to process wholesale settlement process done in MVWEB, suite meter account setup, manipulation of service point, meter change in an optimized manner • Reports to control the process efficiency and effectiveness
All Customer Care	Customer Care	• Ability to simplify the organization (chronological) or modification/deletion or reduce duplicates of same note type class of customer contact notes for reducing average customer call handling time and provide holistic view customer interaction and escalations • Ability to communicate (proactive notifications and transaction confirmation) with customer through different communication channel • Ability to simplify process steps and management controls for end users through proactive reminders and optimized workflows (e.g. Idle process - To create a reminder to trigger action at the time of the move out, collection & severance process etc.) • Optimize the bill print process and improve bill appearance • Ability to track and audit account level information • Ability to process online payments in the CIS • Ability to classify segment of customer based on new segment agreement definition (e.g. new SA for FIT customers) • Ability to mass update system (e.g. different types of payments) • Optimize the bill print process and improve bill content accuracy • Optimize the process and content of capturing customer information (e.g. address) • Evaluate the feasibility of driving billing change decision at account level instead of service agreement level • Evaluate the feasibility of having one to one relationship between customer (person), account, service agreement and service point • Evaluate the feasibility to create low/high threshold based on consumption as billing is factor of rates • Evaluate the feasibility of creating an automated control to reduce the variance in following the business process step • Maintain or reduce system refresh rate • Business rules for segmentation of data for archival purposes

2.3 Assumptions & Dependencies

The following assumptions have been made related to the initiation of this project:

- Project Stakeholders with executive authority to make decisions with respect to the outcomes of the project will be identified as the single point of contact for the project team throughout the project.
- Toronto Hydro staff will be available as required to support the development of the business and process designs, and system architecture.
- Deliverables which require approval by non-project team members will be reviewed within five business days, with approval not unreasonably withheld.
- Toronto Hydro Business Units will provide Subject Matter Experts to the project as required to ensure the timely completion of deliverables.
- Cost outlines high level project implementation cost doesn't include cost for peripherals

Any change in this understanding will result in a change to the project scope and will be subject to the established change process.

3 PROPOSAL DESCRIPTION

3.1 Options Analysis

The following options have been considered:

1. **Do Nothing (i.e. Delay Investment):** In this scenario, the CIS system will be maintained as-is and will continue to operate on the current version and infrastructure. Through minor incremental investment, the CIS will be sustained, where possible, to provide the minimum operational functionality required. The integration, configuration and customization will be retained as-is without any further investment.
2. **Base Technical Upgrade:** In this scenario, Toronto Hydro would identify the simplest path to upgrading the CIS system to a version fully supported by the vendor. All CIS applications interfaces and integration with other IT systems would be maintained, "as is", with no new functionality within or additional connectivity between applications provided. Existing customizations would require case-by-case evaluation to determine the appropriate treatment.
3. **Enhanced Implementation of CIS:** In this scenario, Toronto Hydro will build upon Option 2 through targeted, incrementally expanded, and cost justified scope that seeks to maximize the use of base functionality in the new version and leverage new opportunities to enhance value to customers. The configuration and development work necessary to implement Toronto Hydro's future state requirements would be undertaken to achieve cost reduction and productivity improvement goals
4. **New Implementation of CIS:** In this scenario, Toronto Hydro would decommission the current CIS system, replacing it with an entirely new system. A new integration architecture around the CIS system will replace the existing architecture. All the integrated technology systems will be optimized based on current standards. The configuration and development work necessary to implement Toronto Hydro's future state requirements would be undertaken to achieve cost reduction and productivity improvement goals. In this approach the likely first system to be considered would be SAP to leverage the recent ERP investment and skills acquired internally.

Each option was evaluated based on the following criteria:

a) Alignment with Tactical and Strategic Goals: Assessment of how well the option achieves the goals of risk reduction, improving customer satisfaction or experience, reducing costs, or improving ability to respond to public policy initiatives.

b) Solution Capability: Does the option align technologies and applications, while minimizing the amount of customization to the system.

c) Operations and Maintenance: How costly is the option to support and operate on an ongoing basis.

d) Comparative High-Level Cost vs Direct Benefits: Does the option provide direct and quantifiable benefits, and to what magnitude. How do those benefits compare to the estimated cost of the option.

See below for a high-level summary of the detailed option evaluation.

Criteria / Option	Do Nothing – Delay Investment	Base Technical Upgrade	Enhanced Implementation of CIS	New Implementation of CIS
Alignment with Tactical and Strategic Goals				
Solution Capability				
Operations and Maintenance				
Comparative High-Level Cost vs Direct Benefits				

Legend
No Alignment to Criteria
Some Alignment to Criteria
Meets or Exceeds Criteria

3.2 Working Program Approach Description

Toronto Hydro developed its working program approach considering the high-level options assessment and to lower the program delivery risks. As a result, Toronto Hydro is adopting the Enhanced Implementation of CIS approach based on the available information.

The first initiation and discovery step will be focused on understanding and documenting the current state and detailed requirements. Following this each requirement will be assessed and a suitable solution architected, given each requirement may have multiple ways to deliver this will be a significant undertaking. At this point greater information about opportunities is expected to be available, also the project team will have developed a greater understanding of the capabilities in the new version. Toronto Hydro will individually evaluate elements to determine if they should be added to the project scope due to positive cost justifications.

The majority of the work and cost occurs in the Implementation phase. This is due to three primary reasons. Firstly, there are more than 164 changes between Toronto Hydro's current version and the in-market version. For each of these, Toronto Hydro must assess the impact to current business processes and associated users, how the change interacts with the 1000 customizations or 460 reports. Interfaces and technical changes must also be evaluated and addressed along with a fundamental underlying code change from COBOL to Java, requiring each portion of code written in COBOL to be located, assessed, recoded and tested in Java.

Secondly, the latest version of the CIS requires changes to underlying messaging technology as the current technology is not supported by the vendor, plus it allows all the Tier 1, highly-available infrastructure to be moved to the current standard.

The final component that primarily contributes to the time and cost of the program is the testing element, which is critical to ensure all billing, customer and regulated requirements are met. Given the number of changes that will occur during the upgrade, this will be the most labour intensive part of the program.

Finally, the program will complete the Support phase which is to address any immediate issues and support the 270 users of the new system adapt to the changes.

3.3 Solution Scope and Cost

This section outlines the scope of the solution and the associated cost required to deliver the high-level proposed solution.

Requirements	Scope
Initiation and Discovery	• Governance ○ CIS governance model ○ Core and secondary team allocation • Project approach ○ Workshops on CIS latest version

	○ Definition and acceptance by governance body ○ High level “Time boxed” project plan ○ Selection of external vendor to support process definition work – latest version will be installed in-house
Strategize and Architect	• Future state business and process architecture and installation of latest version to initiate a discovery exercise • Creation of the blueprints for future state business processes • Options evaluation – cost and benefit analysis of different methods to meet the business requirements • Finalization of future state process (Level 1-2- & 3) • SIPOC (suppliers, inputs, process, outputs, and customers) and business requirements document for the finalized process architecture • Technical requirement finalized to support the business requirements • Finalize solution architecture and supporting documentation • Project charter and scoping document finalized • System integrator selection - System Integrator contract for services required to support the completion and management of the program • Quality management strategy • Change management strategy • System and user acceptance test strategy • Training strategy • Change readiness assessment • Master data strategy • Data cleansing and conversion strategy
Implementation	• Finalization of blue print documentation • Integrated project plan for technical and optimization phases • Technical infrastructure installed, tested and deployed • Interface and integration architecture • Configuration and development • Data architecture and clean up • Unit testing • System integration testing • User acceptance testing • Training need analysis and creation of “work day” scenarios • End user process and system training • “Hour-by-Hour” cutover and cutover plan • Fall-back/roll back plan • Support and sustainment analysis and plan • Go Live • Quality and go live verification
Support	• 90 days post go live support • Roll off / transition plan execution • Project closure report

Cost Estimation

Program Element	Capex
Initiation and Discovery	$1 million
Strategize & Architect	$2.1 million
Implementation	$30.9 million
Support	$4.4 million
Total	**$38.5 million**

In 2015, Toronto Hydro operated five different legacy wireless SCADA technologies, which it proposed to address as part of the 2015 to 2019 Distribution System Communication Infrastructure ("DSCI") Program (see 2015 CIR Application, Exhibit 2B, E6.22). During the course of the upgrade, the underlying GE SD9 technology reached end of life and became functionally obsolete, meaning that it would no longer be vendor-supported and thus be prone to longer outages that impede restoration efforts. Toronto Hydro plans to replace GE SD9 with GE Orbit, the current technology that is supported by the vendor.

4. Underground Radio Expansion

This initiative is intended to address gaps in Toronto Hydro's radio coverage at certain underground vaults that are located well below ground level (i.e. parking level 2, "P2", or lower). Based on operational experience, current radio technology has connectivity challenges at specific locations, which create safety and operational concerns. To mitigate these risks, Toronto Hydro intends to procure and deploy powered wall-mounted units with wireless Bluetooth microphones, which pair to standard radio units so they can be used in locations where they otherwise could not receive a signal.

E8.4.4 Expenditure Plan

Table 5: Historical & Forecast Program Costs ($ Millions)

Segments	Actual			Bridge		Forecast				
	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
IT Hardware	7.5	9.3	10.1	7.8	7.8	11.5	10.3	11.6	14.0	14.5
IT Software	14.8	21.7	40.3	50.8	19.7	41.0	43.0	35.8	40.5	48.2
Communication Infrastructure	6.1	17.6	4.9	6.0	6.9	2.2	2.4	2.1	2.1	2.1
Total	**28.4**	**48.6**	**55.4**	**64.6**	**34.4**	**54.8**	**55.7**	**49.5**	**56.6**	**64.8**

Over the 2020 to 2024 period, Toronto Hydro forecasts spending $281.4 million across the three IT/OT Program segments. This represents an increase of $50.2 million (or approximately 22 percent) compared to 2015 to 2019 spending, which is inclusive of the following programs from Toronto Hydro's 2015 Distribution System Plan:

- E8.4 (IT Hardware)
- E8.5 (IT Software)

2.16 Finance

There were no material changes in 2018. Please refer to Exhibit 4A, Tab 2, Schedule 16 for information about this program, including detailed variance analyses.

2.17 Information Technology

Table 11 below provides the Historical (2015-2018), Bridge (2019), and Test Year (2020) expenditures for the Information Technology program by segment.

Table 11: Information Technology Program Costs by Segment ($ Millions)

	2015 Actual	2016 Actual	2017 Actual	2018 Actual	2019 Bridge	2020 Test
IT Governance	2.7	2.9	3.0	3.2	3.3	3.4
IT Operations	27.9	28.3	30.9	31.4	35.3	35.6
Project Execution	1.6	1.4	1.6	3.2	1.6	1.7
Security & Enterprise Architecture	2.7	2.4	2.9	3.2	3.3	3.4
Total	**34.4**	**35.0**	**38.4**	**41.0**	**43.5**	**44.0**

In 2018, the cost of the program was aligned with the forecast in Exhibit 4A, Tab 4, Schedule 17. However, there were variances at the segment level. In the Projection Execution segment, there was a one-time increase for additional labour resources required to support migration and training activities related to then ERP project. This increase was offset by lower than forecasted costs in the IT Operations segment related to maintenance for newly implemented or upgraded systems. The unrealized maintenance costs are expected to commence in 2019, contributing to a higher increase from 2018 to 2019 in the IT Operations segment. Additional labour requirements to support new systems and higher costs for purchased services contracts are also contributing to the variance between 2018 and 2019.

Toronto Hydro-Electric System Limited
EB-2018-0165
Exhibit 2B
Section E8.4
Appendix A
ORIGINAL
(35 pages)

IT Budget Assessment Final Report

16 March 2018

Prepared for: Torys LLP

Project Number: 330045299

GARTNER CONSULTING

Executive Summary

- In connection with THESL's upcoming distribution rate application, Gartner completed a peer benchmark of the THESL IT budget.
  - The assessment included a comparison of high level IT metrics and spending and staffing distributions with a view to providing insight into how IT spending aligns with peer organizations.
- For 2017, THESL IT Spending as a Percentage of Revenue and of Operational Expense are both lower than the peer group (2.2% vs 2.5% and 2.4% vs 3.1% respectively).
  - Infrastructure support cost is also less than other peer organizations would spend to support the same workload – $32.4M compared to $37.1M (12.6% or 4.5M less).
- Distribution of spending by cost category, investment category and functional area are all comparable to the peer group, with some variation but no significant issues identified.
- THESL also provided Gartner a forecast for 2020 spending and staffing in addition to 2017 data.
- Results of the comparison of the 2020 forecast to the 2017 peer group show similar results.
  - For 2020, THESL IT Spending as a Percentage of Revenue and of Operational Expense are both lower than the peer group (2.3% vs 2.5% and 2.7% vs 3.1% respectively).
- As in 2017, the distribution of spending by cost category, investment category and functional area are all comparable to the peer group, with some variation but no significant issues identified.
- THESL did not forecast infrastructure workload or users, so Gartner did not calculate comparable infrastructure efficiency or employee-based metrics for 2020 data.

Gartner

Benchmark Analysis Methodology
Peer Comparisons

- A peer group of 15 Utilities was selected based on industry and revenue.
  - The same peer group is used for both the 2017 and projected 2020 results.

	THESL 2017	THESL 2020	Peer Average
Revenue (millions)	$4,016.9	$4,042.5	$4,477.8
Operational Expense (millions)	$3,572.7	$3,447.5	$3,659.8
Organization Employees	1,390	1,467	4,730
Organization Users (from Active Directory)	3,430	N/A	N/A
IT FTEs	214	200	305
IT Capital and Operational Expense (millions)	$87.1	$92.9	$110.4
Customers	758,193	784,095	1,233,000

  - Peer geographic distribution is 7 United States, 4 Canada and 4 Western Europe.
  - All serve major urban locations.
  - THESL 2017 data is based on 11 months of actuals plus one month estimate to complete.

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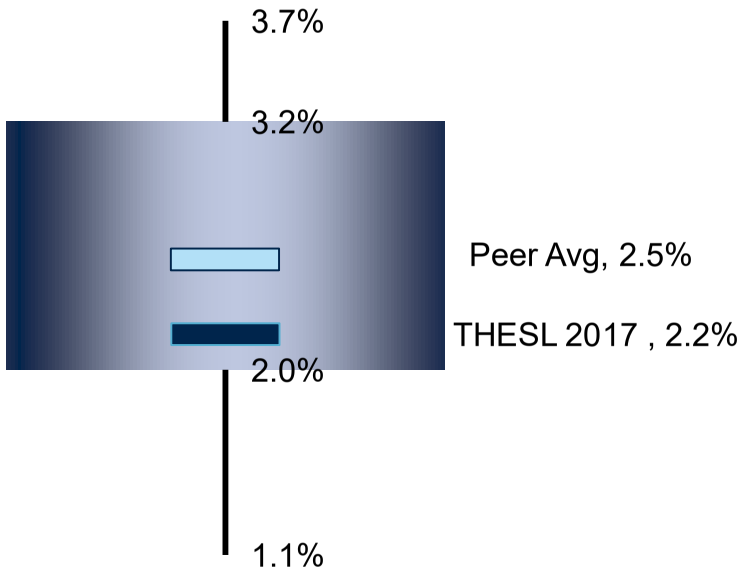
Gartner

2017 IT Spending as % of Revenue



- IT Spending as a Percentage of Revenue for THESL is about 14% less than the peer group, 2.2% compared to 2.5%.
  - IT Spending as a Percentage of Revenue is a common measure of IT's role in the business, and a measure to assess the comparative level of spending with industry peers.
- Being above or below average does not necessarily mean spending is "too high" or "too low."

Cylinder denotes the median 50% of responses

= Peer Range **= Peer Middle Quartiles**

= Peer Average **= THESL 2017**

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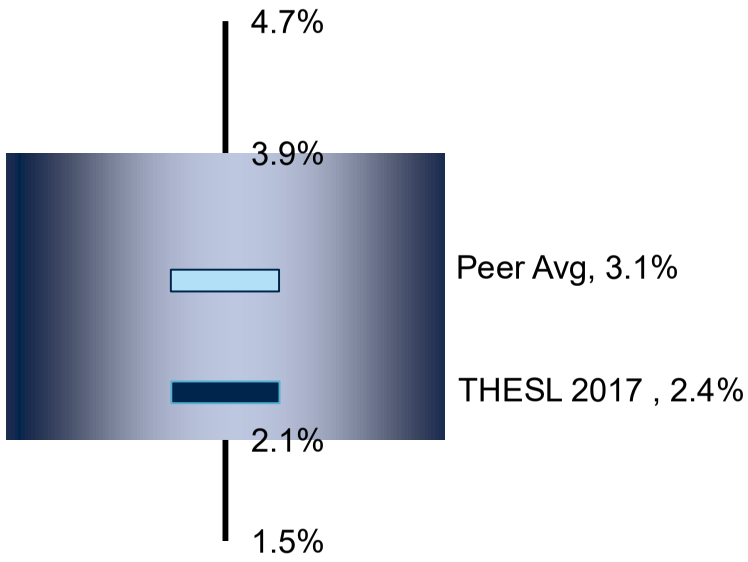
Gartner

2017 IT Spending as % of Operational Expense



- IT Spending as a Percentage of Operational Expense for THESL is about 22% less than the peer group, 2.4% compared to 3.1%.
  - IT Spending as a Percentage of Operational Expense provides a view of the role IT plays in business spending patterns: the greater the amount of operating expenses is dedicated to IT, the greater the business generally requires visibility into IT investments.

Cylinder denotes the median 50% of responses

= Peer Range **= Peer Middle Quartiles**

= Peer Average **= THESL 2017**

Gartner

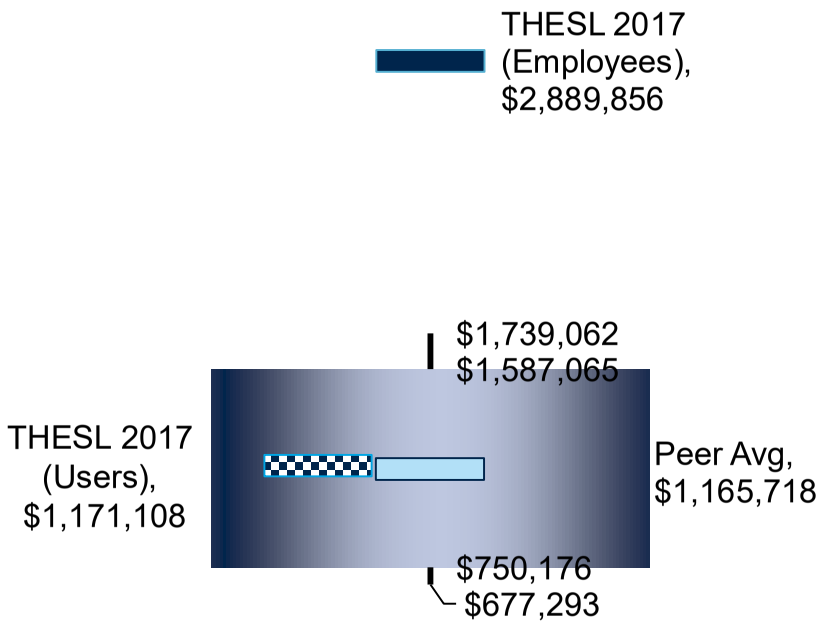
Employees versus Users at THESL

- Gartner typically collects the number of employees for an IT Budget Assessment, and bases three standard metrics on employee count: Revenue per Employee, IT Spending per Employee and IT FTEs as a Percentage of Employees.
  - Many of the IT departments Gartner works with and has in our peer benchmark database typically do not know the number of contractor labour or level of outsourcing in the lines of business, and Gartner does not normally collect a number of users.
- As with other measures comparing IT spending to business measures, these three metrics can be influenced by both the numerator and denominator.
- For THESL, these three metrics appear to be skewed compared to the peer group based on the employee count, rather than by IT spending and staffing.
- As a test of this assumption, Gartner computed metrics using THESL number of Users rather than Employees and compared results.
- While metrics based on Employees are about 2.2 to 2.5 times greater than the peer group, the results based on Users are between 0 and 10% less than the peer group.
  - The metrics based on Users are in line with the other metrics (IT Spending as a Percentage of Revenue and Operational Expense), supporting the assumption that it is THESL employee count not IT spending or staffing that drives the results on the next three slides.

Note that the number of Users has not been forecast for the 2020 period, so Gartner has not reported 2020 results for these metrics.

Gartner

2017 Revenue Per Employee



- THESL Employee count is comparatively lower than the peer group, reflected in Revenue per Employee.
- Based on 3,430 Users from THESL Active Directory, Revenue per User is roughly equivalent to the peer group Revenue per Employee.
  - This suggests that THESL lines of business may have a higher reliance on contract or outsource support than the peer group.

Cylinder denotes the median 50% of responses

= Peer Range

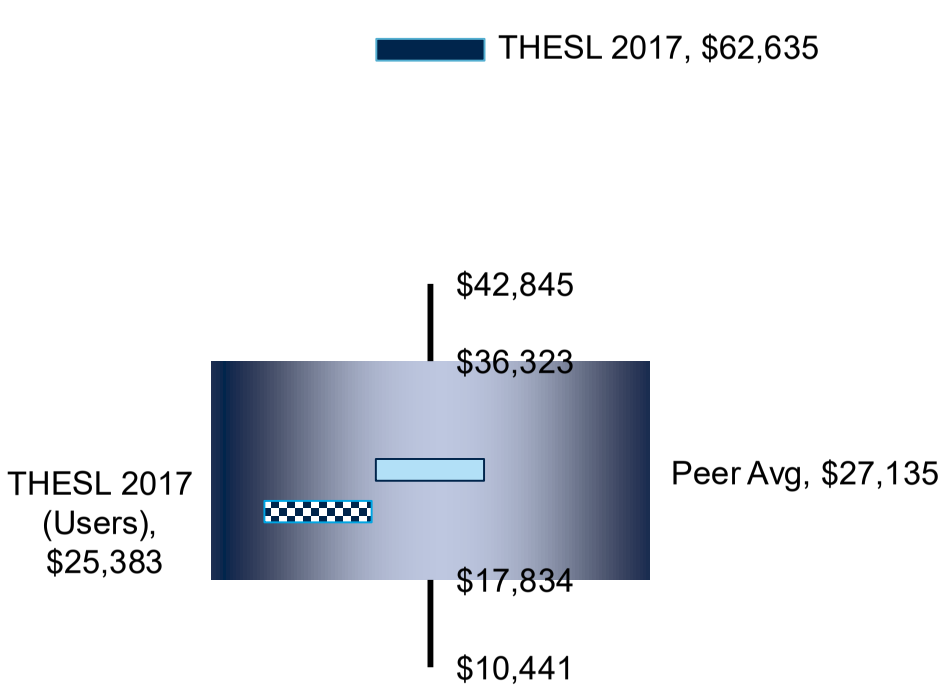
= Peer Average

= Peer Middle Quartiles

= THESL 2017 based on Employee Count

= THESL 2017 based on User Count

2017 IT Spending Per Employee



Cylinder denotes the median 50% of responses

= Peer Range

= Peer Average

= Peer Middle Quartiles

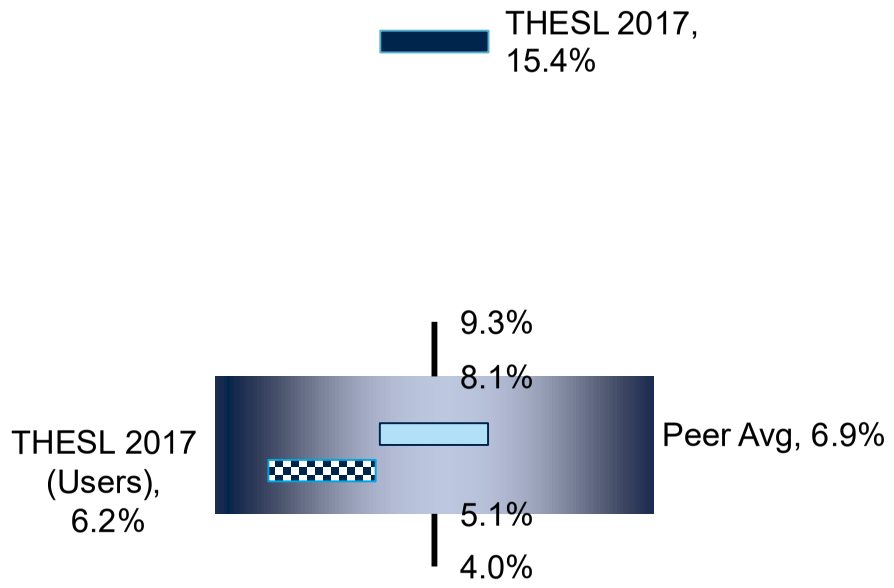
= THESL 2017 based on Employee Count

= THESL 2017 based on User Count

- While IT Spending per Employee is about 2.3 times greater than the peer group, IT Spending per User is about 6.5% less.
  - Based on the comparison of Revenue per Employee and Revenue per User to the peer group, Gartner believes that IT Spending per User represents a better comparison for THESL.
  - Gartner believes that a relatively lower employee count skews results for IT Spending per Employee, not higher IT spending.

Gartner

2017 IT FTEs as % of Total Employees



Cylinder denotes the median 50% of responses

= Peer Range
= Peer Middle Quartiles
= Peer Average
= THESL 2017 based on Employee Count
= THESL 2017 based on User Count

- While IT FTEs as a Percentage of Total Employees is about 2.2 times greater than the peer group, IT FTEs as a Percentage of Total User is about 9.6% less.
  - Based on the comparison of Revenue per Employee and Revenue per User to the peer group, Gartner believes that IT FTEs as a Percentage of Total User represents a better comparison.
  - Gartner believes that a relatively lower employee count skews results for IT FTEs as a Percentage of Total Employees, not higher IT staffing.

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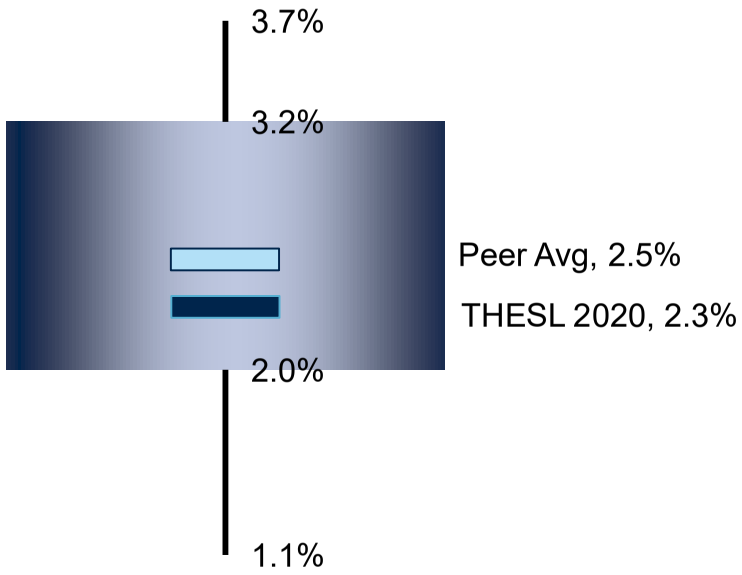
Gartner

Projected IT Budget Results for 2020

- THESL provided a forecast for business and IT measures for 2020.
- Gartner has compared these forecasts to the IT spending and staffing metrics for the 2017 peer group.
  - Gartner does not have comparable forecasts for the peers.
- Results for this forecast may differ from actual results for THESL based on the accuracy of the forecast.
- Not all measures were forecast, so not all metrics for the projected 2020 period can be reported.
  - Infrastructure workload measures were not forecast for 2020 so no comparison of efficiency for infrastructure support is provided.
  - User count was not forecast for 2020. As discussed in 2017 results, THESL has a comparatively low number of employees which skews results for employee-based metrics. As such, Gartner has not calculated or reported results for Revenue per Employee and per User, IT Spending per Employee and per User, or IT FTEs as a Percentage of Employees and Users.

Gartner

Projected 2020 IT Spending as % of Revenue



- Forecast IT Spending as a Percentage of Revenue for THESL in 2020 is about 9% less than the 2017 peer group, 2.3% compared to 2.5%.

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Cylinder denotes the median 50% of responses

= Peer Range

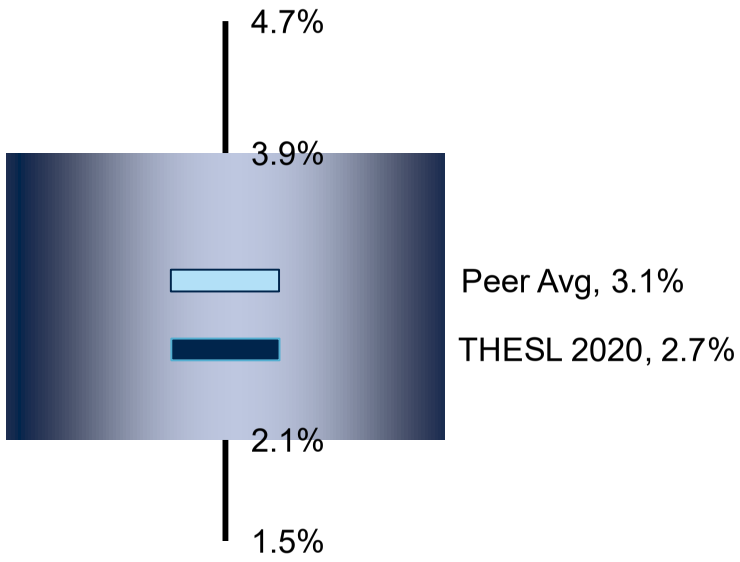
= Peer Middle Quartiles

= Peer Average

= THESL 2020

Gartner

Projected 2020 IT Spending as % of Operational Expense



- IT Spending as a Percentage of Operational Expense for THESL is about 13% less than the 2017 peer group, 2.7% compared to 3.1%.

65

Cylinder denotes the median 50% of responses

= Peer Range **= Peer Middle Quartiles**

= Peer Average **= THESL 2020**

Gartner

RESPONSES TO SCHOOL ENERGY COALITION INTERROGATORIES

INTERROGATORY 72:

Reference(s): Exhibit 2B, Section E8.4, Appendix A

With respect to the Gartner 'IT Budget Assessment Final Report':

a) [p.8] Please explain how the peer group was selected.

b) [p.8] Provide a list of the peer group utilities.

c) [p.8] Please confirm that the revenue and operational expenses include non-distribution costs such as the cost of power.

d) If the response to part (c) is confirmed, are similar costs included in the peer group information?

e) [p.8-32] If the response to part (c) is confirmed, please revise the Toronto Hydro information, and if possible the peer groups, to show on all metrics on costs related to distribution revenue and distribution expenses.

f) Please explain why Gartner did not include an IT spending per customer metric.

g) [p.19] Gartner states in explaining why it generally bases its metrics on employees count: "Many of the IT departments Gartner works with and has in our peer benchmark database typically do not know the number of contractor labour or level of outsourcing in the lines of business, and Gartner does not normally collect a number of users". Why would IT departments not know the number of users

that have active accounts on their systems?

h) Please provide a copy of the completed questionnaire that was provided to Toronto Hydro to collect the necessary data for the study.

RESPONSE (*RESPONSES PROVIDED BY GARTNER):*

a) The peer group was selected based on industry and revenue. For the benchmark of Toronto Hydro, Gartner selected utilities that had conducted a benchmarking study with Gartner within the previous 18 months, that had total annual revenue similar to THESL and that had distribution services in urban areas.

b) Gartner cannot name the members of the peer group due to confidentiality agreements with the peer organizations that are standard for all our benchmarking clients.

c) Confirmed.

d) Yes.

e) Revising Toronto Hydro's information to show all metrics on costs related to distribution revenue and distribution expenses would be a significant burden for both Toronto Hydro and Gartner. The level of effort and time involved in doing this work would likely be similar to the original benchmark project, which ran from project kick-off on December 5, 2017, to delivery of the final report on March 16, 2018. Toronto Hydro would need to report revenue, operational expense and employees for its distribution business only (if project scope were similar, this would need to be done

for both 2017 and the 2020 projection). In addition, because Gartner benchmarks are based on an alignment of business and IT support for that business, Toronto Hydro would need to revise all IT data (total IT spending, IT spending distributions, total IT staffing levels, IT staffing distributions, and infrastructure workload measures) to align with the narrower scope (again, if project scope were similar, this would need to be done for both 2017 and the 2020 projection). Where IT spending and staffing are not tracked at this level of detail, THESL would need to provide estimates (for example, the IT spending for distribution vs non-distribution businesses for application development, application support, servers, storage, end-user computing, IT service desk, data network, voice services and IT management and admin, as well as for hardware, software, personnel and outsourcing). The accuracy of results would only be as accurate as these allocations. Gartner would need to work with Toronto Hydro through data collection, review of initial results, and any clarification or revisions to data.

Gartner does not have a break-out of peer distribution and non-distribution revenue and cost, nor a break-out of IT spending and staffing for support of distribution and non-distribution businesses and so cannot provide these calculations for the peer group.

f) Gartner does not collect data for the number of customers and so cannot calculate IT spending per customer.

g) IT departments may know the number of active accounts on their systems, but these do not always correspond one-to-one with users. There may be duplicate users or group accounts.

h) Toronto Hydro provided two data collection questionnaires, one for 2017 and one for 2020. Please see Appendix A and B, respectively.

E8.1 Control Operations Reinforcement

E8.1.1 Overview

Table 1: Program Summary

2015-2019 Cost ($M): N/A	**2020-2024 Cost ($M):** 40.2
Segments: Control Operations Reinforcement	
Trigger Driver: Operational Resilience	
Outcomes: Reliability, Safety, Customer Service, Public Policy	

The Control Operations Reinforcement program (the "Program") will increase Toronto Hydro's operational resiliency and improve the utility's ability to safely operate the distribution grid by creating a fully functional dual Control Centre at its [redacted] work centre. The dual Control Centre at Toronto Hydro will be designed to withstand evolving hazards and threats, deliver reliable electricity, and support the capability to restore electricity as efficiently as possible.

Toronto Hydro's existing Control Centre is a critical infrastructure that acts as a control authority and real-time operator of the distribution system within the City of Toronto. Control Centre operations are hosted from Toronto Hydro's 500 Commissioners work centre and include the following two primary responsibilities:

1) maintain real-time control of Toronto Hydro's distribution plant through telemetry and remote operation of station breakers and field devices; and
2) coordinate all activities involving field crew workers within the "safe limits of approach" to Toronto Hydro plant that is energized above 750 Volts, as prescribed by the Ontario Electrical Safety Code and Electrical Utility Safety Rules.

Failure of Toronto Hydro's existing Control Centre can have substantial financial and economic consequences for Toronto, the largest city in Canada, the fourth largest in North America, and the economic and financial centre of the country.

The proposed dual Control Centre at [redacted] will replace the existing back-up Control Centre at Toronto Hydro's [redacted] location and will be used to operate and control Toronto Hydro's distribution grid in parallel with the primary Control Centre. [redacted]

[redacted]

E8.1.4 Expenditure Plan

Toronto Hydro requires $40.2 million over the 2020-2024 plan period to construct a dual Control Centre that will be built with hazard and threat resilience in mind. The expenditure plan for the dual Control Centre is separated into four categories (non-direct construction costs, alterations & demolition, building construction and site works), which spans over a three year period between 2020 and 2022.

Table 7: Forecast Program Costs ($ Millions)

	Forecast				
	2020	**2021**	**2022**	**2023**	**2024**
Non-direct Construction Costs	3.4	2.6	4.8	-	-
Alterations and Demolitions	-	14.1	11.8	-	-
Building	-	0.3	0.6	-	-
Site-works	0.5	0.4	1.7	-	-
Total	**3.9**	**17.4**	**18.9**	**-**	**-**

Work associated with non-direct construction costs begins in 2020 and includes feasibility cost planning, design, and permitting. Deliverables include a detailed drawing package for the dual Control Centre. Once deliverables are finalized, the building permit application process and any Preliminary Project Reviews or Site Plan approval applications with the City of Toronto will commence. A team of experienced project managers will then manage the construction of the dual Control Centre from inception to completion. The construction phases will include regular construction inspections, shop drawing reviews & approvals, payment certifications, and overall construction support. The expenditure plan will conclude in Q4 2022 with closeout document preparations, deficiency reviews, and asset testing and commissioning.

E8.1.4.2 Planned Project Timeline

Table 11: Planned Project Timeline

	2020				2021				2022			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Non-Direct Construction Cost												
Interior Demolition												
Building Construction												
Site work												

E8.1.5 Options Analysis / Business Case Evaluation ("BCE")

E8.1.5.1 Option 1: Status Quo

The status quo option will entail continuing with the existing Control Centre set-up, i.e. the Control Centre located in 500 Commissioners serves as the primary Control Centre, while the facility located in [redacted] serves as the backup Control Centre. There will be no incremental spending to further safeguard the 500 Commissioners location from the threat of flooding or other catastrophic events. Under this scenario, the primary Control Centre would remain vulnerable to severe weather-related events, due to its location that is adjacent to Lake Ontario and along the path of the Don Valley flood plain. [redacted]

E8.1.5.2 Option 2: Fortification of 500 Commissioners Street Work Site

One option in mitigating some of the risks associated with the primary Control Centre would be to introduce enhanced fortification of the current 500 Commissioners facility such that the risk of catastrophic failure is reduced. As described above, the primary Control Centre at Toronto Hydro's 500 Commissioners facility is located along the path of the Don flood plain and is adjacent to Lake

Ontario. This places the facility at a significantly elevated risk of flooding, which would result in the catastrophic failure of the primary Control Centre. There are several methods available in order to safeguard office buildings and structures from potential flooding events. As described by the Federal Emergency Management Agency ("FEMA") within their study "Floodproofing for Non-Residential Structures", recommended actions for safeguarding commercial facilities such as 500 Commissioners include:[27]

- Elevating the existing structure using posts, piles, piers or walls;
- Installation of flood shields and closures; and
- Installation of floodwalls and levees.

However, elevating the current Commissioners structure would be infeasible due to the multiple levels of structure and materials utilized as part of the construction. It would be possible to install flood shields and closures around the primary control centre location, coupled with floodwalls and levees along the entire length of the Commissioners facility that faces Lake Ontario.

Using the suggested cost estimate data provided by FEMA in its Floodproofing for Non-Residential Structures study,[28] coupled with the square footage and dimensions of the 500 Commissioners facility, total costs to perform full flood-proofing of the Commissioners facility are estimated to exceed $10 million. This includes secondary costs including the extension of fibre to support the Control Centre functions, waterproofing of walls and floors, installation of subfloor drainage systems as well as backflow prevention devices and testing of flooding shield systems. These costs do not account for the loss of usable space that may be incurred due to the installation of flood shields, closures, floodwalls, and levees respectively. These costs would only contribute towards the protection of a flooding event. However, other risks (e.g. terrorist attack) and natural disaster events could also compromise the Commissioners location and would not be at all addressed by this option, leaving Toronto Hydro and its customers vulnerable to many of the same risks discussed in the option above.

Furthermore, under this scenario, the backup Control Centre at [redacted] would continue to operate in parallel with the primary control centre. [redacted]

[27] "FEMA 102: Floodproofing for Non-Residential Structures", Federal Emergency Management Agency, 1986, available at: <https://www.fema.gov>.
[28] Ibid.

[redacted]

For these reasons, Toronto Hydro does not consider fortification of the 500 Commissioners location to be a viable option.

E8.1.5.3 Option 3: Development of a Dual Control Centre at [redacted]

The third option assessed entails the development of a dual Control Centre at [redacted] The subsequent sub-sections will individually examine each facility to assess the feasibility of developing a fully-operational dual Control Centre within.

1. Option 3.1: Dual Control Centre at [redacted] Work Centre

[redacted]

2. Option 3.2 (Selected Option): Dual Control Centre at [redacted] Work Centre

[redacted]

This location possesses a total of 12,000 square feet of available space to accommodate a fully-functioning dual Control Centre. SCADA and telecom facilities already exist at this location, making this location the most cost efficient for installation and set-up, when compared to other existing facilities. In addition, the facility will be able to perform all operations that can be executed by the primary Control Centre, including monitoring distributed generation and renewable connections.

By far, the greatest advantage of the [redacted] location is that it has the space and other requirements necessary to accommodate a fully functioning dual Control Centre. Employees at both Control Centres will be responsible for different areas of the City, to ensure there is no duplication in work. Since it would be operating in parallel to the primary Control Centre, under an emergency scenario, there will be virtually no impact on operations as the dual Control Centre will be able to resume all functions of the primary Control Centre.

Figure 7: Fiber Cable Routing to [redacted]

3. Option 3.3: Dual Control Centre at [redacted]

It should be stated that many of the advantages associated with the [redacted] location are also associated with their [redacted] location. [redacted]

[redacted]

E8.1.5.4 Option 4: Development of a Dual Control Centre with Limited Functionalities at [redacted]

This option would involve the development of a dual Control Centre with limited functionalities (i.e. not a fully functioning Control Centre) at [redacted] This limited Control Centre would operate in a similar manner [redacted] This option would only be available at [redacted] due to the available space at this location in order to accommodate the requirements, as previously noted above.

[redacted]

[redacted]

[redacted]

While space requirements for this backup facility would be reduced by approximately 50-60 percent when compared to a fully functioning Control Centre, the funding requirements would not be reduced proportionally. This is due to the fact that certain components, such as the Uninterruptible Power Supply, data centre, electrical room, and generators must be fully built at the time of construction. These components cannot be constructed in an incremental manner, even if the Control Centre is utilized only for partial, backup purposes.

E8.1.5.5 Option 5: Development of a Dual Control Centre at a Newly Acquired or Leased Facility

The development of a dual Control Centre at a newly acquired or leased facility would allow Toronto Hydro to select an optimal location of its choice based on a host of considerations, such as risk and cost. This option would allow the utility to custom design a Control Centre to fit all its requirements rather than to design a facility to fit existing infrastructure and space. Since the new location will house all new IT-related infrastructure, it will present a lower risk of failure. In addition, existing Toronto Hydro operations would not be disrupted by construction issues (noise-related or otherwise) since no other Toronto Hydro functions would be co-located on the premises.

However, the utility will incur costs to construct fiber-optic infrastructure to enable SCADA capabilities. There will be added costs of additional support services required for the dual Control Centre at a newly acquired or leased site. For instance, IT personnel will need to be either located within the new site or travel from Toronto Hydro's existing sites to the new Control Centre in case of IT-related issues.

E8.1.5.6 Evaluation of Options

The evaluation criteria used to assess the various options available to Toronto Hydro include the following:

1) Current weather related risks associated with the proposed location (for instance, is it located within the path of a flood plain);

2) Available space within the proposed location (when compared to minimum space requirements for a fully functioning Control Centre);
3) Available technological capabilities within the proposed location (when compared to minimum technological requirements for a dual Control Centre);
4) Impact associated with a terrorist event, and whether the event would prevent the full enablement of the dual Control Centre; and
5) Total cost impact to ratepayers.

Each of the above criteria were taken into consideration when selecting the best overall option for Toronto Hydro.

Table 12, below, illustrates the results of the options analysis, comparison and final recommendations, based upon what has already been discussed for each of the options above.

Table 12: Results of Option Analysis

Criteria / Location	[redacted]	Newly Acquired or Leased Facility
Weather Risks		
Available Space		
Available Technological Capabilities		
Dual Control Centre Enablement		
Impact of Terrorism Attack		
Total Costs		

Legend
Does not meet criteria
Partially meets criteria
Meets or Exceeds Criteria

When assessing current-state risks, availability of space and technological capabilities, costs, as well as overall ability to meet the objectives of dual control centre enablement, this comparison indicates that both the development of a dual Control Centre at [redacted] and at a newly acquired or leased facility satisfies all the criteria. However, the differentiating factor between the two options is cost.

Jurisdictional review and economic case for a dual distribution control center in Toronto Hydro territory

prepared by London Economics International LLC

June 22nd, 2018

Distribution control centers ("DCC") support reliability, resiliency, and the ability to recover quickly from deliberate attacks and natural disasters. LEI has found that there is a precedent for utilities across North America to build fully functional backup control centers, at similar costs to those proposed by Toronto Hydro. Justifications included increasing reliability and resiliency, with certain utilities citing specific situations such as natural disasters or terrorism threats. Growth in distributed energy resources has also caused distribution utility operations to be more complex and take on some of the responsibilities traditionally required in the Bulk Electricity System, including dealing with interconnected generation and taking greater responsibility for bulk system reliability. LEI believes that the evolution of these responsibilities also support the need for Toronto Hydro's proposed dual DCC. Finally, LEI's analysis indicates that the proposed costs can be justified economically, given the significant costs of outages in the city of Toronto, and the potential for the dual control center to reduce the duration of high-impact outages.

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1 Executive Summary

1.1 Scope of services

LEI was engaged by Toronto Hydro to undertake an independent study of comparator utilities with fully functional backup control centers ("BUCCs") in other jurisdictions. The utilities were reviewed and analyzed in terms of their functionality as well as cost. LEI also considered the proposed dual control center from an economic perspective by estimating economic costs of a high-impact outage on Toronto Hydro's service territory.

1.2 Summary of findings

LEI has identified five utilities that have built fully functional BUCCs— Hydro One, Consolidated Edison, Pacific Gas & Electric, Florida Light & Power, and San Diego Gas & Electric. These utilities identify various justifications for their investment, including supporting resiliency, increasing reliability, and ensuring quick recovery from terrorist threats and natural disasters, for example earthquakes and floods. Integration of Distributed Energy Resources ("DERs") was also cited.

All reviewed BUCCs were fully functional and were able to take over operations from the primary control center. However, different utilities varied in terms of their mode of operation: the number of backups, whether they were manned or unmanned, and whether they ran in parallel or not. Toronto Hydro's current BUCC has only [redacted] of the functionalities of the primary control center; the proposed dual control center is to be fully functional and run in parallel with the primary control center.

In its study of comparator utilities, LEI found that the cost of BUCCs built in the past 5 years are aligned with the cost of Toronto Hydro's proposed dual control center. Moreover, the justifications of costs, and challenges faced by comparator utilities are comparable. Compared to the utilities reviewed, Toronto Hydro serves a uniquely important load in terms of political and economic significance, as well as a large base of customers with significant population density.

LEI also reviewed the impact of DERs on the role of the distribution utility. The growth of distributed generation has given distributors some of the reliability responsibilities traditionally reserved for transmission utilities, such as forecasting and dispatching generation. In California, Texas and Hawaii, as well as Ontario, utilities, regulators and reliability authorities have recognized the threat of high DER penetration to the reliability of the bulk transmission system. Bulk system utilities are governed by NERC safety requirements, including the requirement for backup functionality of its control center. LEI believes as distribution utilities evolve towards more complex operations with greater responsibility for reliability, fully functional backup distribution control centers will become increasingly necessary.

Finally, LEI conducted a high-level review of the economic cost of a high-impact outage on Toronto Hydro's service territory, which covers the financial and economic capital of Canada. Extraordinary events such as natural disasters or terrorist attacks could cause the inability to operate Toronto Hydro's primary control center, resulting in delayed service recovery time following an outage. LEI's analysis shows that the proposed costs for the dual control center can be justified economically, given the significant costs of outages in the city of Toronto, and the dual control center's potential to reduce the duration of these outages.

2 Role of distribution control centers

Electricity distribution control centers ("DCCs") are used to control, coordinate, and monitor the distribution of electricity. Utilities in North America are upgrading their control centers to support reliability, resiliency, and to recover more quickly from natural disasters – and in order to further increase reliability, some utilities have built fully functional BUCCs.

DCCs provide real-time management of the grid. Supervisory Control and Data Acquisition ("SCADA") systems are used to obtain data about the distribution system via sensors and operate station breakers and field devices to manage the system. From the DCC, operators are able to monitor grid operation, manage planned and unplanned outages, manage system loading, as well as determine areas to improve grid performance and reliability. Key tasks at a DCC include clearance management and developing switching orders for planned maintenance.[1] Clearance management is the process by which the DCC determines periods that equipment can be taken out of service by asset management for planned work. Operators need to consider the outage length, system conditions and other clearance requests to determine when clearance can be taken. After clearance is approved, a switching order must be developed, which involves deenergizing equipment before any work is performed for safety, as well as reconfiguring the power system to perform reliably during this period. These responsibilities are critical to enable the reliable operation of the distribution system and ensure the safety of the public and utility employees.

Given their important role, DCCs are typically set up to run on a 24/7 basis with multiple levels of redundancy. Electrically they may be supported with an uninterrupted power supply ("UPS"), battery storage and/or a backup diesel generator, while SCADA systems will have multiple communication feeds, and technology systems will be designed to withstand application or hardware failures. BUCCs are used as a type of physical redundancy, where utilities have a separate facility that can take over the responsibilities of the primary DCC, if the primary DCC is inoperable or inaccessible.

Hot vs. Cold Backup Control Centers

Redundancy in BUCCs can be applied in various ways. Cold BUCCs are secondary backups that are only called upon when the primary system experiences a significant failure. Hot backups are a method of redundancy in which both primary and secondary systems are running, so that the secondary BUCC is receiving and processing the same information so that it can assume operations quickly and smoothly.

3 Control center operations in other jurisdictions

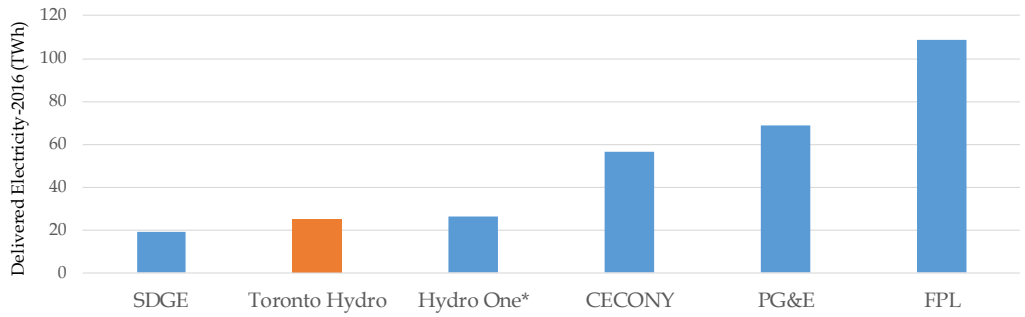
This section provides case studies of control centers in other jurisdictions, all of which are for utilities that have distribution operations. These utilities have sought to bolster their backup plans

[1] Vadari, Mani. *Electric System Operations: Evolving to the Modern Grid*. 2013.

to improve reliability and resiliency against severe weather events such as hurricanes and floods, as well as attacks including cyber-attacks.

LEI reviewed large Canadian and US utilities and identified four utilities that publicly disclose they utilize fully functional BUCCs to improve reliability in their distribution operations.[2] Hydro One has also been included, as they are developing a new 'dual primary' control center to replace their current BUCC, as discussed in its most recent distribution rate application.

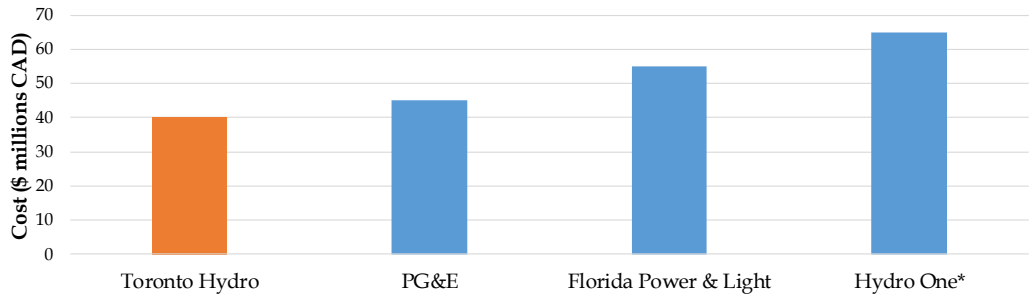
Figure 2. Electricity delivered by utilities



* Note: Electricity delivered to Hydro One distribution customers only
Source: Company reports and websites

In terms of the capabilities of the backup controls centers, all five case studies are fully functional and can completely take over operations from the primary control center. Toronto Hydro has estimated that the existing BUCC at [redacted] of the functionalities of the primary control center. Toronto Hydro's proposed dual control center at [redacted] would be fully functional, and costs are in line with (and slightly lower than) the identified utilities that had publicly available control center construction costs. A comparison of costs is shown below in Figure 3.

Figure 3. Control center construction costs



[2] LEI reviewed the 20 largest US utilities and 5 largest Canadian distribution utilities by number of customers. The excluded utilities may also use a backup control center, however were excluded from this review as no public information was found.

* Note: Budget of distribution portion of control center only, not the total cost

A comparative summary of the profiles and functionalities associated with the selected utilities is shown below in Figure 4. Toronto Hydro falls within the range of the selected utilities in terms of electricity delivered annually, as shown in Figure 2. Although certain selected utilities serve a larger load or area, Toronto Hydro serves a uniquely important load. Toronto Hydro serves the provincial capital as well as the economic and financial center of Canada; in fact, it serves the highest proportion of national economic activity out of all the identified utilities. In addition, Toronto Hydro has amongst the highest customer densities of the identified utilities and distributes approximately 19% of electricity consumed in Ontario.[3]

[3] Toronto Hydro. *About Us.* <https://www.torontohydro.com/sites/corporate/AboutUs/Pages/AboutUs.aspx>

Figure 4. Summary of identified utility distribution operations

	Metric	Toronto Hydro	Hydro One	FPL	PG&E	CECONY	SDGE
	Province/State of utility service territory	Ontario	Ontario	Florida, US	California, US	New York, US	California, US
Load Significance	**Delivered electricity (GWh, 2016)**	25,373	26,289*	108,871	68,820	45,745	19,200
	Number of customers ('000)	768	1,355	4,900	5,400	3,400	1,400
	Service area (km^2)	630	962,774	71,613	181,299	1,564	10,619
	Service area density (customers/km^2)	1,219	1	68	30	2,174	132
	Population of largest city served ('000)	2,732	<80	454	1,025	8,538	1,406
	Serving provincial/state capital?	✓	-	-	-	-	-
	Serving national financial center?	✓	-	-	-	✓	-
	% of national economic activity in utility's service territory**	10.0%	<6%***	3.3%	6.2%	4.0%	1.2%
Control center operations	**Qualitative Justification**	Withstand extreme weather events, climate adaptation, terror threat	Reduce financial risk, customer impacts and reputational harm	Increase reliability, reduce time required to recover from storms	Strengthen grid resiliency and reliability, particularly for natural disasters; DER integration	Withstand and rapidly recover from an EMP attack	Maintain reliability, DER related reliability concerns
	Mode of operation	One backup, Proposed: dual control centre	One backup, Proposed: dual primary control centre	Two backups	Parallel Three centers co-run	Parallel Four centers co-run + mobile backup	One backup
	Manned/Unmanned	Unmanned, Proposed: Manned	Manned	Unmanned	Manned	Manned	Unmanned
	Functionality	[redacted] proposed: [redacted]	Equivalent	Equivalent	Equivalent	Equivalent	Equivalent
	Cost (Canadian $ million)****	$40 (estimated cost of the proposed dual CC)	$65 (for proposed ISOC)	$55 (for one DCC)	$45 (average cost across three control centres)	n.a.	n.a.

* A total of 36,525 GWh were delivered through Hydro One distribution lines in 2016 - this includes electricity distributed to consumers who purchased power directly from the IESO

** Economic activity in Toronto Hydro service territory measured by comparing the 2016 annual GDP for the city of Toronto to Canada as a whole, using GDP estimates available from the city of Toronto's website. Economic activities in US utility's service territory was measured using county-level Personal Income data published by the US Bureau of Economic Analysis. Economic activity in counties the US utilities serve were then summed up and compared to total national Personal Income

*** Economic activity in Hydro One's distribution service territory is very difficult to estimate. Data available on Statistics Canada's website [CANSIM Table 381-5000] from 2009 provides GDP estimates for 15 metropolitan areas in Ontario, as well an estimate for 'non-census metropolitan areas' in Ontario. Assuming all economic activity in Ontario's 'non-census metropolitan areas' falls under Hydro One service territory, then this value divided by the total Canadian GDP estimate from the same data source indicates that 5.7% of Canada's economic activity falls within Hydro One's distribution service territory

**** Costs of US control rooms converted to Canadian dollars using an exchange rate of 1.3 CAD:1 USD (as of June 1st, 2018)

Sources: FERC, EIA, BEA, US Census Bureau, Statistics Canada, City of Toronto, Company reports and websites

3.1 Hydro One

Hydro One's primary power control center was opened in 2005 and cost $118 million.[4] The control center monitors both Hydro One's distribution and transmission networks in Ontario. Named the "Ontario Grid Control Centre", it consolidated monitoring and control functions under one roof, instead of the previously isolated regional control centers.

Hydro One also maintains a BUCC in Toronto originally commissioned in 1956 and is seeking to upgrade its control center capabilities (including both distribution and transmission) under its ongoing custom Incentive Rate-setting application for 2018-2022 electricity distribution rates [EB-2017-0049]. Hydro One has stated that its current BUCC requires upgrading due to an increased risk of facility failure. Hydro One has cited the main reasons to upgrade the facility as:

(i) regulatory compliance;
(ii) financial risk;
(iii) customer impacts; and
(iv) reputational harm.[5]

Hydro One presented a number of alternative approaches to replace/upgrade the existing BUCC operations, which are summarized in Figure 5 below (along with the costs associated with the distribution portion of these alternatives).

Figure 5. Alternative BUCC replacements initially presented by Hydro One

Alternative	Description	Distribution portion of costs ($ million)
1	Maintain status quo and use offsite leased space	$39
2	Build Network Operating Division ("NOD") BUCC and Data Centre ("DC") exclusively	$52
3	Build Integrated System Operations Center ("ISOC") as BUCC and Backup IT Management Center ("BUITMC"), with back office support areas and an integrated DC	$62
4	Acquire an existing facility for BUCC and BUITMC and integrated DC	N/A
5	Build Primary NOD Control Centre, primary SOC, and BUITMC	$71
6	Build ISOC capable of "dual primary" operations ***[Recommended by Hydro One]***	$65

Note: The above values represent only the distribution portion of costs. Total cost estimates for these listed alternatives are approximately double the values shown above.
Source: Hydro One exhibit B1-2 (OEB case EB-2017-0049) from April 4, 2017, pdf page 1314-1315

Of the approaches presented, Hydro One recommended the construction of a new Integrated System Operations Center ("ISOC"). Importantly, the ISOC would eventually allow Hydro One

[4] Hydro One. *Exhibit B1-2 from OEB case EB-2017-0049.* April 4, 2017 <http://www.rds.oeb.ca/HPECMWebDrawer/Record/569822/File/document>

[5] According to Hydro One's rate application for the 2015-2019 period

to operate a "dual primary" scenario, where both the current and new control centers can operate in parallel. Hydro One's distribution rate application is currently still ongoing.

3.2 Consolidated Edison

Consolidated Edison Company of New York ("CECONY") is a regulated utility which provides electric service to 3.4 million customers in New York City and Westchester County.[6] In addition to servicing a 604 square mile electric service territory, it also distributes natural gas and district energy steam. CECONY is divided into four different operating regions (Bronx/Westchester, Brooklyn/Queens, Manhattan, and Staten Island), each with an Electric Distribution Control Center which is responsible for coordinating switching operations and feeder processing for restoration of outages.[7] These DCCs are staffed 24/7. CECONY has highly concentrated underground distribution networks, which typically witness fewer interruptions in the face of weather events, in comparison to overhead systems common elsewhere.[8]

In recent years, CECONY has undertaken significant expense to upgrade its DCCs. A review of its reported annual capital expenditures from 2011-2016 shows total actual costs for "Electric Distribution Control Center Upgrades" of $23.7 million USD. [9,10,11,12,13,14] This work includes a project to upgrade the IT server, network, UPS infrastructure, and enhance the electrical and HVAC design of all DCCs. CECONY's justification for the project was that the DCCs are "vital to maintaining [their] ability to deliver safe and efficient services".[15] CECONY's

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[6] ConEdison. *Company History and Statistical Information.* <https://www.coned.com/en/about-us/corporate-facts>

[7] NYDPS. *ELECTRIC INFRASTRUCTURE AND OPERATIONS PANEL.* Jan 29, 2015. <http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId=%7B4BEE2FD7-6E49-40AE-B007-3B76085F31AC%7D>

[8] NYDPS. Office of Electric, Gas, and Water. *2016 Electric Reliability Performance Report*. June 2017. <http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId=%7BBBCBF3C3-1812-4EEC-9E31-6901AED885D3%7D>

[9] ConEdison. *Report on 2011 Capital Expenditures*. February 28, 2012.

[10] ConEdison. *Report on 2012 Capital Expenditures*. February 28, 2013.

[11] ConEdison. *Report on 2013 Capital Expenditures*. February 28, 2014.

[12] ConEdison. *Report on 2014 Capital Expenditures and 2015-2019 Electric Capital Forecast*. March 2, 2015.

[13] ConEdison. *Report on 2015 Capital Expenditures and 2016-2020 Electric Capital Forecast*. February 29, 2016.

[14] ConEdison. *Report on 2016 Capital Expenditures and 2017-2021 Electric Capital Forecast*. February 28, 2017.

[15] NYDPS. *Electric Infrastructure and Operations Panel*. Jan 29, 2015. <http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId=%7B4BEE2FD7-6E49-40AE-B007-3B76085F31AC%7D>

decision to invest in the project was to provide "a high level of availability to allow the operators, designers and engineers to make proper decisions during major distribution system events".[16] CECONY continues to invest in updating its distribution management; a multi-year outage management system integration project was initiated in 2018.[17]

In addition to multiple DCCs, CECONY is building the world's first utility Hardened Mobile Control Center ("HMCC") to enhance its ability to withstand and rapidly recover from an Electromagnetic Pulse ("EMP") attack. An EMP would potentially destroy many key control center systems and devices, leaving the utility operating with limited visibility, vulnerable to multiple contingencies, and possibly requiring reduced load and extended outages.[18] The HMCC is a modular backup system consisting of completely self-sufficient and self-contained elements that have their own power supplies. It would take over system operations in less than one day after an EMP attack, down from weeks or months. The system will be on a mobile platform consisting of three tractor trailers enclosures that can be deployed to one or several locations, that can support workstations for 16 operators in total. The contract to build the HMCC was awarded in December 2017.

As justification for the HMCC, CECONY cited growing tensions in world events and findings from a commission established by US Congress to assess threats of an EMP attack.[19] This commission concluded several potential adversaries would have the capability to attack the US with an EMP, even without a high level of sophistication, and that an "EMP is one of a small number of threats that can hold our society at risk of catastrophic consequences". CECONY describes the HMCC as a proactive and sensible approach to prepare for this threat.

3.3 Pacific Gas and Electric

Pacific Gas and Electric ("PG&E"), which serves around 5.4 million customers in California and has 140,000 miles of lines, operates three electric distribution control centers (Fresno, Rocklin, and Concord) over an entire service area exceeding 180,000 km^2. PG&E consolidated its 15 existing electric operations centers into these three centers in 2016, as part of its effort to create a "smart, more resilient grid". Each of the three centers monitor and control approximately one-third of PG&E's service region, also known as a parallel mode of operation. The centers provide the ability

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[16] ConEdison. Exhibit IIP-13. <https://legacyold.coned.com/documents/2013-rate-filings/Electric/Exhibits/076-IIP-13-ITCategory.pdf>

[17] GridBright. *ConEd Selects GridBright for Distribution Management Integration*. August 2017. <https://gridbright.com/coned-integration>

[18] Consolidated Edison. *Case 16-E-0060 - Proceeding on Motion of the Commission as to the Rates, Charges, Rules and Regulations of Consolidated Edison Company of New York, Inc. for Electric Service*. Feb 28, 2018 <http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId=%7B105D820F-4CE5-4E84-9E28-CC4F813E6158%7D>

[19] Ibid.

"to shift operations to the two other regional control centers if support is needed at one in the event of a major storm or natural disaster."[20] The centers were constructed with redundant data feeds and emergency back-up capabilities to be able enhance resiliency in the face of unforeseen events such as major storms or natural disasters.

PG&E's three DCCs cost a total of approximately $105 million USD. The first control center in Fresno opened in late 2014, at a total cost of $28.5 million USD. The second control center in Concord cost $40 million USD and was opened in August 2015. The third control center in Rocklin opened in February 2016, at a total cost of $36 million USD.[21]

According to PG&E, investment in these control centers will "strengthen resiliency of the grid, while enhancing electric reliability",[22] as well as advancing the integration of DERs into its distribution system. Smart grid technologies were also piloted and deployed alongside the control center consolidation.[23]

3.4 Florida Power & Light Company

FPL is one of the largest US electric utilities, serving approximately 4.9 million customers in Florida.[24] FPL operates three DCCs and maintains two backups near two of its control centers, and has "implemented multiple levels of resiliency and redundancy in both its transmission and distribution substations and control centers".[25] Not only is each facility equipped with redundant energy management systems, but each backup facility is geographically diverse, fully functional, and has dedicated and redundant communication links. This allows a BUCC to quickly and effectively take over if the primary control center loses functionality. The BUCCs closely replicate the main control centers and can also be accessed remotely from the nearby DCC. The BUCCs are

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[20] PG&E. *PG&E Opens New $40 Million State-Of-The-Art Electric Control Center in Concord.* August 20, 2015. <https://www.pge.com/en/about/newsroom/newsdetails/index.page?title=20150820_pge_opens_new_40_million_state-of-the-art_electric_control_center_in_concord>

[21] PG&E. With Opening of New Rocklin Facility, PG&E Completes Move to Industry-Leading, High-Tech Electric Distribution Control Centers. February 03, 2016. <https://www.pge.com/en/about/newsroom/newsdetails/index.page?title=20160203_with_opening_of_new_rocklin_facility_pge_completes_move_to_industry-leading_high-tech_electric_distribution_control_centers>

[22] Ibid.

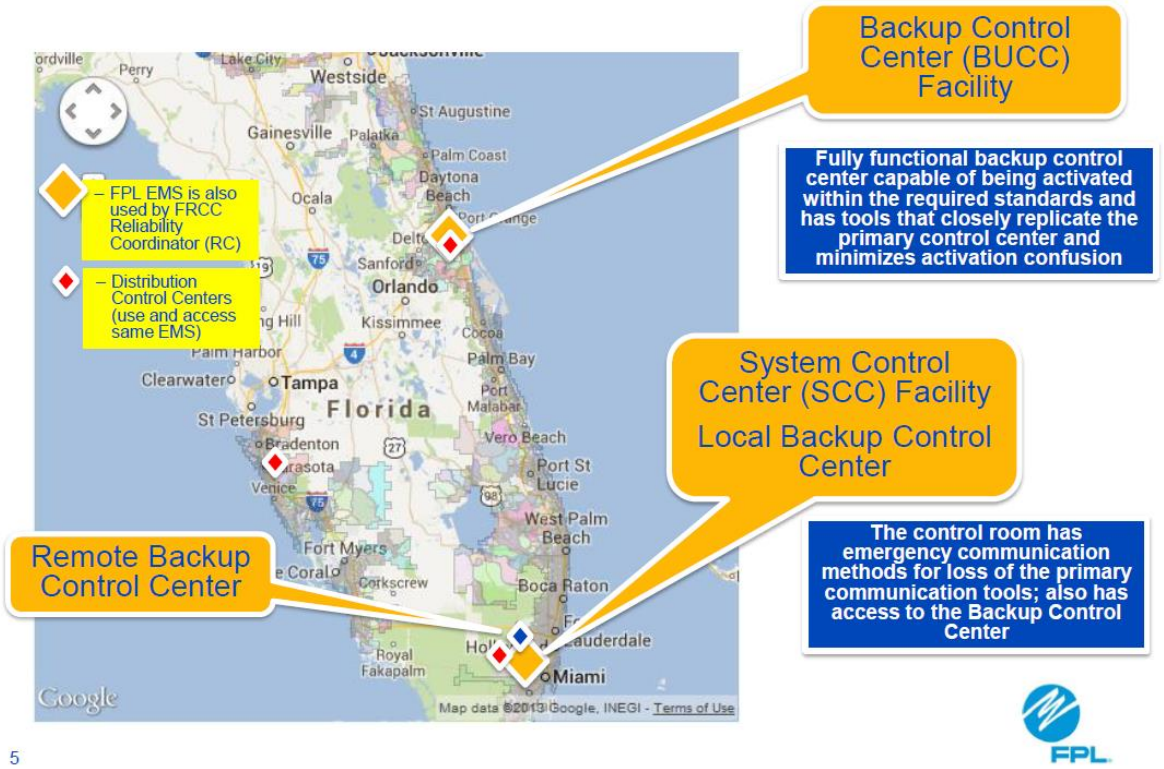
[23] PG&E. *Smart Grid Annual Report – 2017.* September 29, 2017. https://www.pge.com/pge_global/common/pdfs/safety/how-the-system-works/electric-systems/smart-grid/Annual-Report-2017.pdf>

[24] Florida Power & Light. *Company Profile.* <https://www.fpl.com/about/company-profile.html>

[25] State of Florida Public Service Commission. *Review of Physical Security Protection of Utility Substations And Control Centers.* December 2014. P. 29 <http://www.psc.state.fl.us/Files/PDF/Publications/Reports/General/Electricgas/Physical_Security_2014.pdf>

unmanned, so they do not run in parallel,[26] and can be considered "cold" backups. These DCCs support FPL's business continuity and recovery plans, and increase reliability and reduce time required to recover from storms.

Figure 6. FPL DCC locations



Source: NERC. *NERC Monitoring and Situational Awareness Conference: Loss of Control Center Procedures and Testing Practices*. September 19, 2013

In January 2017, FPL began construction on a $42 million USD DCC in West Palm Beach. It is located next to FPL's command center, a hub opened in 2012 that coordinates overall storm response.[27] The new center will be built to withstand Category 5 hurricanes, and will consolidate the two existing distribution control centers located in Miami and Sarasota. These enhancements come as part of FPL's $2 billion USD plan to harden its infrastructure against natural disasters.

[26] NERC. *NERC Monitoring and Situational Awareness Conference: Loss of Control Center Procedures and Testing Practices*. September 19, 2013 <https://www.nerc.com/pa/rrm/Resources/MonitoringSituationalAwarenessDL/9.%20FPL_Loss_of_CC_Testing%20-%20Ed%20Batalla.pdf>

[27] Palm Beach Post. *"FPL breaks ground on distribution center to be Cat-5 storm ready"*. January 18, 2017. <https://www.palmbeachpost.com/business/fpl-breaks-ground-distribution-center-cat-storm-ready/n5kRoKXSks4jcUpGRbz9SN/>

3.5 San Diego Gas & Electric

San Diego Gas & Electric ("SDGE") is a regulated utility which provides electric service to 1.4 million customers in San Diego County and a portion of Orange County, California, over a total area of around 10,600 km^2. SDGE owns 21,000 miles of distribution lines serving 25 communities and operates transmission lines as well as two generating stations. The monitoring, operation and dispatch for the entire SDGE electric network occurs from the Mission Control facility. A project to modernize these operations in terms of data infrastructure and workstations was forecast to cost $16.3 million USD;[28] justifications included "reducing time to identify abnormal or adverse system conditions" allowing for better and faster decisions.

SDGE also has a fully-functional backup DCC located 10 miles away from its primary control center which is used to continue to maintain reliability under emergency scenarios such as loss of the primary facility or any failure of computer or communications systems.[29] The "cold" backup center has redundant connectivity allowing for operators to virtually connect to the BUCC in the case of a failure of the primary energy management system, while physically remaining in the primary control center. The BUCC is also able to handle the situation where a total failure of connectivity means operators must relocate physically to the BUCC.

Note that SDGE is one of the leading utilities in incorporating DERs – in 2016 they were the first California utility to reach their net metering cap of 617 MW (though they continue to install solar capacity through the NEM 2.0 program).[30] In their control centers, SDGE has recognized that the high penetration of DER has contributed to greater risk of safety and reliability incidents.[31] Specific challenges identified include: reverse power flow, increased voltage variability, reduced switching flexibility, and a lack of visibility of actual circuit loads, among others.[32] For their operators, these challenges have added complexity to decision making and switching requirements.

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[28] SDGE. *Direct Testimony of R. Dale Tattersall (Real Estate, Land Services and Facilities)*. October 6, 2017.

[29] SDGE. *Prepared Direct Testimony of Don Akau on Behalf of San Diego Gas & Electric Company*. Sept 25, 2015. <https://www.sdge.com/sites/default/files/FINAL%2520Akau%2520Testimony.pdf >

[30] Utility Dive. *As SDG&E edges closer to net metering cap, solar installations not expected to slow*. June 22, 2016 <https://www.utilitydive.com/news/as-sdge-edges-closer-to-net-metering-cap-solar-installations-not-expected/421312/>

[31] SDGE. *Revised San Diego Gas & Electric Company Direct Testimony of William H. Speer (Electric Distribution O&M)*. December 2017. <https://www.sdge.com/sites/default/files/SDG%2526E-15-R%2520Speer%2520Revised%2520Prepared%2520Direct%2520Testimony.pdf>

[32] Utility Dive. *How SDG&E is dealing with high penetrations of rooftop solar*. July 25, 2014 <https://www.utilitydive.com/news/how-sdge-is-dealing-with-high-penetrations-of-rooftop-solar/290227/>

RESPONSES TO BUILDING OWNERS AND MANAGERS ASSOCIATION INTERROGATORIES

INTERROGATORY 22:

Reference(s): Exhibit 1B, Tab 2, Schedule 1, p. 28

Why did the Customer study use a peer group of utilities with an average number of customers approximately fifty percent (50%) larger than the number of THESL customers?

RESPONSE (PREPARED BY LEI):

The purpose of LEI's engagement was to study comparator utilities with fully functional backup control centers ("BUCCs") in other jurisdictions. LEI's methodology for identifying comparator utilities was to review the 20 largest US utilities and 5 largest Canadian distribution utilities by number of customers. While the selected comparator utilities generally had a higher number of customers, in terms of overall load significance the selected comparator utilities are appropriate. Figure 1 below summarizes the load significance of the selected utilities, which is extracted from Figure 4, page 8 of LEI's report.

Metric		Toronto Hydro	Hydro One	FPL	PG&E	CECONY	SDGE
Province/State of utility service territory		Ontario	Ontario	Florida, US	California, US	New York, US	California, US
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	Serving national financial center?	✓	-	-	-	✓	-
	% of national economic activity in utility's service territory**	10.0%	<6%***	3.3%	6.2%	4.0%	1.2%

Figure 1: Summary of identified utility distribution operations

Not only does Toronto Hydro fall within the range of the selected utilities in terms of electricity delivered annually, but it also serves a uniquely important load. Toronto Hydro serves the provincial capital as well as the economic and financial center of Canada; in fact, it serves the highest proportion of national economic activity out of all the identified utilities. In addition, Toronto Hydro has amongst the highest customer densities of the identified utilities and distributes approximately 19 percent of electricity consumed in Ontario.[1]

[1] Toronto Hydro. *About Us.* <https://www.torontohydro.com/sites/corporate/AboutUs/Pages/AboutUs.aspx>