2017

Energy Imbalance Market Project

Detailed Business Case Analysis Report

March 14, 2017

1. **Explain the status of your project (e.g. New Planning, Design, Updated)** Explain changes in cost, benefit and scope and why.

This is an update to the Business Case requested in Ordinance 125176 enacted by City Council on October 31, 2016, and signed by the Mayor on November 4, 2016, approving City Light to prepare to enter the California Independent System Operator (CAISO) Energy Imbalance Market (EIM) and requesting the utility to provide a detailed analysis of costs, benefits, and potential risks to council no later than April 10, 2017. This business case reflects the best and most current information on costs, benefits, and risks available to City Light.

City Light has completed that analysis and while the basic costs and benefits of the project have not changed significantly since the 2016 budget work, there have been significant improvements in City Light understanding of the uncertainties, contingencies, and risks associated with market entry, as well as a better understanding of the specific implementation details that need to be accomplished for this project to be successful. City Light signed an implementation agreement with the CAISO on December 13, 2016, which will facilitate City Light's participation in this market commencing on April 1, 2019.

City Light trades a complex portfolio of resources in the bilateral markets today (from next hour out through two years) to ensure City Light has a reliable power supply at the most economic cost City Light can obtain on behalf of City Light's customers. To better optimize and monetize the flexibility of City Light's portfolio, assist the region in more effectively integrating renewable generation, and improve the reliability of City Light's system, City Light needs to move its power marketing efforts to the sub-hourly granularity of an automated auction market, namely, the Energy Imbalance Market (EIM), operated by the California Independent System Operator (CAISO).

As discussed in the original business case, City Light will need to invest in new operational technology (OT) systems, incremental staff, and additional training to be successful. The expected cost of these up-front investments includes $8.8 million in capital, with a recurring annual O&M cost of $2.8 million after stable entry into the market.

The updated revenue analysis shows the expected gross revenue from the EIM market to be about $6.3 million annually. This has been offset by $0.9 million annually to account for the opportunity cost of transmission that will be reserved for participation in the EIM, but which may otherwise have been re-marketed. This participation is expected to produce annual net revenues of $5.4 million commencing in the first full year of operations.

The Cost-Benefit Analysis results indicate a Net Present Value, for the Base Case Preferred Option, to City Light ratepayers of $14.5 million, using a 3% discount rate. The study period for this analysis is through year end 2032 – an effective CAISO EIM life of 15 years from today. This Net Present Value does not include any value to carbon reduction, whether market- or societal- valued. If included, these would add between $11.0 to $35.1 million to the NPV.

City Light has identified several software tools that may be appropriate to support the EIM implementation. There are some tradeoffs associated with many of these systems. A bid to bill software system is required for participation; yet other systems such as outage management are optional. If City Light elects not to invest in an automated outage management system, more staff time will be required to effectuate the operation of this requirement. During the

procurement and buildout, these tradeoffs between the amount of system automation and the amount of staffing required will be continually evaluated.

It should be noted that while the potential benefits to City Light ratepayers are significant, they are also uncertain and the costs will be incurred. Due to how net wholesale revenues (NWR) at City Light are booked, revenues for these sales will flow to the Rate Stabilization account (RSA) and will not offset the costs in the annual budget. This will increase rates slightly over what they would have been absent this project (about 0.5% - this increase has been accounted for in the future rate projections in the approved Strategic Plan). City Light has consciously been decreasing its dependence on NWR through its Strategic Plan since 2013, and plans to continue doing so in the future. NWR received has been less than NWR budgeted in three of the four years since this strategy was adopted. Net revenue from City Light's participation in the EIM market can, therefore, make it more likely that the amount in the RSA will remain above the $90M mark that triggers a rate surcharge, and might even raise the level of funds in the RSA to the point (greater than $125M) where ratepayers could receive a refund, but this was not included in City Light's financial forecast as added revenue to offset the added EIM cost.

2. **Provide a description of the problem or opportunity that you are addressing.** Provide sufficient documentation and background information to justify why you are proposing this project.

Participation in the EIM presents both a positive revenue opportunity for City Light customers, as well as an opportunity to enhance environmental objectives by aiding the region in variable energy resource (VER) integration.

The purchase and integration of VERs such as wind and solar continues to accelerate in the region. These resources provide an increased societal value but are costly to integrate into the grid due to their variability. The EIM was developed in part to provide an efficient market solution for the integration of VERs. In practice, it also provides for a more efficient dispatch of resources across balancing areas and therefore a more cost effective regional generation solution.

The EIM and the continued increase of VERs integration into the western grid have placed downward pressure on wholesale energy prices. Due to the rapid adoption of solar in California, it is likely that California could soon become a net energy exporter placing further downward pressure on wholesale energy prices. The problem of declining wholesale prices and declining net revenue for City Light is compounded as more trading partners enter the EIM; resulting in fewer trading opportunities for City Light. At the same time, most of bilateral trading is done on an hourly basis and does not have access to more dynamic 15 minutes or shorter trading transactions. City Light expects positive revenue opportunities by participating in the EIM due to the fast ramping and energy storage capability of its hydro portfolio.

3. **Describe each option that you have examined,** including those you have screened out early in the process and explain why.

The three options evaluated were joining the EIM, delaying joining the EIM or doing nothing and maintaining the status quo.

Preferred Option – Join CAISO EIM: There have been four major efforts in the Pacific Northwest to evaluate and consider forming an "organized market" that could include a within-hour market like the EIM. All have failed to gain critical mass. To understand why the above efforts failed, and the eventual success of the CAISO EIM, it is important to understand what the EIM is and is not. The EIM is an expansion of the CAISO's pre-existing real-time market to utilities that are

not within its market footprint. The EIM allows the voluntary participation in the CAISO market without disrupting the existing market structure or the existing customers within the CAISO footprint. Energy in the EIM is locationally priced and incorporates transmission scarcity and reliability concerns into the pricing and dispatch of generation and loads. EIM entities participate in both the fifteen and five minute dispatches of the CAISO real-time market. EIM entities do not participate in the CAISO day-ahead or ancillary services market. Each participating EIM entity remains responsible for maintaining its own reliability, including reserve and capacity requirements. Numerous other entities, both publicly and investor owned, are announcing plans to sign EIM implementation agreements.

Delay Option – Put off the decision to join the CAISO EIM: A delay in joining the EIM would likely impact City Light in the following ways; a loss of the ability to effectively impact rule making; a loss of revenue associated with EIM participation; and a societal loss due to less Greenhouse Gas (GHG) reductions from loss of City Light's participation impact on the integration of variable energy resources.

A delay in joining the EIM could exclude City Light from participation in policy formation. CAISO EIM is an emerging market with rules that are still nascent. Potential EIM participants, once an implementation agreement is signed, are invited to join the Implementation and Policy Forum (IPF), where they can influence how those rules are formed. This forum provides a unique opportunity to engage with the CAISO and potentially impact the rule making process in a way not available to non-participant stakeholders. This provides City Light an opportunity to help shape solutions and impact new products that are not being addressed in the stakeholder process.

A delay could also result in a loss of potential revenue to City Light. This revenue loss would likely come not only from the loss of EIM revenue during the delay but also a loss of wholesale revenue due to the continuing deterioration of the bilateral energy markets.

Delayed City Light participation will also delay the displacement of thermal generation which will impact the integration of renewable resources and result in the potential continued curtailment of wind and solar, and lead to greater GHG emissions.

Status Quo Option: The case of the Status Quo/Do Nothing presents several risks. Seattle City Light relies on other utilities and marketers in the region to buy City Light's non-firm surplus output and to sell power to City Light on those occasions when City Light needs power in the short term. The EIM may become the primary, and possibly only, market for short-term transactions. As more of the region's utilities and possibly independent generators join the CAISO EIM, City Light may not have sufficient trading partners to effectively manage short-term energy surpluses and deficits. Limiting City Light's ability to sell non-firm surplus power has financial consequences if City Light is unable to realize revenue opportunities, and may have environmental consequences as City Light could spill water rather than displace thermal generation and concomitant greenhouse gas emissions. Limiting City Light's ability to purchase power in the market could also have financial consequences as City Light might have to purchase from relatively expensive generators.

4. **Describe the key costs, benefits, and risks of each option.** Note whether the benefits are an increased revenue, avoided cost to the utility, increased quality of service to customers or an avoided risk.

The key costs and benefits for the preferred option are summarized below. See Question 13 for a detailed discussion of the preferred option, the risks associated with the project and the mitigation actions taken/to be taken by City Light.

City Light has recently completed a "Gaps Analysis" to compare its existing business process and software systems to the requirements for participation in the EIM. This study also provided insight into the issues, challenges and cost experienced by existing EIM participants. The Gaps Analysis helped refine costs and risks of EIM participation.

Costs:

Initial costs: The three most significant costs for the project relate to increased labor, increased training costs and the cost of EIM related software systems. City Light is continuing to evaluate its labor cost estimate verses the cost and potential labor reduction associated with increased software automation. City Light is also in active discussions with its existing software vendors to attempt to leverage existing systems for EIM participation.

In additional to up-font capital costs, there will be ongoing costs such as increased labor, increased training, software licenses and upgrades, and CAISO fees.

Benefits/Revenues:

The monetary benefits to City Light will be increased revenue from wholesale energy marketing activities. City Light has considerable flexibility in its generating assets, and could maximize the value of this attribute in the EIM. A recent E3 benefit study demonstrated that the primary benefit to City Light was its ability to both buy and sell into the EIM where purchases and sales will likely offset. Due to its energy storage capability, City Light will also be able to arbitrage between the EIM and the bilateral markets, increasing the potential to maximize positive revenue opportunities. In addition, EIM participation furthers the City's policy goals of supporting renewable generating resources and mitigation of climate change.

City Light has quantifiable opportunities for revenue in this market. The primary revenue is related to the ability of the City Light portfolio to respond to balancing needs in the market. Statistical modelling estimates of revenues have been prepared by City Light Power Management and Risk Oversight staff, supported by studies conducted by Energy + Environment Economics (E3). The incremental revenue for participation in the EIM is expected to range annually between \$2.6M (25th %tile) and \$11.2M (75th %tile) (depending on specific market conditions of liquidity and market depth, based on 2015 market prices and before subtracting lost transmission revenue opportunity costs). The maximum range of revenue estimates are from a 1-year loss of \$4.4 million to a gain of \$14.5M. The \$4.4 million loss is at 2016 market prices and an assumption of market participation but never changing operating methods in response to incurred losses. (See "2017-02-22 Risk Oversight CAISO-EIM Benefits Analysis Overview_FINAL.docx")

There are additional potential benefits that are not quantified in the market studies. First is the more efficient use of the regional transmission system, increased reliability of delivering electricity to City Light's customers and enhancing City Light's Operational Technology portfolio. The City Light Transmission Operations will be improved with access to more detailed information about transmission congestions and will have access to additional generation resources provided by the market to mitigate those congestions. In the EIM, optimized and automated dispatch facilitates the most economic dispatch of resources to serve loads. If a resource exists that can serve City Light imbalance needs more economically than its own resources, the EIM will dispatch it accordingly. Currently City Light is limited by its own resources and transmission. The ability to leverage a larger pool of resources and transmission equates to greater efficiency which results in better economics for City Light customers.

A second benefit is the opportunity to arbitrage the bilateral markets and the EIM. Today City Light is limited to transacting primarily in the bilateral markets. EIM participation allows City Light to continue to both transact in the bilateral market as well as the EIM. City Light will have the ability to analyze and select which market, or a combination of markets, will yield the most value for its resources and transact accordingly. The EIM is only continuing to grow; the ability

to access a larger pool of buyers and sellers gives a new opportunity to maximize economic opportunities. The EIM could also enable the ability for City Light to sell new products, such as flexible ramping products, to CAISO participating utilities. City Light's hydro resources lend themselves well to support flexible ramp needs. CAISO's flexible ramping requirements create an opportunity to leverage City Light's resources in new ways which can result in additional revenue.

In addition to new product opportunities, EIM participation can also reduce City Light's internal costs incurred for the requirement to hold regulating reserves. This benefit, like the others discussed above, again comes from the pooling nature of the EIM. Currently City Light, like all other utilities, is required to hold a certain amount of regulating reserves for system reliability purposes. In the EIM, this obligation is pooled, shared, and spread over numerous entities. The end result of sharing this responsibility is that each entity is required to hold fewer reserves than would be required without access to this pool. Holding fewer reserves means expending fewer resources which reduces costs.

System reliability will improve from greater system visibility for System Operations. System Operators are concerned with maintaining reliable service to City Light customers and preserving the stability of the bulk electric system ("the grid") to prevent black-outs from propagating from a small problem to a large one that can encompass many states. EIM participation will allow City Light's System Operators access to a broader set of information than they have access to today, through access to the tools the CAISO's system operators use themselves. The same detailed information is also used by the grid operators to better manage the regional transmission system and resolve transmission congestion, therefore increasing reliability of the system. This benefit is difficult to quantify or place a financial value to, but there is a consensus that the benefit is real and is itself a solid reason for EIM participation.

Risk management benefits from EIM participation will derive from both the current design of the CAISO market and the contracts for EIM participation. Additional enterprise risk mitigation will derive from the improved skill set of City Light employees; and the systems and tools they will have available to them.

EIM participation comes with a potential reduction in the cost of managing load and weather forecast uncertainty. Participating in the EIM means that the CAISO takes on a portion of this management. Shifting part of this forecasting obligation not only reduces management costs, but allows City Light access to a more expansive, larger scale, continually improving forecast. The CAISO is actively expending resources and increasing modeling inputs which allows for more comprehensive forecasting across the region.

Further, with City Light's participation in the EIM there are Greenhouse Gas reductions, which have value. Although these benefits were not included in the Cost/Benefit Analysis, estimates of their Net Present Value (NPV) have been prepared. The Integrated Resource Plan prepared by City Light in 2016 established market values for GHG. Using these most recent GHG values, for a low market depth of 150 MW, the NPV of City Light's participation in EIM adds an additional $11 million or more. Alternately, consideration of societal benefits from GHG reductions using the value directives of the U.S. E.P.A. to all federal agencies adds $17.3 million or more to the NPV (expected carbon emissions). (Note that these two are not cumulative. The societal NPV includes the market value.)

Risks:

See Question 13 below for a detailed discussion of additional Risks

5. **Prepare a Life Cycle Cost/Benefit Analysis (EXCEL Template).** For each option examined, document cost, benefit and risk assumptions and calculations. Quantify if possible, but also list non-quantified costs, benefit and risk and indicate potential impact (high, med, and low).

See question 3 above for descriptions of the three options – Status Quo/Do Nothing, Delay, and Preferred Option.

The selected option is to participate in the EIM, beginning in spring of 2019. This option has a 15-year functional period, from 2017 to 2032. All costs and benefits required for the EIM are incremental/decremental to the current Status Quo.

Options	Description	Estimate	Document calculation and assumptions
Status Quo			
• Costs			
• Benefits			
• Risks			See discussion above for Q# 3
JOIN EIM **Preferred Option**	EIM participation in Spring 2019		
• Costs	Start-up and ongoing costs	$51.4M total	
• Benefits	Additional wholesale revenues	$74.2M total	Assumes Spring 2019 start, $6.3 million/yr. gross revenues, $5.4M/yr net revenues
• Risks			Market depth or price sensitivity may be different than studies indicate resulting in lower benefits.
One year delay			
• Costs	Start-up and ongoing costs	$48.6M total	Delay costs to 2018 – one year less operating expenses
• Benefits	Additional wholesale revenues	$68.8M total	Delay revenues to Spring of 2020 - one year less revenues
• Risks			See discussion above for Q# 3.

See question 4 above for discussions of costs and for benefits quantified and not quantified, and see question 13 below for discussions of the risks and mitigation steps taken/to be taken for the preferred option.

6. **Summary of Economic Results** - For each option considered, calculate the net present value using the EXCEL spreadsheet provided. Summarize the results of your cost/benefit analysis here. (See file: "SCL EIM.xlsx" for details.)

Discount rate (3% to 10%)	Range of NPV	Range of B/C ratio	Significant Qualitative Factors Supporting Project
1. Status Quo	0	0	Doing nothing forgoes benefits
3. EIM Market Entry	$14.5M to $4.3M	1.4 to 1.2	Reliability benefits, improved information about generation and transmission system
2. Delay	$12.6M to $3.4M	1.3 to 1.2	Delay incurs one year less operating costs and one less year revenues

7. **Sensitivity of Economic Results (NPV) for Preferred Option** - For your preferred option only, summarize the sensitivity of your net present value to a range of estimates for key variables.

	NPV for Chosen Variable's Amount		Amount Chosen for the Variable		Amount in Recommended Option for this Variable	
Key Variable Modified	NPV-Low (at 3%)	NPV-High (at 3%)	Low	High		Source of estimate
CIP - total project cost	$15.8.M	$11.3M	$7.4 million	$12.3 million	$8.8 million	Internal estimates and Utilicast review
O&M - annual	$26.9M	$(3.5)M	$1.7 million	$4.4 million	$2.8 million	See above
Revenue - annual net revenues	($22.9)M	$64.1M	$1.7 million	$10.3 million	$5.4 million	Risk study (high, low),[1] Res. Planning study (base)
Market Life	$6.3M		10 years		15 years	

[1] The 25% and 75% probabilities for 2015 pricing and the hourly trading model are the low and high revenue cases, respectively.

This sensitivity analysis asks several 'what if' questions. To understand the material in this table, consider the Key Variable "CIP – total project cost". The total project cost in the Base Case is estimated at $8.8 million. For CIP, one question here is what if the total CIP project cost escalated to a high amount of $12.3 million?. What would then happen to the Net Present Value (NPV) for the project? As shown above, in this scenario, the NPV, at the 3% discount rate, would decrease (from the Proposed Option NPV or $14.5M) to $11.3M. Each entry is interpreted in this manner. Consider also the Key Variable "Revenue – annual net revenue". What would happen to the project NPV if the high level for revenues were to be achieved for each year of participation? The high level of revenue, as shown in the table, is selected as (net) $10.3 million (300MW market depth, at 2015 prices, $11.2 million, 3rd Quartile amount – Risk Oversight analysis, less $900K transmission opportunity costs). Under this scenario, the project NPV would increase from $14.5M to $64.1M. (Note, that all the NPV figures exclude from the benefits any market- or societal-values for the attendant GHG reduction of CO_2.)

CIP and O&M Costs: High and expected costs cases are the result of internal estimates. Utilicast performed an EIM Gaps Analysis, and provided preliminary organizational recommendations that may allow for lower cost implementation, which is the basis for the Low cost scenario. Utilicast has worked with several utilities to prepare them for EIM participation. Utilicast provided functional requirements, recommended an organizational structure, and discussed metering and communications requirements for successful EIM participation. Utilicast also provided high level requirements to allow City Light to issue a well-developed request for information and proposals for system vendors to allow the best possible EIM participation.

The low case assumes a net increase of 4 FTEs compared to the base case addition of 8 FTEs. This recommendation would result in a reduction of CIP of $1.4 million and O&M of $1.1 million compared to the base case.

Revenue: The High case revenue assumes that City Light will capture market opportunities at 300 MW of market depth and 3rd quartile revenues of (25% of the time City Light will receive) $11.2 million or more. Low case revenue assumes 100 MW of market depth and 1st quartile revenues of (75% of the time City Light will receive) $2.6 million or more. These cases are from City Light's Risk Oversight team's "trading model" of EIM pricing, assuming 2015 market prices and hydro data.[2] The base case assumes 200 MW of market depth, and median (50%) revenues of $6.3 million (½ of the time revenues will be less than $6.3M, and ½ of the time it will exceed $6.3M). In all cases shown in the table, 100 MW of transmission is assumed to be an opportunity cost, and the presumed opportunity cost of $900,000 reduces the revenue.

8. What is your proposal or preferred option? Based on analysis completed thus far, explain what you are proposing to do and why this is the recommended option?

City Light recommends participation in the CAISO EIM in order to derive environmental, economic, reliability and resiliency benefits on behalf of City Light customers. City Light's participation in the EIM will lower regional GHG emissions through displacement of thermal generation here in the Puget Sound, as well as elsewhere across the West. City Light's EIM participation will also assist in the more cost-effective delivery of wind and solar power, as well as decreasing the risk of curtailment of wind and solar in "over-generation" situations. Financially, as set forth above, City Light believes this project will result in net financial benefits through extending City Light wholesale power marketing transactions into the EIM, allowing us to capture value City Light cannot currently unlock today. We believe that this project will likely derive positive net benefits over a range of expected outcomes despite some risks to costs and

[2] Note that the same model using 2016 data estimated lower revenue in all cases, with small negative revenue at the minimum level in the 100MW and 150MW market depth cases.

benefits discussed above. EIM participation also provides reliability benefits to City Light customers through the improved access to "real time" information from the CAISO and other EIM entities, as well as an improved situational awareness that is part-and-parcel of EIM participation. In addition, the EIM will be the vehicle by which power management, risk management, settlements and control center dispatchers/system operators have an opportunity to develop professionally in a way that benefits City Light customers and the department and will improve the employee experience City Light offers City Light staff. For these reasons, participation in the EIM, without delay, is the recommended option.

9. **What outcome or impact do you expect?** Why should the Mayor and City Council support this proposal? Why will customers care?

The Mayor and City Council should support City Light's participation in the EIM because it will improve the quality and the benefits of the service City Light provides to City Light customers. Qualitatively, City Light service will be more reliable and the skill sets of City Light employees will be enhanced through EIM participation. From a benefits perspective, City Light's participation in the EIM will provide additional net wholesale revenue to assist in moderating the impact of future rate increases to City Light customers. Additionally, while EIM participation will not improve the GHG emission profile of the service City Light provides City Light customers, which is already GHG neutral, there will be a broader, regional environmental benefit to City Light's participation in the EIM through the displacement of thermal generation that would otherwise be required. City Light anticipates this will have a positive environmental benefit in the Puget Sound area, as well as more broadly across the West. City Light also anticipates that City Light's EIM participation will assist in both the more cost-effective integration of wind and solar as well as decreasing the risk that these resources will be curtailed in "over -generation" situations.

10. **Is your proposal related to other proposals, projects, plans, or initiatives?** Is it essential to completing other projects? Is it strategically or politically important? Discuss.

City Light's participation in the EIM is both strategically and politically aligned with the City's environmental goals. Participation is expected to reduce regional greenhouse gas emissions by approximately 32,000 to 65,000 metric tons annually, based on a study by Energy Environmental Economics (E3) directed by City Light. The CAISO has consistently demonstrated GHG benefits associated with EIM operations.[3] In addition to these greenhouse gas reductions, City Light's participation is also expected to reduce emissions of criteria pollutants and hazardous air pollutants including particulate matter, mercury, nitrogen and sulfur compounds. These pollutants are harmful to the environment and to human health. As a utility in the Pacific Northwest, City Light is committed to finding ways to reduce overall emissions of the Pacific Northwest energy system.

11. **Does your proposal affect other Business Units and other stakeholders?** Who will implement your project? Have you communicated with affected parties? Be Specific.

The primary affected business units are the Power Management Division, System Operations Center, Risk Oversight/Settlement, Finance, and Generation Operations. All divisions have

[3] See: http://www.caiso.com/Documents/ISO-EIMBenefitsReportQ4_2016.pdf .

participated in the planning and costing of this project. Representatives from these business units are on the project team, EIM Steering Committee, reviewed the gaps analysis, and provided input to this business case.

Other City Departments impacted by this proposal include the Law Department, Treasury, and Seattle IT (SIT). The Law Department will be involved in reviewing contracts and regulatory filings. SIT will maintain the hardware and communications equipment as they are now doing for the current marketing activities. Treasury will be required to send and receive payments to/from the CAISO within 5 days. Currently, the city's Treasury Dept. takes care of City Light's net wholesale payments on a monthly basis.

12. Is this request required or mandatory? City specific legislation, code, or policy

There is no legal requirement to participate in the CAISO EIM. City Light believes doing so is in its customers' best interests for environmental, financial, reliability and resiliency reasons.

13. Risk Assessment and Mitigation Measures for Preferred Option

Identify risk factors and discuss mitigation measures that may help control or manage such risks.

Many risks have been identified and mitigation plans/methods developed/identified for the preferred option. Below is a list.

COST RISKS

- Cost shifts between CIP and O&M: During the procurement and buildout of the associated operational technology (OT) systems, tradeoffs between the amount of system automation and the amount of staffing may occur.

  It is anticipated that an RFP for new OT systems to support EIM will be issued in Q3 of 2017. The final decision on the best balance of staff vs. OT systems will likely be based on the results of the RFP.

- Overall Costs: The CIP and O&M costs could vary based on the results of procurement activity and the effectiveness of project risk management.

  High and expected costs cases are the result of internal estimates based on discussions with other EIM utilities. The low case is based on the outcome of the EIM Gaps Analysis performed by Utilicast who has identified potential areas where the utility may be able to reduce costs. Utilicast has worked with several utilities to prepare them for EIM participation

  City Light will be hiring an experienced system integrator to help control the project management risk and if an onsite OT solution is chosen, an IT project oversight vendor is expected to be used.

- Additional wear and tear on generation equipment due to additional cycling.

  There is also a risk to City Light's generation equipment due to the increased generator cycling associated with EIM. While there have been no definitive studies correlating hydroelectric generator cycling with increased generator maintenance and decreased availability, City Light Power Production engineering staff have completed an internal study to attempt to quantify the EIM impacts on the generation fleet and has estimated them to be minimal.

City Light intends to take a conservative approach to market participation to limit the cycling exposure to the generation fleet. This approach will likely be modified as the impacts of EIM are fully understood and can be sufficiently quantified, and integrated into City Light's bidding behavior.

- Regulatory and Legal Compliance.

  The City Light regulatory affairs and compliance group has been involved in the legal and policy discussions regarding City Light's potential EIM participation. City Light expects that a variety of actions will be required in the area of compliance, for example revisions to City Light's Open Access Transmission Tariff (OATT), but there are no current compliance concerns with moving forward. It is possible that there may be some additional legal and compliance costs associated with EIM, but they are anticipated to be minor and will be absorbed by existing staff.

  With respect to the legal jurisdiction of the Federal Energy Regulatory Commission (FERC), City Light has consulted with the Law Department and City Light's outside legal counsel in Washington, D.C. Based on the advice of counsel City Light has a strong degree of confidence that EIM participation will not change City Light's "non-jurisdictional status" with regard to FERC.[4] In confirmation of that legal conclusion, several City Light executives met with FERC Commissioners and staff in 2016.

REVENUE RISKS

- Revenue variability: The incremental revenue for participation in the EIM is expected to range annually between $1.7M and $10.3M (depending on specific market conditions of liquidity and market depth).

  City Light's Risk Oversight Division constructed more than 200 scenarios in two different modeling approaches to estimate gross revenue to City Light from EIM participation. The scenarios used actual EIM prices from 2015 and 2016. The scenarios also considered linear optimization and hourly trading. One purpose of these scenarios was to estimate the effect on revenue of known prices compared to actual market participation where prices are not known. Another purpose was to estimate the effect of market depth on revenue. Risk estimated probabilistic revenue under a range of scenarios. The E3 study assumed City Light can sell into the market without affecting price, which was necessary to conduct their study, but this is not a realistic indicator.

  The studies indicate that there is a potential for City Light to have revenues in an EIM that could be less than would have been realized in a Mid-C bilateral market. The lowest revenue scenario is a $4.4 million loss. This case occurs using 2016 prices, when City Light participation is very low (100 MW), and when EIM prices are frequently less than bilateral prices. These results occur when negative events happen in the market and City Light traders do not respond to those events and correct for them. City Light will incorporate actions into its procedures to ensure proper controls are in place to detect and mitigate this type of behavior.

  City Light's Resource Planning group also conducted a study about City Light's EIM participation. The study used the same price information as the Risk study. Resource Planning modelled City Light's load uncertainty and the generation resources' abilities to

[4] It should be noted that all wholesale energy market transactions are FERC jurisdictional, whether EIM related or not. This is true of City Light's power marketing activity today. This is distinct from City Light itself being jurisdictional as a result of wholesale energy transactions.

respond to EIM price changes. This study also estimated and adjusted for the "perfect price knowledge." Resource Planning's estimate of annual EIM revenue is $6.3 million.

The Resource Planning study considers City Light's load and supply resources explicitly whereas the Risk Study looks only at market price and depth. Due to the more comprehensive nature of the Resource Planning study, City Light used that as the Base case revenue. The study is deterministic, and cannot provide a low or high case with iterative runs.

The Risk Study is well suited to providing several scenarios. The extreme loss case is described above. The 25% and 75% probabilities for 2015 pricing and the hourly trading model are the low and high revenue cases, respectively. These are not the highest or lowest cases possible. Rather, they provide plausible bounds.

- Other Revenue Risks: Tradeoff of bilateral and EIM transactions.

  City Light's participation in EIM may reduce City Light's ability to make bilateral transactions for capacity and/or ancillary services. City Light will evaluate on a case-by-case basis whether committing resources to EIM or to third-party transactions is financially beneficial.

BENEFIT RISKS

- Transmission opportunity costs: The cost-benefit analysis reduces total benefits (i.e., the sum of revenues, lost opportunity, societal benefits, environmental benefits, etc.) by $900,000 per year to reflect the possibility of forgone transmission capacity sales.

  City Light's participation in EIM will require dedicated transmission. City Light has considerable transmission assets for Skagit generation that will support both EIM and load service without either use leading to a reduction in the other. Skagit capability and transmission varies by hydro conditions and season, but is nearly always more than 300 MW, the maximum EIM participation case considered. Some of City Light's transmission purchases from BPA will likely be used to support EIM participation. City Light has 1,023 MW of transmission from Boundary dam to Seattle that may also be used for load service and to facilitate EIM participation. Boundary generation is typically less than 1,023 MW, so some transmission is available for re-sale or dedication to EIM transfer.

  City Light has not yet optimized its transmission portfolio for EIM participation. To reflect the possibility that City Light may dedicate some as yet undefined amount of transmission to EIM participation and that has an opportunity cost, the benefit-cost study assumes that City Light would forgo reselling 100 MW of transmission at a market value of $900,000/yr. This opportunity cost reduces the net revenues shown below. City Light does not always remarket 100% of surplus transmission so the estimate of foregone revenue may be too high.

OTHER RISKS

- Project and Software Implementation Schedule: The implementation of the software may take longer than planned.

  CAISO developed the current real time market in 2009, and market participants and vendors have developed proven systems for participating in the market. Three utilities outside CAISO are already participating in the EIM, which is the real time market outside CAISO. City Light is one of several utilities planning to become participants. Each participant helps clarify the means of participation for the next. Proven participation reduces many risks. City Light has been working to develop a core team and project plan to minimize project risks, and will continue to use best management practices during the entire project.

An EIM software vendor is expected to be selected in late Q3 of 2017. City Light has included budget and contingency for software in the business case. Managing this software cost and schedule is a critical success factor in this project.

- Rate impacts: Are there any impacts to the ratepayer because of cost or revenues?

  Due to how net wholesale revenues (NWR) at City Light are booked, revenues for these sales will flow to the Rate Stabilization account (RSA) and will not offset the costs in the annual budget. This will increase rates slightly over what they would have been absent this project (about 0.5% - the project costs have been accounted for in the future rate projections in the approved Strategic Plan). City Light has consciously been decreasing its dependence on NWR through its Strategic Plan since 2013, and plans to continue doing so in the future. NWR received has been less than NWR budgeted in three of the four years since this strategy was adopted. Net revenue from City Light's participation in the EIM market can, therefore, make it more likely that the amount in the RSA will remain above the $90M mark that triggers a rate surcharge, and might even raise the level of funds in the RSA to the point (greater than $125M) where ratepayers could receive a refund, but this is not included in City Light's financial forecast as added revenue to offset the added EIM cost. The Base case costs are in the adopted 2017 and endorsed 2018 budgets, as well as the 2017-2022 Strategic Plan. Rates for 2017-2018 are set. City Light will manage project costs and budgets appropriately to minimize financial and operational risks.

- Decreased Market Liquidity/Loss of Trading Partners:

  Reduction of market liquidity creates a risk of a decrease of revenue to City Light. Further, as several of City Light's most significant counter-parties are or soon will be EIM participants, following them to that market reinforces existing trading relationships and hedges the risk of loss of liquidity in bilateral markets, as has been experienced in other portions of the West.

  Associated with liquidity risk is the possibility that the EIM as a market may have a shorter duration than 15 years and the value proposition for EIM may change significantly as the industry evolves; e.g., current rapid developments in battery storage may significantly reduce the integration problems related to solar, wind and other renewable energy sources that the EIM is meant to mitigate.

- Reliability:

  By providing additional tools and information to City Light's system operations center City Light will be improving their ability to reliably serve City Light customers. The tools and information available through EIM participation are not otherwise available.

- Market Evolution:

  Energy markets are continuing to evolve in the West, nationally and globally. Zero marginal cost energy resources (wind and solar) are changing everything from wholesale energy markets, to distribution system operations. The market rules that affect EIM participation will continue to evolve and change over time. City Light began a deep engagement with the CAISO, and conducted extensive due diligence with existing EIM entities and prospective EIM entities in 2015 and 2016 and it continues to this day. The project budget includes annual allowances for substantial staff training in expectation of the likelihood of the need to maintain a regular training tempo (re-training of existing staff on market changes as well as training of new staff over time).

  Participation in a market with evolving market rules presents a potential risk of market rules changing in a way that could negatively impact City Light. Because the CAISO conducts robust stakeholder processes which City Light participates in, and the CAISO must obtain FERC approval of tariff changes, it is possible but unlikely that market rules would change

drastically enough to have significant negative financial implications. There are no market rule changes contemplated at this time which City Light is aware of that would have drastic implications but it is possible that market rule changes could affect the economics of EIM participation.

- Change Management: Organizational changes are expected.

  City Light will ensure employees are properly trained to participate successfully in the EIM, with project budget designated for this purpose. Entry into the EIM will impact the business processes in Power Management, Risk and Settlements, and the City Light Balancing Authority. City Light anticipates adding dispatchers, marketers, and settlement staff to manage the additional work required to participate in EIM.

14. Success Factors, Milestones, Performance

How will the project monitor know whether the project is on schedule, within budget and performing as expected? Identify key milestones or metrics, which will allow management to track performance of this project.

Deliverables, Milestones, Metrics

The CAISO requires potential participants to meet a detail project timeline with specific deliverables associated with specific dates. City Light has assigned an experience project manager to manage the project and intends to hire an experienced system integrator to lead the integration of City Light software systems and IT systems.

The CAISO requirements include significant mandatory staff training requirements which must be completed per a defined schedule. There is also a requirement for "day in the life" testing to ensure that potential EIM participants have the proper equipment and personnel in place to successfully participate.

Targets	Date	Goal
Sign agreement with CAISO	**Spring 2017**	
Detailed Project Management Plan City Light and the CAISO will develop and initiate a final project management plan that describes specific project tasks each Party must perform, delivery dates, project team members, meeting requirements, and a process for approving changes to support completion of the Project.	**Nov. 2017**	This milestone is completed when the Agreement has been made effective in accordance with Section 1 of the Agreement.
Full Network Model Expansion – Full Network Model expansion for City Light and EMS/SCADA, including, proof of concept of export/import of EMS data; complete model integration into the ISO test environment; complete validation for all SCADA points from City Light; testing of the new market model; and validation of the Outage and State Estimator applications.	**Aug. 2018**	This milestone is completed upon modeling City Light into the ISO Full Network Model through the EMS which will be deployed into a non-production test environment using the ISO's network and resource modeling process.
System Implementation and Connectivity Testing – System requirements and software design, the execution of necessary software vendor contracts, development of Market network	**Sept. 2018**	ISO to promote market network model including City Light area to non-production system, and allow City Light to connect and

model including City Light, allow City Light to connect to a non-production test system.		exchange data in advance of Market Simulation.
Construction, Testing and Training in Preparation for Market Simulation - This task includes IT infrastructure upgrades, security testing, training, day-in-life simulation, and functional testing.	**Sept. 2018**	Start of Connectivity to ISO Testing, Interface testing with minimum data requirements and functional integration testing. ISO will make the test environment available for SCL connectivity testing prior to the delivery date assuming SCL has provided all requisite data and non-production system availability does not conflict with ISO production system Spring Release schedule.
Begin "day in the life" scenario testing	**Oct. 2018**	
Begin structured Market simulation	**Nov. 2018**	
Activate Parallel Operations - Beginning August 1, 2018, the ISO will activate a parallel operation environment to practice production grade systems integration as well as market processes and operating procedures in anticipation of the impending City Light activation as an EIM Entity and to confirm compliance with the EIM readiness criteria set forth in the ISO tariff.	**Jan. 2019**	
Start of Parallel Operations	**Feb. 1, 2019**	
System Deployment and Go Live – Implementing the Project and going live will include resource registration, operating procedures and updates, execution of service agreements, completion of the City Light tariff process, applicable management approvals, the presentation and acceptance of service agreements and tariff changes by the city council, and completion and filing of a readiness criteria certification in accordance with the ISO tariff.	**Mar. 2019**	
Go live	**Apr. 1, 2019**	This milestone is complete upon the first production City Light energy imbalance market trade date.